

## **Smallholder Dairy Production, Motivations, Perceptions and Challenges in Nyandarua and Nakuru Counties, Kenya**

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**Abstract:** *Small-scale farmers dominate Kenya's dairy industry that is among the largest and one of the most successful in Africa. Despite the dairy policies in place, the smallholder dairy farmers are still subsistent and are yet to attain global competitiveness. This study explored socioeconomic characteristics, motivation, perceptions and challenges of smallholder dairy farmers in Kenya. The study used a mixed approach method of cross section survey and multistage sampling procedure to select a sample of 380 smallholder dairy farmers from Nakuru and Nyandarua counties. Structured questionnaires and Focus Group Discussion provided the data for analysis. The study results indicated that smallholder milk productivity was below the world leaders. Zero grazing was the most productive system while open grazing was the dominant production system. Land, income and market factors were core for smallholder dairy farming performance. Even though household dairy commercialization level for Nakuru and Nyandarua Counties were relatively low, Nyandarua County had higher level of smallholder dairy commercialization compared to Nakuru County. Majority of the dairy farmers were intending to continue with dairy production. Those planning to exit cited the venture as either being expensive, not profitable or risky. Challenges faced by the smallholder farmers related to productivity, infrastructure and institutions. To reduce productivity challenges, the study suggested review of land policies, improvement in animal feed, veterinary and insemination services. To reduce infrastructural impediments the study suggested improvement in roads network, rural electrification (and promotion of other sources of energy) storage facilities and exploration of alternative milk preservation methods. Institutional impediments need improvements in financial accessibility, extension services and customized research and technological innovations.*

**Keywords:** *Smallholder Dairy, Motivations, Perceptions and Challenges, Kenya*

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### **I. Introduction**

Dairy production in Kenya is vibrant and is mostly concentrated in Central and Rift Valley counties (FAO, 2011). The dairy industry contributes 14% of the agricultural GDP, 40% of the livestock sector GDP and 4% of the national GDP, and currently grows at an average of 5–7% annually (KDB 2015). The sector has employed directly and indirectly over 1.2 million people (KDB 2015). Smallholder farmers own over 80% of the national dairy herd estimated at 4.2–6.7 million cattle. The smallholders own between 1-3 dairy animals (KDB 2015) and produce over 56% of total milk (Odero, 2017). Smallholder dairy farms produce an average milk yield of about 5–8 litres per cow per day compared to the large-scale farmers whose average yields are about 17–19 litres per cow per day (ACET 2015). Between 2003 and 2012, total milk production grew at an average of 5.3% per year, from 3.2 to 5.2 billion litres (KDB 2015). Total milk output per animal in Kenya is still below the global leaders like the European Union, USA, Canada, New Zealand and South Africa where production per 305 lactation days is above 5,000 liters/cow, with vertically coordinated efficient value chains (Mathenge et al., 2010). The main limitations of the dairy sector in Kenya include seasonality in production, inadequate quantity and quality of animal feed compounded by the limited use of supplement feeds. Inappropriate animal husbandry and farming practices, poor access to breeding, animal health and credit services in addition to the high cost of artificial insemination (AI) service are additional limiting factors. Dairy producing areas have poor dairy infrastructure (including roads, electricity), insufficient milk collection and marketing system. Poor interaction and priority setting between research, extension and training, and limited farmers' involvement in the output market also hinder dairy sector performance (Bebe et al., 2015).

Dairy farmers consume 45% of the milk produced at the household level. In 2016, annual milk consumption was at 115 liters per person. This observation was associated with population growth especially due to urbanization (USAID, 2018). Projection of national milk consumption per capita is to grow at 6% annually for the period 2012 to 2022. This is an increment from 106 to 139 liters per person (USAID, 2018).

