Leveraging on Agricultural Cooperatives in Feed and Fodder Production Among Smallholder Dairy Farmers in Meru County, Kenya

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Abstract

Climate change is having a severe effect on the availability of feeds and fodder, which causes irregular milk output and high production costs for farmers and cooperatives. This study focuses on role of agricultural cooperatives on promoting feed and fodder, management. A cross-sectional survey design with concurrent mixed methods approach entailing quantitative and qualitative methodologies was adopted. The target population was drawn from seven dairy producer groups supported by the Meru dairy cooperative union. Systematic random sampling was used to sample one hundred and ninety-five respondents from seven selected dairy cooperatives. Purposive sampling was used to select key informants in dairy value chain. Primary data was collected using key informants interview guides, household survey questionnaires and focus group discussion guides. The data collected was analyzed quantitatively and qualitatively. The study findings, indicate that 92% of respondents produced their own fodder, while 28.3% outsourced. High cost of feeds and fodder was a major challenge. The agricultural cooperatives supported farmers in production and bulking of super Napier fodder. They also support farmers in access feeds and fodder for This study recommends agricultural cooperatives should conduct trainings on modern feed and fodder production, as well as conservation of fodder and homemade rations. The study also recommends that policy makers should legislate laws that support dairy cooperatives in feed and fodder production. Also, laws should be legislated to protect smallholder farmers from exploitation by feed manufacturers. The study also recommends further studies on feed, fodder contamination qne quality analysis.

Keywords: Smallholder Dairy Farmers, Agricultural Cooperatives, Feed and Fodder Management

Introduction

The expansion of the livestock sector has been the primary driver of Kenya's feed and fodder industry's recent steady growth (Sala, Otieno, Nzuma & Mureithi, 2020). The primary feed ingredients for cattle include concentrates, minerals, vitamins, and roughages. Cereals (corn, wheat, barley, oats, and millet), legumes and oilseed cakes (soybeans, cotton seed cake), and animal byproducts (fish meal, blood meal, meat and bone meal) are the sources of these raw materials (Kenya Markets Trust, 2016). While the actual production of 10 million MT in 2021 met the expected yearly need of 30 million MT for fodder, the demand for synthetic feed and additives increased from approximately 8 300,000 MT in 2020 to approximately 700,000 MT in 2021. Of the approximately 1,000,000 tons of installed feed production capacity, about 60% is utilized (Kenya Dairy Board & Tegemeo Institute, 2021). The amount of usage of commercial feeds, the unpredictable and insufficient supply of raw materials and feed ingredients, and, in certain situations, farmers' preference to make their own feed on their farms are the causes of the underutilization. A few of the issues the Kenyan animal feed business faces are low-quality ingredients and an unpredictable raw material supply (Njagi, 2016).

Feed materials for cattle are divided into two categories: roughage, which includes agricultural leftovers and grass from pastures, and feed concentrates, which include grains and oilseeds (Lugusa, 2015). Due to climate variability, communities in Kenya's drylands are now turning to fodder cultivation as a way to boost household income and food security during the country's frequent droughts (Joshua & Augustine, 2018). Particularly during Kenya's dry seasons, fodder trees are a vital source of feed for cattle to maintain productivity and lessen the negative effects of subpar feed on milk (Makau, VanLeeuwen, Gitau, McKenna, Walton, Muraya & Wichtel, 2020). As an illustration, Mutimura, Ebong, Rao and Nsahlai (2018) discovered that feeding a dairy cow two kilograms of Calliandra leaf (dry matter) each day has been shown to boost daily milk output by around. A review of the gross margin shows that there is a sizable market for pasture and fodder production, making it a viable enterprise. On the other hand, farmers are left vulnerable to dishonest market actors due to the underdeveloped institutional and regulatory framework that controls the production, processing, and selling of fodder, including support from the commercial sector (Kilelu, Koge, Kabuga & Lee, 2018).

The majority of the forages that are fed to animals in Kenya consist of tropical grasses, legumes, and agricultural leftovers (Mwendia, Ohmstedt & Peters, 2020). The majority of the feed in the primarily bimodal regions' wet seasons is made up of weeds and fodder crops, with crop wastes added during the dry seasons (Auma, Omondi, Githinji, Rao, Lukuyu & Baltenweck, 2018). Notably, forests in developing nations like Kenya supply cattle with fodder for stall feeding and grazing in the forest areas; nonetheless, the removal of fodder supplies from forests frequently results in the degradation of the forests (Paterson*). The majority of animal food, according to Lugusa, (2015), comes from crop wastes such rice straw, wheat and barley straws, maize stalks, pigeon peas, beans, and sorghum. In Kenya, the most common kinds of fodder used by dairy farmers in a zero grazing system are lucerne (8%), maize (17%), Rhodes grass (21%), and Napier grass (33%). Less than 2% of the ratings were for other species (Maina et al., 2020). When grazing is forbidden, napier grass is the most commonly used fodder because it accounts for around 70% of all forages used by smallholders (Mwendia et al., 2020). The most traded fodder is hay (made from Brachiaria and Boma Rhodes grass) and lucern, while sales of nearby farmers' hay are dominated by those

of Napier grass. Napier grass is marketed straight from the producer to the end user due to its shortest value chain (Auma, Omondi, Githinji, Rao, Lukuyu & Baltenweck, 2018).

