

Influence of Farm-Level Interventions on Households' Livelihoods in Nandi County, Kenya

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Abstract

Original Research Article

Smallholder dairying is significant economic activity. However, the activity is fraught with low productivity thus increasing vulnerability of dairy farmers to poverty. Thus, the main purpose of this study was to investigate the contribution of dairy projects interventions on households' livelihoods in EADD projects in Nandi County of Kenya. The objective of this paper was to establish the influence of farm-level interventions on the households' livelihoods in Nandi County. The study adopted the mixed-methods approach and utilized the descriptive research design, with the target population of 5,400 small-scale dairy farmers and staff spread over three dairy projects of Kabiyet, Lelchego and Tanykina Dairies in Nandi County. The sample size was 360 respondents based on modified Cochran's formula with the head of the household being selected using a proportionate stratified random sampling technique. Data was collected using semi-structured questionnaires and interview schedules, which was validated by expert judgments while reliability were assessed using Cronbach Alpha coefficient. Quantitative data obtained was analysed using descriptive and inferential statistics which Pearson Correlation Coefficient. Qualitative data from interview schedules was analysed through content and thematic analysis. The inferential statistics showed that households' livelihoods positively correlated with farm-level interventions ($r = 0.385, p < 0.05$). It was concluded that farm-level interventions have a significant influence on households' livelihoods and positively relates to livelihoods. The study thus recommended that dairy farming cooperatives should improve the nature and form of technological interventions through the introduction of new breeds and sires to the farmers' pool of resources to improve the milk production. They should also promote knowledge diffusion and innovation by taking the best farmers to the farmers training centres for short-term courses. The findings of this study will benefit various stakeholders engaged in development initiatives and programmes within Nandi County and beyond to device and adopt best dairy farming practices for better productivity and poverty reduction.

Keywords: Influence, Farm- level, livelihood, Intervention, Nandi, Kenya.

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INTRODUCTION

Farm-level interventions are initiatives and/or strategies carried out in individual farms and include knowledge and skill transfers, training on animal nutrition and management. The dairy industry policy was revised in the early 1993. With time, new opportunities and challenges have emerged in the industry demanding the need for a current and accommodating dairy strategy. It is expected that the interventions proposed in this policy will address these challenges and opportunities to realize a vibrant dairy industry in Kenya will be utilized. Globally, milk production was 711 million tons in 2011 and was

expected to rise above 794 million tons in 2017, with the most significant milk producers are the EU, the United States and from the Asian countries, India and China [1]. Developed countries contribute about one-third of world milk production with more than two-thirds of world dairy herd can be found in developing countries [1]. Studies done on the livestock sector indicate that it is a significant source of livelihoods and employs at least 1.3 billion people globally and directly support the livelihoods of 600 million poor smallholder farmers in the developing world [2].

In America, dairy farming gives an average output of 257 million tons [1]. The US dairy sector is

facing structural changes, including a geographical shift in dairy production and a tendency toward the implementation of more intensive production systems. These changes significantly affect farm efficiency, profitability and the long-term economic sustainability of the dairy sector, especially in more traditional dairy production areas [3]. In Europe, about six percent of the farms in Europe apply full grazing, with close to 70% of the farms applying grazing to some extent.

In several Central and Eastern European (CEE) countries, the dairy sector is very important, particularly for poor farmers in rural areas [4]. Majority of farms have less than 10 cows and 96% of the farms have less than 20 cows, with an average herd size of over 15 cows. In the past few decades, the dairy industry has exhibited significant structural changes and production system changes, in both the United States (US) and European Union. There is a significant move to more intensive systems as opposed to extensive pasture-based systems [5]. These dairy production systems in the developed countries are more advanced and intensive and use more sophisticated systems coupled with less grazing [6].

In the sub-Saharan African countries, milk is produced on both small and large-scale dairy farms. The smallholder dairy farms have anything from one to five milking cows and contribute to national dairy production while playing an important part in the dairy value chain. In Zambia, smallholder dairy farmers own an average of 4 dairy cows, yet more than half of the milk in the country is produced by them and most of them are organized in cooperative 14 societies around milk collection centres from which processors collect the raw milk [7].