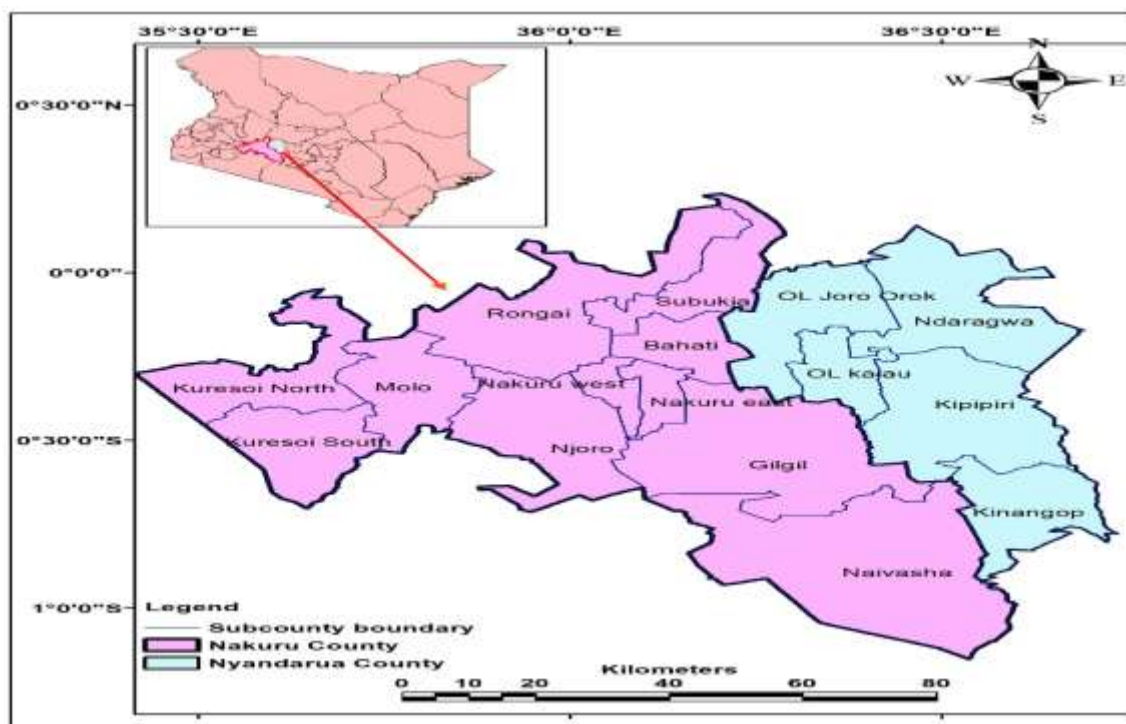
The projected consumption is to reach 220 liters per capita by the year 2030. Informal and formal market channels absorb the remaining 55% of the produced milk (approximately 2.8 billion liters) (USAID KAVES, 2014). The informal channel accounts for between 80-90% of the marketed milk while the formal channel accounts for the remaining 10-20% (USAID KAVES, 2014). Players in milk marketing include producers, hawkers and traders. They supply the raw and semi-processed milk to cooperatives, milk bars and dispensers. The informal channel mostly markets raw milk with a small percentage of their milk being processed and distributed (Bebe et al., 2015). Processors, mini dairies, cottage industries and milk bars form the formal channel of the licensed operators.

Four themes that explain the dairy sub-sector include landholding size, wealth, market orientation and level of vulnerability to risk (Hazell et al., 2010). A smallholder farmer is, therefore, one with limited land availability, restricted or poor-resource endowments of land, capital, skills and labor and low technology, subsistence-oriented and highly vulnerable to risk. However, a smallholder may or may not simultaneously have all these dimensions of smallness (Chamberlin et al., 2009; Hazell et al., 2010). The main objective of this study was to explore the characteristics of the smallholder dairy farmers, motivations, perception and challenges in the light of the four themes identified above. This study contributed towards a more robust, reliable, and resilient dairy sector.

## II. Materials and Methodology

The study focused on smallholder dairy farmers in Nyandarua and Nakuru counties in Kenya, which share common borders with each other. Agriculture is the main source of household food, raw materials to agro-based industries as well as income in both counties. Nyandarua is the leading milk producing while Nakuru is the third largest milk producer in the country. The two counties undertake the highest concentration of dairy activities in the country ranging from production, processing and consumption.