A study on fodder production and adaption techniques was conducted in the drylands of Kenya's Baringo County by Sala, Otieno, Nzuma and Mureithi (2020). The purpose of the study was to map the impact of the value chains for grass seeds and feed on household income. The study's conclusions suggested that producing fodder might help farmers in pastoral communities meet their financial needs. In order to protect fodder farmers from potentially poor prices offered for the grass seeds, the study stressed the importance of connecting them to dependable marketplaces. Furthermore, in order to reduce the costs of inputs related to the input market, farmers must have greater access to inputs in the fodder and grass seed value chain. For example, Njagi, Kamau, Gitau, Onyango, Kinyumu and Mathenge (2015) found that farmers adopted climate-smart push-pull technology that consumes brachiaria grass because they noticed that it provided feeds for livestock during the period of drought and this increased milk output. In Kenya, fodder farmers who adopted brachiaria grass had an increased milk output. In a similar vein, Joshua and Augustine, (2018) discovered that farmers' profit efficiency increased dramatically when the cost of fodder produced on the farm decreased. Feeding fodder shrubs to dairy cows quickly results in an increase in milk output, which in turn makes it easier for farmers to quickly assess and implement the change (Mwendia, et al., 2020). It was also discovered that one advantage of producing fodder and using silage was higher milk production (Maina, et al., 2020). To address the seasonality in fodder supply, fulfill market demand, lower the cost of fodder production, and unlock the production potential of high genetic stock, it is critical to have year-round access to high-quality fodder. Hay that has been preserved is crucial for increasing milk production (Kilelu et al., 2018).

Agricultural technologies affect farmers' economic prosperity through a variety of ways, which is a result of their diversity. Kenya's dwindling international competitiveness in the dairy industry is mostly due to the country's rapidly rising milk production costs. Many academics have noted that implementing contemporary feed, fodder production, and conservation technology is the primary way to address the high expenses associated with milk production. Stated differently, the utilization of agricultural technology is a crucial strategy for farmers seeking to lower production costs and boost milk yield. Because they may successfully minimize labor input, feed and fodder production and conservation technologies constitute a significant category of cost-reducing and efficiency-enhancing agricultural technologies (Makau, 2020).

Informal groups have been established by participants in the fodder and feed value chain to encourage the expansion and improvement of forages. About 60% of the demand is met by the major feed makers, with the other 40% coming from importers, small-scale producers, and home-based feed formulators (Auma, 2018). The majority of the grains produced in the area are meant for human use; only the byproducts of milling, such as rice, wheat, and maize bran, can be used to make animal feed. As a result, the livestock feed sector is heavily dependent on imports, oil seed cakes, brewers, and food processors' byproducts. Low oil crop productivity also results in a reliance on imports.

Cooperatives are becoming more often seen as a way to advance advanced agricultural technologies, reduce poverty and food insecurity (Maina, 2020). In addition to lowering transaction costs in order to access input and output markets, cooperative membership typically results in higher agricultural yields, household income, and household assets. This is the case because cooperatives are generally seen as having a greater

potential to reduce poverty than other forms of institutional innovations because they are linked to social capital and collective action. Most people see agricultural cooperatives as a way to promote rural development rather than as organizations that help members with their financial needs. The goals of dairy cooperatives, which are thought to have around 20,379 registered members in Meru County, have changed over time to better influence and support the growth of the dairy value chain (Mwendia, Ohmstedt & Peters, 2020). Because farmers can now obtain inputs and extension services at a reduced cost, agricultural cooperatives have gained significance.

The Meru County government have started promoting fodder cultivation in an effort to boost milk production and raise household income, working with a number of non-governmental groups. Lack of animal feed has been linked to a number of livestock losses, loss of assets used for subsistence, and an increase in poverty. The cultivation and preservation of fodder has been recognized as a suitable measure to enhance the nutritional status of households and mitigate poverty. A variety of fodder are produced by farmers who engaged in fodder farming, such as hay, banana stems, desmodium, banana leaves, sweet potato vines, Napier grass, and Brachiaria grass. This is made possible by better community-managed disaster risk reduction strategies that protect against the effects of drought by giving dairy animals excess feed. The use of agricultural cooperatives to advance enhanced agricultural technologies and reduce poverty and food insecurity is growing. The contribution of agricultural cooperatives to hastening the adoption of feed and fodder production and conservation, however, is not well understood. Thus the need to fill this knowledge gap.The main objective of the study was to examine the new technologies, production practices of fodder and feed within the dairy value chain in support by agricultural cooperatives.

Methodology

A cross-sectional survey design with concurrent mixed methods approach entailing quantitative and qualitative methodologies was adopted in generating rich information that helped in exploring each of the study objectives. The target population included smallholder dairy in the county while the accessible population included smallholder dairy from the seven (7) producer groups (Buuri DFCS, Nyaki DFCS, Kiamitumi DFCS, Mujwa Digital, Ruiga DFCS, Nyambene Arimi DFCS and Mt Kenya East DFCS) which are supported by the Meru dairy cooperative union. The accessible population of 23,400 registered members were targeted. A formulae was used to determine a study sample size of 195 members. The selected dairy farmer's cooperative societies were a representation of the administrative sub counties (Buuri, Central Imenti, Igembe Central, Igembe North, Igembe South, North Imenti, South Imenti and Tigania East) of the larger Meru county. Systematic random sampling was used to sample 195 respondents from the list of the active members in the seven selected dairy cooperative. Non-probability sampling technique (purposive sampling) was used to select fifteen key informants in the dairy value chain. The KII participants included: Mt Kenya dairy processing plant manager, Meru Dairy feed processing mill manager, Buuri Agro vet rep, County government extension officer, County government livestock production officer, Meru dairy SACCO CEO, Kenya Dairy Board officer, KEBS officer, representatives of milk transporters, chairpersons of dairy cooperatives, county cooperative officer, shop attendants of Mt Kenya Milk, youth group leaders, extension officer stationed at Nyaki DFCs, among others. Primary data was collected using household survey questionnaires, key informant's interviews and focus group discussion guides. Quantitative data was analyzed using SPSS and Microsoft Excel while NVivo software was used to analyze qualitative data.

Results And Discussions

Demographic information

Age of the respondents

Many household heads (50 percent) were aged between 35 and 54 years, followed by 45.5 percent aged between 36 and 55 years. Only a small percentage, 4.8%, of farmers were youth (18 to 35 years) (Figure 1). Although the majority of dairy farmers interviewed are in their productive age group and could engage in production activities to impact the larger community, youth (individuals aged 18 to 35 years) are notably absent in dairy farming. The low youth participation in fodder and feed production could be affected as well as uptake of dairy value chain.