In Ethiopia, Gizaw *et al.* [8] identified the major constraints to the productivity of the smallholder dairy farming systems. They included the low scale of production, low productivity that varies across systems, failure to maintain high productive exotic breeds of cattle, lowered access to artificial insemination (AI) service, lower breed supply, least satisfactory among breeding services, cost of concentrate feed for the urban/peri-urban dairies, unhygienic milk handling and consumption, lower price of milk. However, smallholder dairy farming in different regions has employed contrasting strategies to improve the feeding value of low-quality feed resources and thereby improve milk production. In highland regions, the introduction of improved forage species such as Napier grass, Guatemala grass and Rhodes grass, either as a pure stand or intercropped with cereals and tubers have been successful [9]. Other studies have indicated that smallholder dairy farmers have adopted dairying technologies, which include the use of crossbred animals, improved feed technologies and improved management practices. Application of acaricides,

deworming, vaccination, heat-detection and haymaking had wide application [10].

In Kenya, estimates show that there are up to 6.7 million dairy cattle with about 1.8 million households relying on the dairy industry, which create thousands of jobs within the dairy milk marketing chains [11]. Farm-level interventions in Kenya have taken the form of supplementary feeding through the use of concentrates with the studies showing that less than 20% of the farmers use concentrates. For instance, in Kiambu District, close to 70% of the farmers use concentrates while the percentage of the use of concentrate drops to less than 10% as one move away from urban areas [11]. An analysis by Wambugu, Kirimi and Opiyo [12] indicated in Kenya, the non-zero grazing systems have a higher gross margin than the zero-grazing systems. However, the study showed that the zero-grazing system performs better under conditions of collective marketing, good linkage to markets in terms of processing, access to production information, credit as well as other benefits.

In Nandi County, dairy animal husbandry is also a major income earner to the residents. Dairy farmers in the County earned Sh3.9 billion from their produce in 2012. The milk produced is sold mainly to Kabyet Dairies, Tanykina Dairies, Lelchego Dairies and other established firms such as the New Kenya Cooperative Creameries (KCC), Brookside and many others. Due to the growing demand for livestock products especially dairy-related in the area where urbanization is the driving force, innovations in livestock farming need to be adopted. However, various factors influence the adoption of these technologies [13].

The East Africa Dairy Development (EADD) programme is designed to boost the milk yields and incomes of small-scale farmers so they can lift their families and communities out of poverty. The project is implemented through a consortium led by Heifer International (HI). HI's consortium partners are Techno Serve (TNS), the International Livestock Research Institute (ILRI), African Breeders Total Cattle Management (ABS- TCM) and the World Agroforestry Centre (ICRAF). It is funded by the Bill & Melinda Gates Foundation and implemented in partnership with Heifer International [14]. The overall vision of EADD is to transform the lives of farming families with improved market access to a robust dairy value chain that benefits all industry stakeholders. They provide a dependable source of income, producing milk for substantial periods that farmers can sell and rely on short-turnaround for payment. Smallholder dairy husbandry provides a secure livelihood for families while respecting cultural values and promoting women's social and economic status [15].

Farm-Level Interventions and Households' Livelihoods

Win, Win, Kyi and Myatt [16] conducted a random trial study to evaluate the impact of several interventions such as included training workshops for farmers and feed interventions on the reproductive performance of cattle bred by artificial insemination in Myanmar. The study sought to understand the economic effects of feeding urea molasses multi-nutrient blocks (UMMB) on six pilot farms by comparing the feed costs with the income from milk in groups of supplemented and control cows. The authors found that supplementary feeding of cows and heifers with UMMB during late pregnancy and the post-partum period resulted in a significant reduction in the interval from calving to the onset of ovarian activity and a significant increase in the monthly milk yield. The cost: benefit ratios ranged from 1:1.4 to 1:7.2 in the different farms. They concluded that feed supplementation resulted in shorter intervals from calving to the onset of ovarian activity, increased milk production in cows and increased body weight gain in calves. The study focused and estimated the impact of training and feeding intervention on the productivity of the smallholder dairy farmers in Myanmar while the current study examined the impact of farm-level interventions in improving the productivity of the farmers and by extension the livelihood of the smallholder farmers in Kenya.