The study used cross sectional survey approach and Multi-stage sampling procedure in selecting the sample of smallholder dairy households to provide data. The study identified Nyandarua and Nakuru counties (Figure 1) purposively because of their large number of smallholder dairy producers. The study identified three sub – counties from each county to form strata for the purposes of sampling. These sub - counties were Bahati, Rongai and Molo sub - counties from Nakuru County and North Kinangop, West Kinangop and South Kinangop from Nyandarua County. The sub - counties were selected for inclusion in the study due to their unique characteristics, which included geographical location, milk production levels, diversity of dairy activities and their high extent of small-scale dairy production. Selection of the sample villages and the 380 smallholder milk-producing households was through simple random sampling. The study used structured questionnaire and focus group discussion to collect data from the selected smallholder dairy farmers.



**Figure 1:** Map of Nakuru and Nyandarua Counties

### III. Results and Discussion

#### 3.1 Smallholder Dairy Characterization

Land and its tenure systems form the first theme and the major component of dairy production. Performance of dairy enterprise and its operations are on land. In the study area, land defined, the size of dairy stock kept, dairy feed availability and amount of labor required. Dairy farmers who had less land or who relied on rented land were restricted in the decisions regarding their dairy enterprises. Table 1 provides results of land ownership. Smallholder dairy farmers owned an average of 2.7 acres and had access to an average of 3.5 acres of land. Even though there was no significant difference in total land accessed, owned, rented out and land communally owned, households in Nyandarua County rented-in significantly ( $P < 0.05$ ) more land (0.6 acres) compared to those in Nakuru County (0.4 acres).

**Table 1:** Household Land Ownership

Characteristic	Nakuru	Nyandarua	t-test	Overall
Land Ownership				
Total acres owned	2.8	2.6	0.54	2.7
Total acres rented in	0.4	0.6	-2.40**	0.5
Total acres rented out	0.2	0.1	1.34	0.1
Total acres communally owned	0.2	0.1	1.23	0.1
Total land accessed	3.6	3.4	0.55	3.5

Source: Calculations by author based on the 2017 survey data. \*\* $P < 0.05$

Table 2 provides results of the commonly practiced dairy production systems in Nakuru and Nyandarua counties. Overall, the predominant systems were zero grazing (31.7 percent), open grazing (54.3 percent) and tethering (14.0 percent). In Nakuru, 34.1 percent, 55.0 percent and 10.9 percent of households practice zero grazing, open grazing and tethering respectively while 30.2 percent, 53.8 percent and 16.1 percent of the households practiced the three systems in Nyandarua respectively. Open grazing was therefore the most widely used grazing system in the study area.

**Table 2:** Smallholder Dairy Production Systems

Category	Nakuru			Nyandarua			Overall		
	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering
Dairy system (%)	34.1	55.0	10.9	30.2	53.8	16.1	31.7	54.3	14.0
Type of dairy housing structure used (%)									
Permanent	52.3	11.3	14.3	27.9	9.4	6.3	38.1	10.1	8.7
Semi-permanent	47.7	47.9	57.1	72.1	49.5	28.1	61.9	48.9	37.0
No structure	0.0	40.8	28.6	0.0	41.1	65.6	0.0	41.0	54.3
Type of grazing land used (%)									
Own	95.1	89.9	92.3	98.4	92.6	62.4	97.0	91.5	71.1
Community	4.9	5.8	7.7	0.0	0.9	0.0	2.0	2.8	2.2
Leased	0.0	1.4	0.0	0.0	2.8	6.3	0.0	2.3	4.4
Roadside	0.0	2.9	0.0	1.6	3.7	31.3	1.0	3.4	22.3
Main source of labor for dairy (%)									
Family	75.0	95.8	100	86.9	92.5	90.6	81.9	93.8	93.5
Current number of dairy animals kept	3	3	1	3	3	2	3	3	2
Years of practicing dairy farming	11	13	9	12	14	11	11	14	10