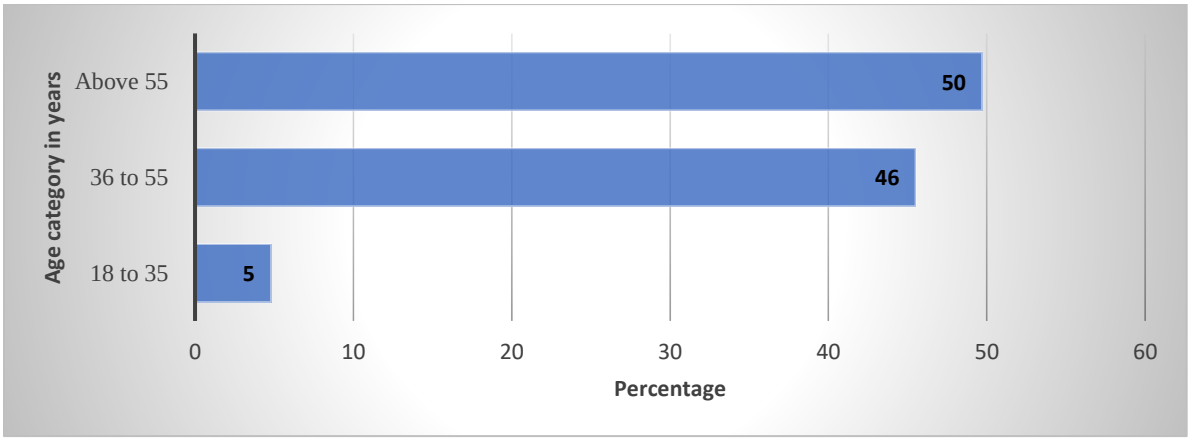

Figure 1: Age of household head

Sex of the Respondents

A majority of household heads interviewed were male, represented by 66.9% as shown in Figure 2. However, there were more female participants in the KIIs and FGDs, hence providing gender-balanced responses.

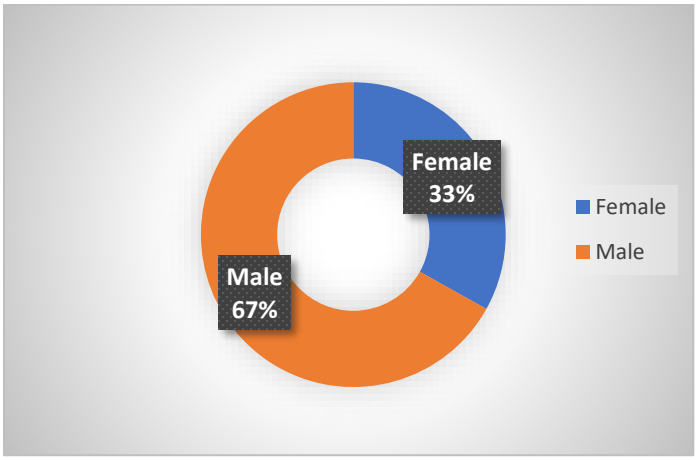

Figure 2: Gender of household head

This is an indication that men were dominant in decision making process in dairy value chain activities.

Level of Education

From the study results about (53%) of the respondents had primary education and below. This is an indication of low literacy levels which may affect member's participation in cooperative activities that require minimum education requirements. Education levels influence access to information, decision making and participation in training which in turns affects access to health care and subscription to a health insurance scheme. According to (Kenya Dairy Board & Tegemeo Institute (2021) farmers with higher education level than secondary are able to access information and make better decisions. According to (Kilelu et al., 2018) cooperatives with members of low education attainments should invest more on member education so that they are able to make better decision in management as well as supervisory roles. According to Maina, et al., (2018) decision involvement is when an individual takes an active role in management decision making and solving problems, which is mostly affected by level of education. Education helps in communication, understating and interpretation of the problem in order to solve through an informed perspective.

Main Source of Income

The study results indicate (82%) of the household income is derived from farming, while (11%) from business and (7%) from employment. This is an indication that farming is the main occupation of the respondents. Since agricultural production is seasonal in nature, prices of agricultural produce are prone to fluctuations which led to financial risk to farmers since they depend on one source of income from agricultural production. Income levels may affect access and contribution to insurance premiums. Delays in payment from agricultural proceeds supplied to agricultural cooperatives and inconsistency in accessing stable income may lead to defaulting in remittance of insurance premiums thus affecting farmers from accessing health care. According to Sala, et al., (2020) diversification of income reduces risk since agricultural production is seasonal in nature and prone to climate change thus affecting income. According to Joshua and Augustine (2018) for farmers who rely on agriculture as their primary, or even only, source of income and consumption, diversifying their agricultural revenue in the face of weather-dependent environments is a critical decision.

Monthly Household Income

Figure 3 show the distribution of individual household incomes per month. From the study findings (50.6%) of the respondents earn an income of Kenya shillings 0 –Kenya shillings 19,999. This is an indication of low-income levels. Since the main source of income for the respondents is farming shown in Figure 3 above the level of income may affect subscription to health insurance scheme thus translating to low access to health care. In a focus group discussion with men, it was reported that "*low income is attributed by the fact that the farm sizes are small, farmers incurred high cost of producing fodder, high prices of concentrates, low quality concentrates which reduce the yield, climate change, seasonal milk production as a cow lactate for only 305 days, high cost of controlling pests and diseases."* In another FGD, a participant added, "

According to Altech. (2018) low-income levels among smallholder farmers can be attributed to small scale production, low productivity fluctuations in prices of agricultural produce, seasonal production, lack of proper storage thus necessitating quick sales, perishability and low technology update for value addition.

This concurs with this study since most of the respondents are small scale farmers. According to Altech. (2018) developing countries agricultural production and low income is attributed to use of traditional farming methods, poor agricultural practices, climate change, low training among others. According to Kenya Markets Trust (2016) smallholder farmers earning high income are more likely to participate in social activities than those with low income. Studies by Altech. (2018) indicate farmers with low income inhibits their engagement in social activities such as fundraising for medical care.