Richards *et al.* [17], in a study, sought to estimate the impact of dairy meal feeding interventions on early lactation milk production in smallholder dairy farms of Central Kenya. The study was conducted on a sample size of 108 farms in Murukweini Sub-County, Nyeri County. It sought to determine the effect of feeding locally produced dairy meal (DM) on early lactation daily milk production (DMP) among smallholder dairy farmers. It applied regression analysis to assess the actual DM fed as an independent variable rather than assigned feeding groups. The study findings showed that DMP was positively associated with each kg/day of DM fed (0.53 kg/day), low weight (0.13 kg/day), feeding DM in the month before calving (1.42 kg/day), and feeding high protein forage (0.41 kg/day), and was negatively associated with having mastitis (-0.30 kg/day). In interaction terms, taller cows had higher DMP than shorter cows, whereas heifers (first parity cows) had similar DMP regardless of height. Also, thin cows (2+ parity with body condition score < 2.5 out of 5) produced less milk (1.0 kg/day less) than cows with a better body condition score at calving, whereas thin heifers produced more milk (2.0 kg/day more) than heifers in better body condition – this association is possibly due to a small unrepresentative sample size of heifers. The study concluded that feeding DM in the month before calving, improving body condition in cows before calving, and enhancing dietary DM and high protein forage were positively associated with DMP in early lactation on Kenyan SDF. The study

recommended that farmers should be educated on good genetic selection and heifer management. The study focused on understanding how nutrition and feed interventions influence the growing productivity of the livestock of the smallholder dairy farmers in Kenya. The current study conceptualized these interventions as part of the farm-levels interventions that were used to improve the productivity of the farmers and by extension the livelihood of the smallholder farmers in Kenya.

VanLeeuwen *et al.* [18] undertook a study to describe the farm-level interventions such as those addressing animal health and nutrition and milk quality on a three-year intervention on farmer livelihoods. They used 30 women smallholder dairy farmers from the Wakulima Self-Help Group Dairy (WSHGD) in Nyeri County of Kenya. They then used questionnaires and focus group discussions as the main data collection tools and used logistic regression analysis to determine the impact of these interventions on farmer livelihoods. At the onset, the study showed that external parasites, poor hygiene, and long claws were common cows among the dairy farms. The findings of the study revealed that the farm-level interventions brought significant improvements to the proportion of farms that planted high-protein forages, used better milking procedures, and on-farm milk storage methods with a reduction in the reported cases of mastitis incidence rate falling from 0.55 to 0.20 cases/cow-year while the average number of cows and youngstock significantly increased from 1.5 and 0.9 to 2.9 and 2.6, respectively. It was concluded that there were improvements in the livelihoods among the member families and recommended that partnership-based intervention program significantly improves the management and productivity of smallholder dairy farmers in rural Kenya. The study examined how training and feed interventions impact on the growing productivity of the livestock of the smallholder dairy farmers in Kenya. The current study conceptualized these interventions as part of the farm-levels interventions that were used to improve the productivity of the farmers and by extension the livelihood of the smallholder farmers in Kenya.

Young *et al.* [19] carried out a study on the impact of best practice health and husbandry interventions on smallholder cattle productivity in southern Cambodia. The study sought to estimate the effect of the dairy farming intervention and was carried out in six villages whose cattle population was ≥ 250 in number. There were eight repeat-measures capturing data on animal health and production, including cattle weights used to evaluate the impact of interventions on average daily gains, was completed. Cattle in higher interventions areas had significantly higher mean live weight during the last three sampling periods, and average daily gains were 2.4 times higher than in cattle of the low intervention areas. The study concluded that

that best practice intervention resulted in improved cattle productivity, farmer knowledge and positive impacts on household income over time, offering a pathway that can address food security concerns and more rapidly alleviate rural poverty. Young *et al.* focused on the impact of health and husbandry interventions can on the growing productivity of the livestock of the smallholder dairy farmers in Cambodia. The current study conceptualized these interventions as part of the farm-levels interventions that are used to improve the productivity of the farmers and by extension the livelihood of the smallholder farmers in Kenya.