Main feeding methods used (%)									
Natural pasture	76.4	81.7	78.8	60.8	72.0	68.8	71.4	75.7	71.7
Fodder	9.1	7.3	7.1	24.6	7.5	25.0	18.1	7.3	19.6
Crop stocks	10.0	3.8	9.1	6.6	12.1	3.1	6.7	8.4	4.3
Dairy meal	4.5	7.2	5.0	8.0	8.4	3.1	4.8	8.6	8.7
Frequency of daily dairy meals & concentrates feeding (%)									
Once	15.9	22.5	21.4	21.3	36.5	59.4	19.1	30.9	47.9
Twice	40.9	28.2	64.3	68.9	60.7	40.6	57.1	47.8	47.8
Thrice	43.2	49.3	14.3	9.8	2.8	0.0	23.8	21.3	4.3
Who treats dairy animals (%)									
Veterinary officer	97.7	95.7	78.6	96.7	99.1	87.5	97.1	97.7	84.8
Self	2.3	4.3	21.4	3.3	0.9	12.5	2.9	2.3	15.2
Source of veterinary services (%)									
Agrovet store	34.1	44.3	50.0	86.7	76.6	59.4	64.4	63.8	56.5
Veterinary	61.4	37.1	42.9	13.3	19.6	34.4	33.7	26.6	37.0
Cooperative / Group	4.5	18.6	7.1	0.0	3.8	6.2	1.9	9.6	6.5
Source of dairy breeding (%)									
Own bull	4.6	5.7	35.7	0.0	5.6	0.0	1.9	5.6	10.9
Borrowed bull	6.8	8.6	7.2	4.9	5.6	18.7	5.7	6.8	15.2
AI	88.6	85.7	57.1	95.1	88.8	81.3	92.4	87.6	73.9

Source: Calculations by author based on the 2017 survey data

In this study, the dairy system management practices considered included housing, feeding livestock and health. More farmers in Nakuru practiced zero grazing with permanent structures than in Nyandarua at 52.3 percent and 27.9 percent respectively. Across the three feeding systems, farmers in the study area had semi-permanent dairy housing structures with 61.9 percent, 48.9 percent and 37 percent representing zero grazing, open grazing and tethering grazing respectively. Overall, 97 percent, 91.5 percent and 71.1 percent of the farmers practicing zero grazing, open grazing and tethering respectively used own land for dairy farming. Most households owned between 1-3 cows with a few owning more than three dairy cows. Overall, the average number of years for practicing dairy farming was 11, 14 and 10 for zero grazing, open grazing and tethering respectively.

Dairy production is a labor-intensive enterprise in Kenya and the farmers involve both family and non-family labor to meet the requirements. Results in Table 2 showed that households practicing the different production systems relied minimally (6.5%) on casual/hired labor. This suggests that dairy producing households in the study areas heavily relied on family labor (93.5%) for the operations. This, therefore, signifies the importance of family labor employment in dairy production in Kenya.

Smallholder dairy farmers mainly serve their dairy with fresh natural pasture across the three feeding systems. Overall, zero grazing, open grazing and tethering recorded 71.4%, 75.7% and 71.1% respectively as the main feeding methods. Fodder in addition to natural pasture, were used to feed the animals. Fodders mainly used were maize stalks, straws from rice and a minimum of sorghum and millet stalks. Households in the study area mostly grew less than a hectare of napier, and grass for the dairy animals. The low acreage resulted from land inadequacy, due to the intensive land subdivision coupled with the need to grow food crops for the family. Even though napier grass was preferred, households also grew minimal quantities of star grass and rhodes grass. Quantities of these feeds grown or stored for cattle were however insufficient because of drought, low soil fertility, and overgrazing. To supplement the pasture served to animals, most farmers in the study area fed their livestock twice a day with dairy meal and concentrates. However, only 23.8%, 21.3% and 4.3% of the farmers fed their livestock thrice a day for zero grazing, open grazing and tethering respectively. All the households fed concentrates during milking time. Both the frequency and the quality of concentrate fed depended on the farmer's ability to purchase it. However, most of the households purchased inadequate quantities of concentrate because of high prices and far distances of up to 10 kilometers from some homesteads to the supply centers.