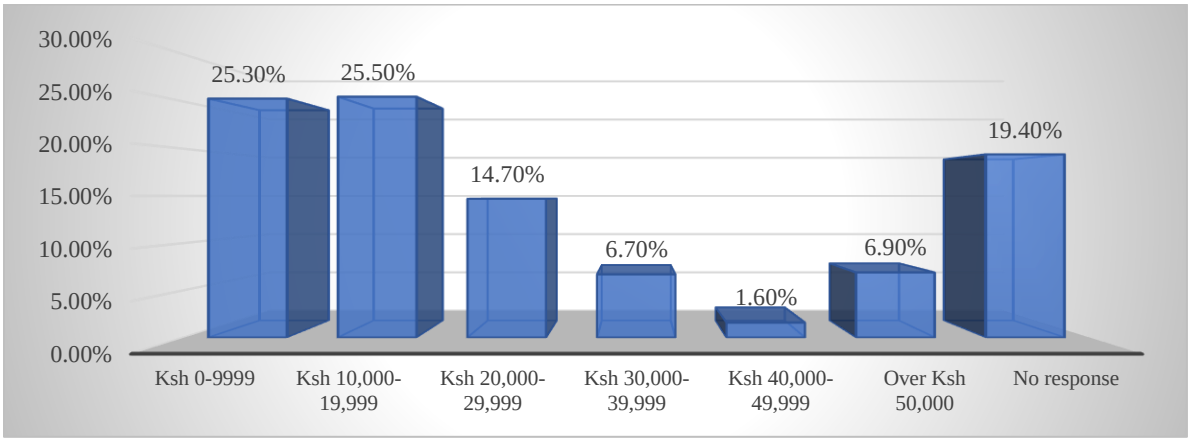

Figure 3: Monthly household income

Household Land Holding in Acres and Land Allocated to Dairy Production

More than half of the households (59%) interviewed owned between 1 and 3 acres of land. About 24.1 percent, had access to less than 1 acre (Figure 4).

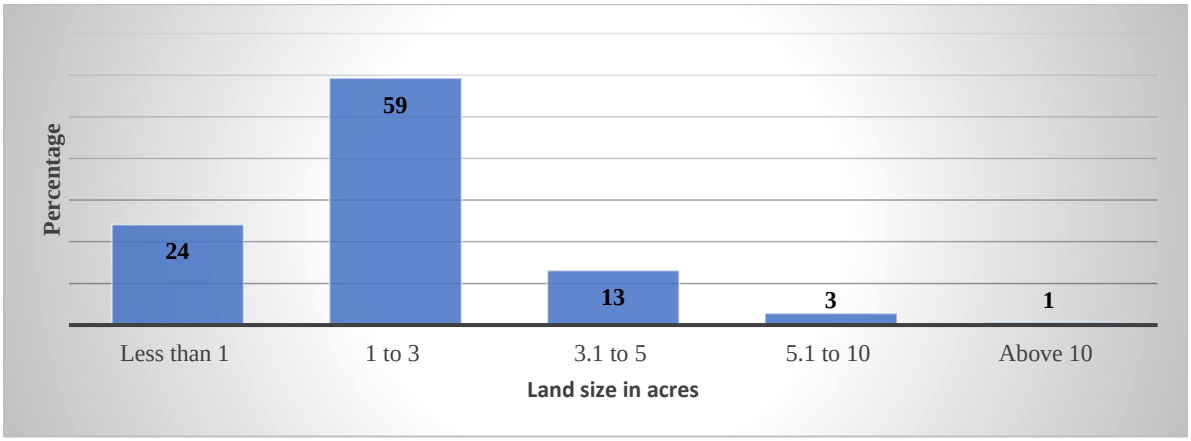

Figure 4: Land accessed by household

Regarding land allocated to dairy production, 89 percent of respondents indicated that their households allocated less than an acre to dairy, with 11 percent of households dedicating between 1 and 3 acres of land to dairy. Limited access to land by dairy farmers restricts grazing and the growing of fodder, resulting in a low number of dairy cows reared, which affects milk production and income. The results from the focus group discussion members indicated that *"women only access land and utilize it partially which affects*

their decision making on the land utilization and planning on what to produce, when to produce, and what quantity to produce.

Women also reported that *"cultural issues of land succession is a major hindrance in owning land by women and youth".*

The discussants in one of the focus group discussions with youth indicated that *"their fathers have discouraged them to venture in dairy farming as when they see they are making money they want to dictate what to be done which discourages one to continue".*

Consequently, farmers face higher input costs for feed, housing, and waste management. Expansion opportunities are limited, hindering growth and scalability. Moreover, smaller production volumes can impact market access and competitiveness, affecting profitability and market presence.

Dairy Production

Dairy Production System Practiced by Farmers

Dairy production in Meru is predominantly zero grazing, as reported by the majority (97 percent) of respondents (Figure 5). This could be associated with the small pieces of land owned by farmers.

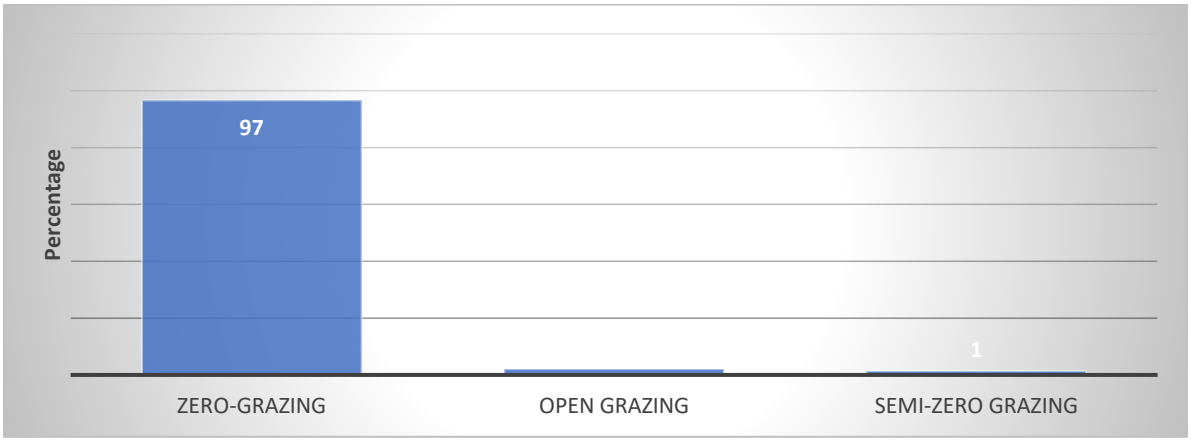

Figure 5: Dairy production systems

A zero grazing production system suggests intensive management practices with cows restrained in small enclosures to optimize feeding, breeding, and health. Figure 6 shows a zero-grazing unit of one farmers, a supplier of milk to Buuri Dairy Cooperative Society.