The studies on farm-level interventions in smallholder dairy farmers have approached it from nutritional and feeding components and feed supplementation. In Kenya, randomized trials by Richards *et al.* (2016) focused on feeding and nutrition. VanLeeuwen *et al.* [18] used logistic regression analysis to identify the impact of animal health and nutrition while Gelan and Muriithi [20] used panel data to measure the technical efficiencies of feeding arrangements. In Myanmar, a controlled trial feeding programme of calving cows affirmed the impact of the feeding [16] while in Cambodia; Young *et al.* [19] focused on the feeding interventions and arrived at the same conclusion.

Statement of the Problem

Majority of the studies on smallholder-dominated agri-value chain interventions have predominantly focused on the organization of the value chain processes and innovations. Specifically, these studies examined the impact of such processes and innovations have helped to improve value addition [21]. As such, most studies have not drawn a link between the functioning of these processes with specific outcomes relating to upgrading as the pathway towards smallholder integration into the growing market. Gelan and Muriithi [20] note that dairy farms in East Africa operate at a considerably high level of inefficiency.

The smallholder dairy farming sector in Kenya faces several technical, economic and institutional constraints in milk production, processing and marketing. These problems are compounded by seasonality in production, inadequate quantity and quality of feed and low animal husbandry and farming

practices, low access to quality breeds and breeding services, animal health and nutrition and low access credit services. These farm factors are further exacerbated by poor road infrastructure, inadequate marketing system, low research, extension and training, and limited farmers' involvement in the output market [12].

Kilelu *et al.* [21] note that smallholder dairy farmers tend to accrue minimal benefits from production-oriented interventions at farm-level with a limited focus on market integration. Empirical evidence indicates that most of the dairy project interventions do not address the value chains but focuses on availing improved heifers to the farmers to increase milk production [22]. Further, some of these interventions have varied priorities thus making it impossible to achieve their desired developmental objectives or offer any meaningful value chain improvements. Therefore, this study sought to examine how the EADD dairy project interventions impact on the households' livelihoods in Nandi County of Kenya. Based on the study, this paper sought to establish the influence of farm-level interventions on the households' livelihoods in Nandi County, Kenya.

MATERIALS AND METHODS

The research used the descriptive research design and blend both quantitative and qualitative approaches. The target population were small-scale dairy farmers and the staff of the three dairy projects funded by the EADD programme. Individual farmer in the study represented a single household, mainly based on a single household head. Therefore, the target population comprised 5,400 small-scale dairy farmers and staff spread over three dairy projects of Kabiyet, Lelchego and Tanykina Dairies in Nandi County. From the target population, a sampling frame of 360 was derived as shown in Table 1. The sample size of 360 for the study was calculated using Cochran's [23] formula. The researcher applied proportionate stratified random sampling technique from the sampling frame at the respective EADD projects in selecting the representative respondents for the study. This approach gave each item in the population an equal chance of being selected and therefore it provided a chance to farmers in the study area to be included in the study.

Table-1: Sampling Frame

Dairy project	Proportion	Members	Staff	Total
Kabiyet Dairies	0.3344	115	5	120
Lelchego Dairies	0.3048	108	2	110
Tanyina Dairies	0.3608	127	3	130
Total	1	350	10	360

Source: Omondi et al. [14]

Primary data was collected using questionnaires and interviews schedules. Data collected using the questionnaire was coded into the Statistical Software called the Statistical Package for Social Science (SPSS) and then analysed through descriptive and inferential statistics. Nominal and ordinal scaled data were analysed by the use of frequency table proportion (percentages) mode or frequency distribution while interval and ratio scaled data were analysed through the use of measures of central tendencies such as means, and measures of dispersion inferential statistics tools, which include Pearson Correlation Coefficient was employed to determine the relationship that exists between the independent variables and dependent variables. Qualitative data from interview schedules were analysed using thematic and narratives.