In all the three production systems, over 84 percent engaged veterinary officers for treatment of dairy animals in both counties. Farmers who treated their animals themselves sought drugs and related services either from agrovet stores, veterinary officers or from cooperatives/groups. Overall, 64.4 percent, 63.8 percent and 56.5 percent of the zero grazing, open grazing and tethering respectively (who treated their animals themselves) sought for the drugs and veterinary services from agrovet stores while 33.7 percent, 26.6 percent and 37.0 percent of zero grazing, open grazing and tethering respectively sought veterinary services from veterinary officers. Smallholder dairy breeding was majorly through own bull, borrowed bull or artificial insemination

(AI). However, artificial insemination was the preferred breeding method as reported by 92.4 percent, 87.6 percent and 73.9 percent by the zero grazing, open grazing and tethering systems respectively.

Market orientation and commercialization is an important theme and a major component of smallholder dairy production. Table 3 shows results for milk production and marketing of the smallholder farmers in the study area.

**Table 3:** Market orientation of smallholder dairy farmers

Category	Nakuru			Nyandarua			Overall		
	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering
Milk produced per day (litres)									
Highest	10	10	7	22	17	10	17	14	9
Lowest	4	4	2	9	8	4	7	6	3
Mean	10.3	11.0	8.3	17.4	14.6	8.0	13.8	13.1	8.1
Milk sales									
Average price /litre (KSh)	35	36	33	35	34	31	35	35	32
Mean sales / day (Litres)	7.5	7.1	3.8	14.4	11.6	6.2	10.8	9.4	5.4
Mean sales / day	6.9			11.6			9.4		
Commercialization Index	0.73	0.64	0.46	0.83	0.79	0.77	0.78	0.72	0.66
Commercialization Index	0.66			0.80			0.73		

Source: Calculations by author based on the 2017 survey data

In the study area, zero grazing was the most productive system yielding a maximum of 17 liters/day, and a minimum of 7 liters/day. Tethering was the least productive with households realizing a maximum milk production of 9 liters/day and a minimum milk production of 2 liters/day. Nyandarua County substantially produced higher quantities of milk compared to Nakuru County across the three production systems. Producers under zero grazing registered the highest milk production of 22 liters/day in Nyandarua compared to 10 liters/day in Nakuru. Open-grazing and tethering systems reported 17 and 10 liters/day respectively in Nyandarua as Nakuru recorded 10 and 7 liters/day respectively. In Nyandarua, zero grazers produced an average of 14.4 lit/day while open-grazers and those undertaking tethering produced an average of 11.6 and 6.2 lit/day respectively. In Nakuru, zero grazers produced an average of 10.3 lit/ day while open-grazers and those on tethering produced 11.0 and 8.3 lit/day respectively. Zero grazers from Nyandarua sold an average of 14.4 lit/day compared to 11.6 lit/day and 6.2 lit/day for open grazers and tethering systems respectively. In Nakuru, zero grazers sold an average of 7.5 lit/day compared to 7.1 lit/day for open grazers and 3.8 lit/day for tethering system. Nyandarua recorded mean sales of 11.6 lit/day whereas Nakuru recorded mean sales of 6.9 lit/day. On overall, mean sale were 9.4 lit/day. The average sales price was Ksh. 34 for Nyandarua and Ksh. 35 for Nakuru. Farmers in Nyandarua sold more of their milk than farmers in Nakuru did in all the categories of dairy systems as reflected by the mean Commercialization Indexes. The results indicated that both counties practiced dairy commercialization. The mean Commercialization Index for Nakuru and Nyandarua counties were 0.66 (66 percent) and 0.80 (80 percent) respectively. The observed difference in commercialization level was due to the varied socioeconomic factors (endowments) in the two counties. Factors that influenced the observed difference in commercialization level were number of dairy animals kept, dominance of the dairy enterprise as an economic activity, amount of milk produced and consumed per day. Farmers in Nyandarua were significantly closer to markets compared to farmers in Nakuru. Farmers in Nakuru were closer to tarmac roads compared to those in Nyandarua.