Figure 6: Zero grazing unit of a milk supplier at Buuri dairy cooperative society

Breeds Reared by Farmers

Friesian was the breed kept by the majority of farmers, represented by 80.0 percent, followed by Ayrshire, kept by 30 percent of farmers. Other breeds kept by less than 6 percent of farmers included Guernsey and Jersey (Figure 7).

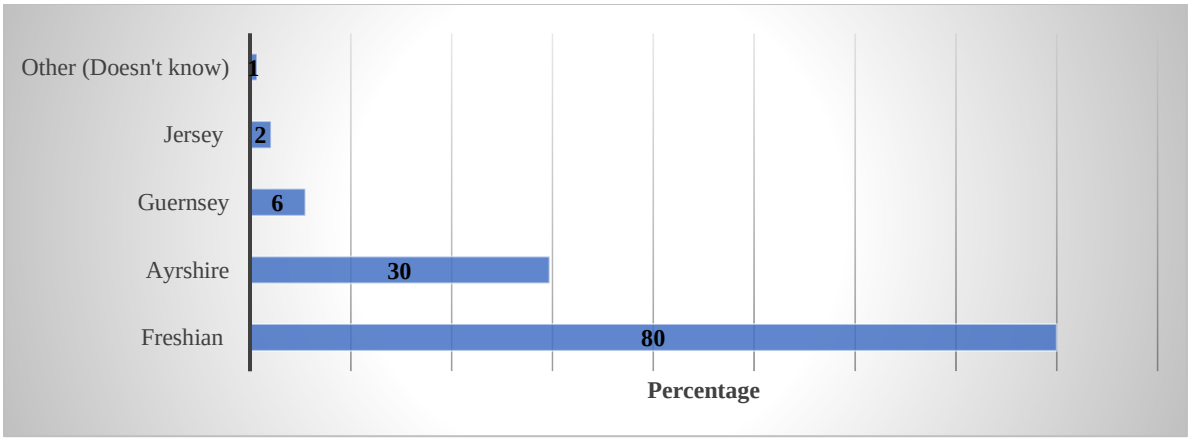

Figure 7: Common breeds kept by farmers

The type of breed reared impacted on the amount of fodder feed and stage of growth**.**

Fodder Produced by Farmers

Regarding the type of fodder produced, Napier grass and maize stover were reported as the most grown fodder by a majority (97 percent) and 76 percent of respondents, respectively (Table 2).

Table 1: Type of fodder produced by farmers

Fodder produced	Frequency	Percentage
Napier grass	141	97.2
Maize stover	110	75.9
Maize silage	40	27.6
Weeds	27	18.6
Cut grass	17	11.7
Grass hay	12	8.3
Legume fresh (e,g Lucern)	10	6.9
Bracharia	9	6.2
Boma Rhodes	4	2.8
Grass silage	3	2.1
Other crops by products	3	2.1
Legume hay	2	1.4
Others	2	1.4

Others, represent tree fodder trees such Calliandra, Gliricidia, Leucaena,Sesbania, and Sudan grass

Feeds and Forages Fed to Dairy Cows and Their Sources

Above 90 percent of respondents fed their dairy cows with fresh forages and concentrates. Other feeds given to cows included plant remains and silage (Figure 10). According to FAO (2022) fodder supply is one of the things that hinder good animal husbandry. The primary source of feed for organic husbandry should be the farm's own fodder. There is a clear correlation between the diet and the health of the animals, just as there is with humans. In a focus group discussion, the respondents from Ruiga DFC reported that "*Farm animals must have enough nutritious food in appropriate amounts if they are to produce milk, meat, and other products. Reducing the number of animals while maintaining their food supply could make sense economically if your farm produces less fodder than average. Of course, the kind of animal and its primary purpose will determine the proper amount and combination of feed items"*. According to USAID (2023) In Kenya, forage is the main source of animal nutrition, and its quantity and quality can fluctuate over time and space. The weather during the rainy season yields high-quality fodders, but as the dry season approaches, they lignify and lose some of their nutritional value. Farmers make up for the decrease in the nutritional value of feed during the dry season by conserving silages during the rainy season. This is in concurrence with the current studies.