RESULTS AND DISCUSSION

The study are examined the farm-level interventions brought by the EADD project. At the onset, there were two themes related to the farm-level interventions, namely the nutritional and feeding arrangements of the dairy cows and the training

programmes for the farmers. As deduced from the respondents, the project intervened in the nutrition and feeding arrangements and this, in turn, has resulted in several advantages to the farmers within the project. Importantly, the project seems to have trained farmers on the various feeding ways such as the use of silage, hay and Napier grass that can be used for feeding as well as the introduction of the concentrates and mineral supplementation. Hay and silage can be stored for longer periods and thus ensures sufficient nutritional requirements to the animals during the dry season and this has enabled these farmers to continue feeding the animals throughout the year. The respondents listed the following contributions of the project to the dairy farming activities: the provision of sufficient and improved nutrition to the cows; the optimization of space for keeping a large number of cows, and the continuity in the nutritional and feeding arrangements to the dairy cows. These initiatives had greatly improved the amount of milk produced as well and avoiding the loss of animals during dry seasons as droughts.

Table-2: Effect of Farm-Level Interventions

Variable		SD	D	N	A	SA	Tot	Mean	SD
The project provided technical assistance on animal feeding and nutrition	F	0	19	0	119	58	196	4.1990	0.5959
	%	0.0	9.7	0.0	60.7	29.6	100		
The project offered hands-on training on silage preparation and feed management	F	0	13	0	110	73	196	4.3061	0.5889
	%	0.0	6.7	0.0	56.1	37.2	100		
The project aided in the provision and access of supplementary diet for animals	F	0	6	0	113	77	196	4.3622	0.5419
	%	0.0	3.0	0.0	57.7	39.3	100		
The project established a fund for farm feeds	F	0	8	0	101	87	196	4.4031	0.5691
	%	0.0	4.1	0.0	51.5	44.4	100		
The project trained personnel to be extension staff for the cooperative	F	0	11	0	97	88	196	4.3928	0.5938
	%	0.0	5.6	0.0	49.6	44.9	100		
The project provided training materials and support to the cooperative	F	0	9	0	100	87	196	4.3979	0.5772
	%	0.0	4.6	0.0	51.0	44.4	100		
The project facilitated training on animal feeding and nutrition	F	0	16	0	92	88	196	4.3673	0.6306
	%	0.0	8.2	0.0	46.9	44.9	100		
The project provides support for the group training of the board	F	0	22	0	88	86	196	4.3265	0.6683
	%	0.0	11.2	0.0	44.9	43.9	100		

The descriptive statistics in Table 2 displays information on the project interventions at the farm-level. The statistics show that 90.3% of the respondents reported the project provided technical assistance to farmers on feeding and nutrition while 9.7% disaffirmed that the project did not provide any assistance to farmers on issues regarding feeding and nutrition of animals. As shown, a majority (93.3%) of the respondents affirmed that the project introduced training on silage preparation and feed management, with 6.7% of the respondents reporting that the project did not intervene with regard to feed management.

The information shows that virtually all (97%) of the respondents reported that the project aided the farmers in the provision and access of supplementary concentrates to the farmers for feeding the animals and 95.9% of the respondent affirmed that the project established a fund for farm feeds for the dairy cooperatives. Further, the data shows that 94.4% of the respondents reported that the project provided training support for the extension staff for the cooperatives while 5.6% of the respondents disagreed that the project intervened in the training of the extension staff for the cooperatives. Additionally, 95.9% of the respondents

affirmed that the project provided training materials and support to the managers of the dairy cooperatives, with 4.1% of the respondents dissenting.

As drawn from the data, 95.4% of the respondents affirmed that the project provided training on animal feeding and support to the cooperative officials, with 4.6% reporting that the project did not provide any training on feeding and nutrition. Lastly, 88.8% of the respondents affirmed that the project provided group training to the board of directors of the dairy cooperatives, while 11.2 % held the opinion that the project did not train the board of the directors of the dairy cooperatives.

The responses from the respondents indicated that the project had provided technical assistance to farmers on the nutrition of animals, introduced silage preparation and feed management, provided access to supplementary concentrates and established a fund for farm feeds for the dairy cooperatives. Further, the project had provided training support for the extension staff for the cooperatives in addition to the training materials and support for the farmers. Past studies have highlighted several ways in which projects intervened at the farm- level. For instance, in Tanzania, Ogotu *et al.* [22] reported that interventions included the promotion of feed supplements.