Wealth and income are major components of dairy production and form another theme. Dairy operations are capital intensive, need appropriate technology and good farm infrastructure. Effective and efficient dairy farming therefore requires substantial amounts of financial resources. Income defined a households' capability to finance farm capital, land, secure necessary dairy inputs, appropriate technology adoption and intensification of dairy production. Availability of income increases the incentive for commercialization of smallholder dairy. Table 4 compared the various sources of income in Kenya Shillings (KSh.) between the two counties. The results showed that households in the study area earned monthly income from several services.

**Table 4: Household wealth and income sources (Monthly)**

Income source	Nakuru	Nyandarua	t-test	Overall
Employment income	18,448	14,002	0.878	6,942
Profit from businesses	6,850	13,483	-3.08***	8,990
Dairy enterprise income	6,839	12,565	-4.91***	10,044
Income from sale of other farm produce	17,656	30,561	-2.86***	23,977
Income from sale of livestock	23,086	59,717	-3.22***	37,488
Income from compost manure	5,125	1,000	0.546	4,300
Income from relatives	3,978	3,250	0.373	3,899
Income from land rented out	3,000	1,067	1.124	22,109

Source: Calculations by author based on the 2017 survey data. \* P < 0.1, \*\* P < 0.05, P < 0.001  
1\$ = KSh. 101

Nondairy business profits, dairy enterprise, sale of other farm produce, sale of livestock and other assets were the main sources of income. The results indicated that smallholder dairy farmers in Nyandarua County earned significantly (P < 0.01) higher monthly incomes compared to Nakuru. In the mentioned categories, Households in Nyandarua County earned KSh. 13,483, KSh. 12,565, KSh. 30,561 and KSh. 59,717 while households in Nakuru received KSh. 6,850, KSh. 6,839, KSh. 17,656 and KSh. 23,086 respectively. The results also revealed that even though dairy was not the main contributor to household monthly income, it contributed to overall farm incomes in both Nakuru and Nyandarua Counties.

### 3.2 Motivation and Perception of Smallholder Dairy farming

Table 5 presented the various possible motives for undertaking dairy farming. The results showed that milk production for home consumption (84 percent) and income purposes (89.6 percent) are the main reasons why households practice dairy farming. 48.2 percent of households engage in the dairy enterprise because it is the dominant economic activity in their area of residence. In Nyandarua, the main reasons why households' practice dairy farming included milk production for home consumption (84.6 percent), income generation (91.5 percent) and the dominant economic activity in the area (70.6 percent).

**Table 5: Reasons for Dairy Farming (%)**

Category	Nakuru	Nyandarua	Overall
Reasons for dairy farming			
For prestige	2.6	1.0	1.8
To produce milk for consumption	83.4	84.6	84.0
To get income and reduce poverty	87.6	91.5	89.6
Availability of technology	11.9	8.5	10.2
The dominant economic activity	24.9	70.6	48.2
No any other work	19.7	2.5	10.9
Dairy farming is easy	13.5	8.0	10.7
Planning to continue in dairy in the next 5 years			
Yes	90.7	99.5	95.2
Reasons for exiting dairy farming			
Expensive	22.2	100	26.3
Unprofitable	11.1	0	10.5
Risky	66.7	0	63.2

Source: Calculations by author based on the 2017 survey data.

In Nakuru County, a majority of households practiced dairy farming to produce milk for home consumption (83.4 percent) and to get income and reduce poverty (87.6 percent). Only 25 percent of households reported practicing dairy farming because of its dominance as an economic activity in Nakuru. Results also showed that the majority (overall 95.2 percent, 90.7 percent in Nakuru and 99.5 percent in Nyandarua) of the households were planning to continue with dairy farming.

Table 5 also indicated that, only 4.8 percent of households were planning to exit dairy production. These farmers (9.3 percent in Nakuru and 0.5 percent in Nyandarua) cited different reasons. The reasons were that the dairy enterprise was risky (63.2 percent), expensive venture (26.3 percent) and not profitable (10.5 percent). Whereas all the households (100 percent) planning to quit dairy enterprise in Nyandarua pointed out that it was an expensive venture, in Nakuru 22.2 percent believed that it was an expensive venture, 11.1 percent believed it was not profitable and 66.7 percent thought that, it was a risky business.