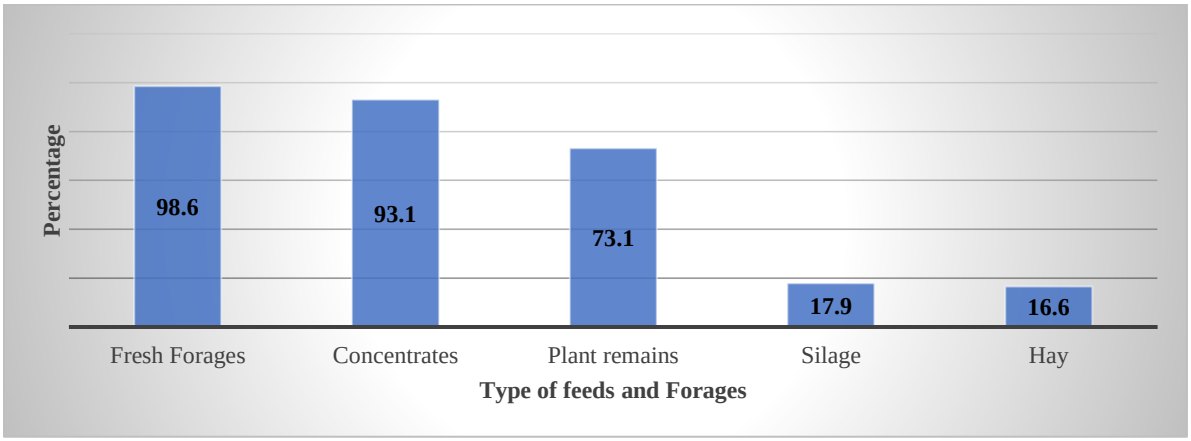

Figure 8: Feed and forages fed to dairy cows by farmers

Findings from the extension officer indicated that "*most farmers produce fodder in small scale especially Lucerne, Napier grass and desmodium which are grown together. They are inadequate thus not conserved. Farmers also use dry maize stalks after harvesting and sometimes buy from neighbors who have no cattle but have grown the fodder. During dry periods farmers buy fodder from commercial suppliers. Boma-rhodes grass is sold at a price of Ksh 200 to Ksh 400 depending on its availability and demand. Concentrates are purchased from individual agro vets and also cooperative managed agro vet. Mineral supplements are also bought from agrovets.This study is in agreement with the study conducted by* ISAAA. (2019) who indicate that crops used for fodder (forage) and pasture leys might be annual, perennial, or permanent. They are grown on fertile soil, where they are either cut or grazed and then fed to the animals either uncooked or preserved in the form of silage or hay. Usually, they are planted alongside cultivated cash crops in a rotation. They are suitable for small-scale farmers due to their high output and quality per unit area, which gives them instant feed for their livestock especially in zero-grazing systems. Surplus material that can be stored for use as silage or hay during the dry season. This is in line with ongoing research.

Sources of Feeds and Forages

Regarding the sources of feeds and forages fed to dairy cows, the majority (92 percent) of respondents sourced from their own production. A considerable proportion of respondents, represented by 81 percent, sourced their feeds from the Agrovet. About 28.3 percent of respondents sourced their feeds from cooperative societies, other farms, and animal feed companies (Figure 9).

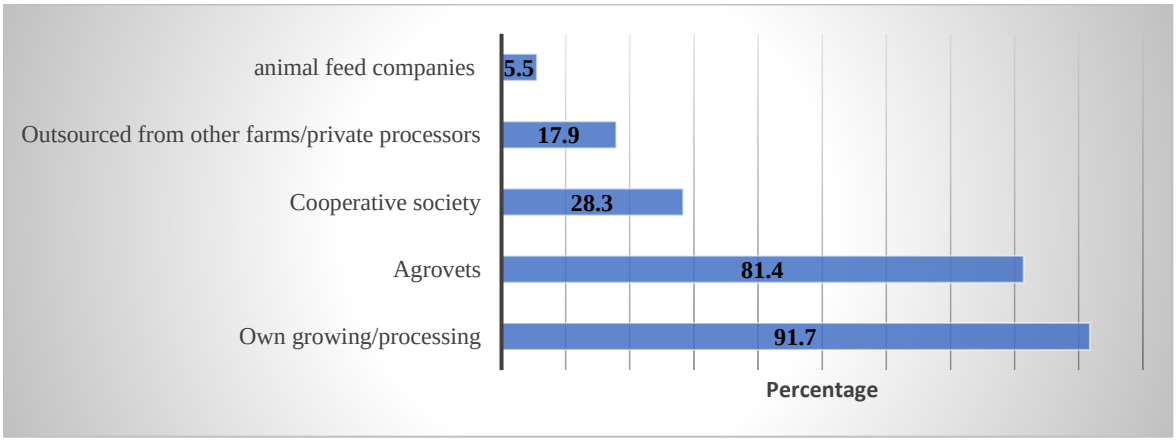

Figure 9: Sources of feeds and Forages

One of the key informants from the agro vets indicated that "*most of the farmers grow their own fodder. Purchases of the concentrates, mineral supplements and multivitamins are sourced in cooperative operated agro vets, individual operated agro vets and direct from suppliers for those who have intensive farming of dairy cows above 20".* The findings are in concurrence with study by Auma et al., (2018) who indicated that majority of ruminant animals in Kenya, including cattle, sheep, and goats, whose diets primarily consist of grasses, natural pastures serve as their food source.

Type of Concentrates Fed to Dairy Cows

Almost all (99.3 percent) of respondents indicated that they feed their livestock on concentrates. The most common concentrate fed to dairy cows, as reported by most respondents, was dairy meal, cited by 97.9 percent of respondents. Other concentrates included maize bran, maize germ, wheat bran, and pollard (See Table 3). This high usage of concentrates indicates a strong and consistent demand for formulated feeds and hence presents a lucrative market opportunity for feed companies to innovate and offer high-quality, cost-effective, and nutritionally balanced products. According to Joshua and Augustine, (2018) Kenyan farmers have resorted to feeding their livestock with low-quality grains and more, which has lowered animal productivity. This is in concurrence with the current study findings.

Table 3: Type of concentrate feed to livestock by farmers

Concentrates	**Frequency**	**Percentage**
Dairy meal	142	97.9
Maize bran	17	11.7
Maize germ	16	11.0
Wheat bran	9	6.2
Pollard	9	6.2
Calf pellets	7	4.8
Home-made feed ration	4	2.8
Oilseed by-products	1	0.7
Brewer's waste	1	0.7
Fish meal	1	0.7

Other*	1	0.7

***Others represents mineral supplements*

Challenges Faced by Farmers in Sourcing Feed and Fodder

The high cost of feeds was cited by the majority (84 percent) of respondents as the main challenge faced when sourcing feeds and fodder for their dairy cows. Other challenges reported by less than 30 percent of farmers included the effects of climate change such as droughts and floods, unavailability of fodder and feeds, access to feeds of compromised quality, inadequate land to grow fodder, among others (Figure 10). According to KEBS key informant "*The feed industry is struggling to keep up with the pace set by the livestock industry due to a number of factors. The scarcity of raw materials, the difficulty in finding novel sources of feed protein, inefficient methods of transportation, storage, manufacture, and application, and the absence of facilities for monitoring feed quality are a few of these. These challenges affect farmers who use feed as well as those involved in the production of feed".* Additional challenges included insufficient funds to purchase feeds, lack of knowledge on how to process feeds at home (e.g., silage), and the distance of the feed source from the farm, resulting in high transportation costs. According to Kenya Dairy Board and Tegemeo Institute (2021) natural pastures are becoming scarce due to drought, climate change, poor management, and persistent overgrazing. Also the price of animal feeds has been increasing; the highest price rises have been linked to a lack of raw materials like soy and oil cakes. The Association of Kenya Feed Manufacturers (AKEFEMA) reports that soy and oil cake prices have gone up.