In Kenya, Ouma *et al.* [11] reported that farm-level interventions have taken the form of supplementary feeding through the use of concentrates. For instance, in Kiambu district, close to 70% of the farmers use concentrates. In India, interventions included animal health camps and on-farm trials, which created awareness among farmers regarding the adoption of better livestock practices like supplementation of the mineral mixture in the concentrate ration, chopping of crop residues [24]. Rademaker, Koech, Jansen and van der Lee [25] indicate that a good number of smallholder dairy farmers in Kenya have adopted intervention approaches which include the use of fodder cropping, fodder preservation through the use of silage with farmers in Central and Eastern regions utilizing more than the farmers in North Rift region.

Moreover, a hypothesis was proposed and tested to establish the relationship between farm-level interventions and households' livelihoods in Nandi County, Kenya. The hypothesis stated that farm-level interventions adopted does not relate with the households' livelihoods in Nandi County, Kenya. To evaluate the influence of farm-level interventions and households' livelihood, Pearson correlation coefficient was used. The correlation analysis results were as depicted in Table 3.

Table-3: Correlation Analysis for Farm-level Interventions

		Households' livelihoods
Farm-level interventions	df	190
	Correlation	.385*
	Significance (2-tailed)	.000
	df	190

Table 3 indicates the correlations between the study variables. The dependent variable, households' livelihoods, positively correlated with farm-level interventions ($r = 0.385$, $p < 0.05$). These findings indicated that any shift in the project interventions would have a corresponding shift in households' livelihoods.

The correlation coefficient for farm-level interventions, $r = 0.385$, $p < 0.05$, was statistically significant. As such, farm-level interventions partially correlated with households' livelihoods of the farmers. Since the $p < 0.05$, the findings indicate that a 0.385-unit shift in farm-level interventions would have a corresponding increase in the households' incomes. The findings show that farm-level interventions introduced by the project have affected the way farmers practise animal husbandry. The way included animal feeding and nutrition, silage preparation and feed management, provision and access of supplementary diet for animals and trainings and support to the farmers have broadened the farmers' knowledge on animal husbandry.

Based on the correlation findings, the study rejected the null hypothesis that the farm-level interventions adopted do not relate with the households' livelihoods in Nandi County, Kenya. It instead concluded that the farm-level interventions had a statistically and significant correlations with households' livelihoods in Nandi County, Kenya. This conclusion was similar to what other studies have found concerning the relationship between farm-level interventions among smallholder dairy production systems. Several studies show that improvements in the nutritional status of the animal management through supplementation with urea treated maize stover improve milk productivity of the cows [9]. Further, Bayemi *et al.* [26] posit that better feed supplementation coupled with farmer training in milk processing improves the productivity of the smallholder dairy farmer. Win *et al.* [16] also note that improvement in the farming conditions through the nutritional management among the smallholder dairy farmers enhances the performance of the dairying sector. Further, Young *et al.* [19] report that interventions introduced to develop the husbandry skills of smallholder farmers included the

implementation of forage technology, disease prevention through vaccination, deworming, and education in animal nutrition, biosecurity, disease control, and marketing resulted in improved cattle productivity, farmer knowledge and positive impacts on household income over time.

CONCLUSION AND RECOMMENDATIONS

From the findings of the study, it is concluded that the EADD project has intervened at the farm-level by providing technical assistance on animal nutrition to farmers. It has also introduced silage preparation and feed management and provided access to supplementary concentrates. Lastly, it has established a fund for farm feeds for the dairy cooperatives. Further, the project provides training support for the extension staff for the cooperatives in addition to the training materials and support for the farmers.

The inferential statistics also led to the conclusion that households' livelihoods positively correlate with the farm-level interventions. Therefore, the study concludes that farm-level interventions have a statistically significant positive influence on households' livelihoods in Nandi County, Kenya. Moreover, the farm-level interventions have a statistically significant positive influence on households' livelihoods. The conclusion is based on the hypothesis test results, which showed that the farm-level interventions have a significant influence on households' livelihoods and positively relates to livelihoods. Therefore, farm-level interventions affect households' livelihoods by introducing nutrition management and feeding of the cows and training farmers on the best farming practises in order to increase milk production.

Since farm-level interventions have a significant influence on households' livelihoods, it is recommended that the management of these cooperatives should endeavour to promote knowledge diffusion and innovation by taking the best farmers to the farmers training centres for short-term courses. This will help improve dairy farmers' knowledge base and thus enhance their agricultural practices and output.

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