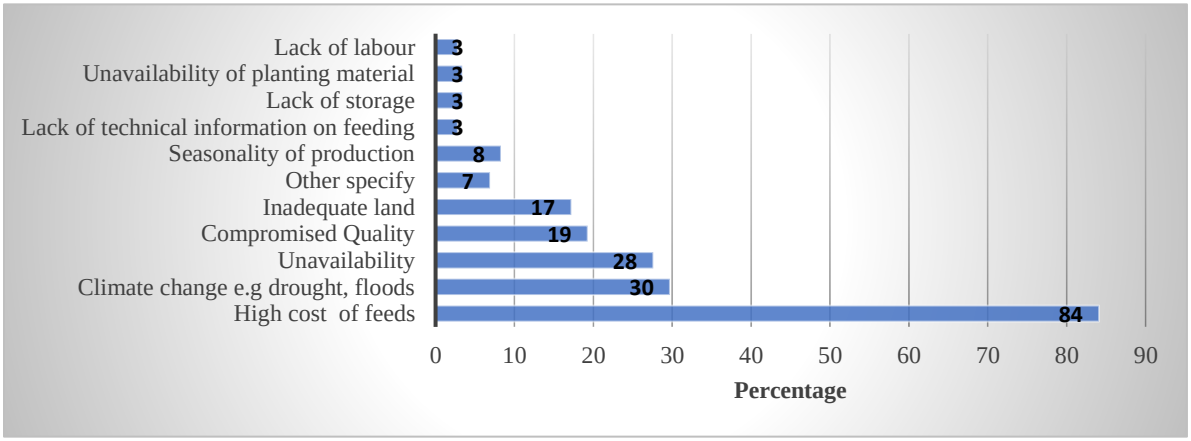

Figure 10: Challenges in sourcing feeds and fodder

Support of Agricultural Cooperatives

From the study results the respondents reported that they have been receiving varied support from their dairy cooperative in varied as indicated in table 4 below. From the results most of the dairy farmers societies supported farmers through seed production and bulking of super napper and selling to farmers (94.2%) while 71.7% of the respondents reported that they were supported by being supplied with subsidized feeds and fodders.

Table 4: Support offered by cooperatives in fodder and feed production

Support Offered	Freq	Percentag
Seed production and bulking of super napper and selling to farmers	145	94.2
Supplying farmers with subsidized feeds and fodders	112	71.7
Collaboration with NGOs to access fodder seeds e.g silage maize	46	24.6
Organizing farmers field days on feed formulation feeding programme	29	16.4
Purchasing and selling hay and packed silage at subsidized prices	20	12.5
Organizing trainings on ensiling green maize stalks	16	7.2
Suppling farmers with subsidized mineral and multivitamins	14	6.8
Collaboration with research institutions in mounting demos on pasture production and	19	6.2
Training on animal husbandry	4	2.6
Offering extension services on feed and fodder production	3	2.5

Homemade Dairy Rations at The Farm

Only 32 percent of respondents reported that they make dairy rations at their farms. According to one of the extension officers “homemade meals have other benefits, such lowering production costs and boosting farm productivity by utilizing byproducts from the farm”. One of the leaders in the dairy cooperative organizations also stated that "*homemade rations are cheaper than commercial ration*." This small percentage of farmers making homemade rations indicates limited self-sufficiency in feed production and higher dependency on commercial feed suppliers. This suggests gaps in knowledge or resources for effective homemade ration formulation, presenting an opportunity for extension services and training programs to educate farmers on cost-effective and balanced feed preparation. The reliance on commercial feeds can increase production costs, impacting profitability and sustainability, highlighting the need for support systems to empower farmers with the necessary skills and resources for homemade feed production.

Fodder Preservation and Form They Are Preserved

Most (76 percent) of respondents reported that they preserve fodder. Among the fodder preserved by most farmers is hay, as reported by 63 percent of farmers. Silage, milled and packaged feeds, crop residues, dried maize stovers, and Napier grass were also among the fodder preserved by farmers for future feeding to their dairy cows. See Figure11.

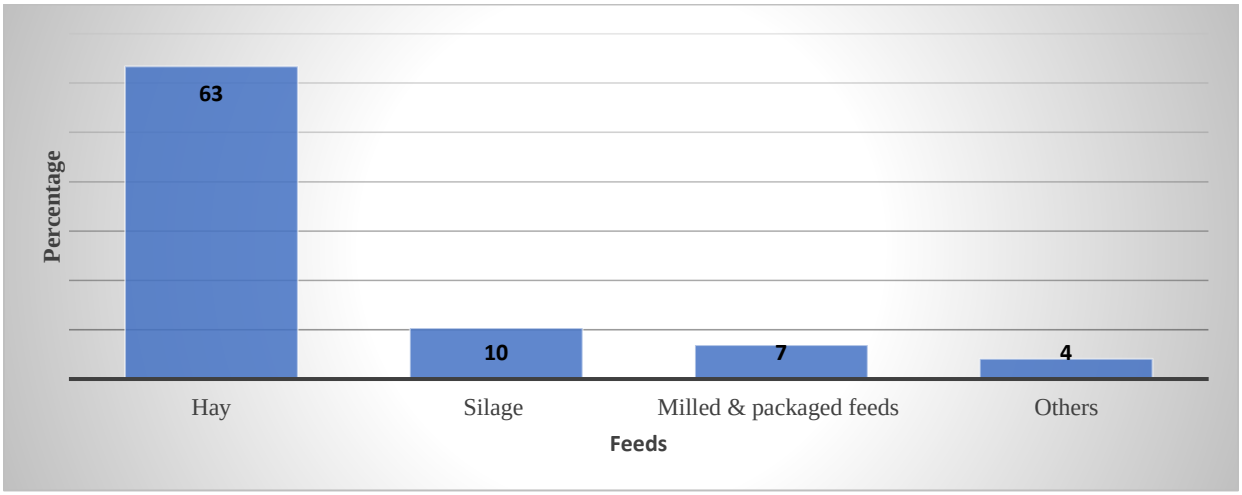

Figure 11: Forms fodder is preserved

Having a large proportion of farmers preserving hay as the sole feed for dairy livestock implies a reliance on a single feed type, potentially leading to nutritional deficiencies that can affect milk production and cow health. This reliance may result in inconsistent feed quality, impacting overall dairy productivity and profitability. This finding highlights the need for farmer education on feed preservation method such as silage making, diversified feeding strategies and the benefits of supplements and other feed types to enhance nutritional intake. Additionally, it presents opportunities for feed companies to market complementary feeds and for extension services to guide farmers on balanced nutrition and feed preservation techniques. Figure 12 shows one of the farmers storages shed.

Figure 12: Storage of dry maize stovers

Figure 13: Wrapped Silage

A Ruiga ward extension worker indicated that "*because maize silage is more appetizing and nutritious than hay, cows consume more of it and yield more milk. Due to its high nutritional content, silage lowers the cost of the entire feed for animals. You will have a greater return on investment with maize silage since it will increase milk production and enhance the cow's overall health"*. Altech. (2018) states that wrapped silage is easily transportable without sacrificing its nutritious content.

Reasons for Not Conserving the Fodder

Respondents who reported that they did not conserve fodder gave reasons for not conserving, including lack of enough feed to preserve, as reported by 14 percent of farmers, and it being expensive, as reported by 12 percent of respondents. Other reasons mentioned by less than 10 percent of respondents included lack of preserving infrastructure, lack of technical information, among others (See Figure14). Other reasons represented lack of enough land for growing fodder for silage.

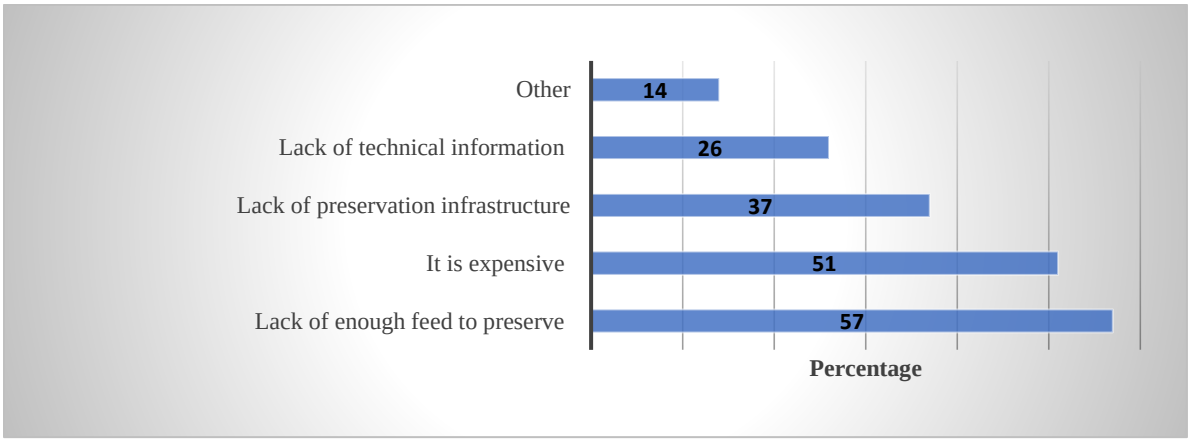

Figure 14: Reasons for not conserving fodder

Not storing fodder makes farmers reliant on seasonal forage, leading to feed scarcity during dry seasons or adverse weather and causing nutritional deficiencies in dairy cows. This not only impacts cow health and milk production but also profitability. To address the lack of enough feeds, farmers may need to buy costly commercial feeds during dry seasons, increasing production costs and reducing profit margins. It also limits future feed planning and leads to inefficient farm management. Adopting fodder conservation practices like haymaking and silage production ensures a steady, high-quality feed supply year-round, enhancing the sustainability and resilience of dairy farming.

Conclusion

From the study findings dairy farmer's cooperative societies have played a critical role in supporting farmers to access feeds and fodder through their outlet shops in various milk collection points at subsidized cost. Farmers have also been supported to access feeds and fodder at a credit and then the cost is recovered through checkoff system at the end of the month. The dairy farmer's cooperative societies have also supported farmers through seed production, bulking of super napper and selling to farmers.

Recommendation

The study recommends that agricultural cooperatives should partner with seed companies, feed manufacturing companies, Kenya beural of stadards and conduct trainings on modern feed and fodder production, as well as formulation and conservation. Agricultural cooperatives can tap on increasing farmers' ability to participate in commercial seed bulking which can help to improve member's livelihoods by generating income and aiding in increasing pasture and fodder production. From the study findings a policy brief should be developed to support agricultural cooperatives support smallholder farmers on

pasture production, conservation and marketing. It is important to critically evaluate and address at the policy level how quality of feeds and fodder as well as taxes on raw materials for feed formulation have affected the growth of the livestock feeds and fodder industries in the area.

Farmers should be encouraged to diversifying the range of forage species instead of relying on dry maize stalks and Napier grass. The study recommends further studies on feed and fodder contamination and how cooperatives can support reduce the cases of aflatoxins in feeds and fodder.

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