### 3.3 Challenges Facing Smallholder Dairy Subsector

The study also sought to unearth the challenges currently facing the smallholder dairy subsector. The challenges varied by geographical location and socioeconomic variables within the study area. Table 6 presents the major challenges posted by the farmers in the study area.

**Table 6:** Smallholder Dairy Farming Challenges (%)

Challenge	Nakuru			Nyandarua			Overall		
	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering	Zero grazing	Open grazing	Tethering
Milk Loss and Point of loss									
During milking	55.0	50.0	44.4	41.1	47.8	40.0	44.7	48.7	41.4
During transportation	10.0	25.0	11.2	23.2	23.2	20.0	19.7	23.9	17.3
During storage	30.0	9.1	11.1	17.8	14.5	20.0	21.1	12.4	17.2
Delivery Failure	5.0	15.9	33.3	17.9	14.5	20.0	14.5	15.0	24.1
Financial Availability									
A problem	78.6			83.7			81.4		
Not a problem	21.4			16.3			18.6		
Extension Services (Information and Training)									
A Problem	79.5			88.7			84.4		
Not a problem	20.5			11.3			15.6		
Input and Output Price Satisfaction									
A Problem	97.7			94.5			95.9		
Not a problem	2.3			5.6			4.1		
Infrastructure									
A Problem	78.8			94.4			87.3		
Not a problem	21.2			5.6			12.7		
Veterinary Services Availability and Accessibility									
A Problem	71.1			81.8			81.8		
Not a problem	29.9			8.2			18.2		
Dairy Production Technology and Equipment									
A Problem	73.7			54.8			63.0		
Not a problem	26.3			46.2			37.0		

Source: Calculations by author based on the 2017 survey data

First, milk losses were generally high among those who practiced open grazing followed by tethering and least in zero grazing. Four milk loss points identified included losses on the farm during milking, during transportation, storage and milk delivery failure. Overall, 44.7 percent, 48.7 percent and 41.4 percent lost milk in the farm during milking for zero grazers, open grazers and tethering respectively. 19.7 percent, 23.9 percent and 17.3 percent lost milk during transportation for zero grazers, open grazers and tethering respectively. 21.1 percent, 12.4 percent and 17.2 percent lost milk during storage for zero grazers, open grazers and tethering respectively. 14.5 percent, 15.0 percent and 24.1 percent lost milk due to delivery failure for zero grazers, open grazers and tethering respectively. There was inadequate and inappropriate investment in cold storage facilities and other essential dairy equipment requiring electricity. Electricity in rural areas was expensive and often unreliable because of frequent blackouts. This study agreed that inadequate cooling facilities result in large quantities of the reported milk loss produced by the smallholder dairy (Bingi & Tondel, 2015). Inadequate and inefficient storage and processing facilities limit the marketability of dairy milk which is highly perishable (Bingi & Tondel, 2015).

Second, dairy operations are capital intensive, need appropriate technology and good farm infrastructure (Olwande et al., 2015; Mpandeli & Maponya, 2014). Effective and efficient dairy farming therefore require substantial amounts of financial resources. The results showed that 78.6 percent and 83.7 percent of the smallholder dairy farmers in Nakuru and Nyandarua counties respectively attested that finance was a problem to them. In the study area, even though farmers had access to loans, the amounts received were inadequate, irregular and not timely. Smallholder dairy farmers also were prone to using the borrowed funds for the unintended purposes instead of financing the dairy enterprise. Due to inadequate financial resources, farmers had to use inappropriate technology and poor farm and dairy infrastructure. As a result, drudgery creeps in

operational activities thereby increasing the costs of transactions. Ultimately, this slows down production and commercialization.

Third, smallholder dairy farmers also cited poor contact with the extension services. The results showed that 79.5 percent and 88.7 percent of dairy farmers in Nakuru and Nyandarua counties respectively cited extension services as a problem. In the study area, poor road network and inaccessibility of many places limited the extension coverage. Motorcycles were the main means of transport used by the extension service providers when reaching out to farmers. The use of motorcycles was becoming even more expensive to run in terms of maintenance and fuel. They were prone to wear and tear as well as constant breakdowns during the field visits. Studies by Hailua et al. (2015); Mpandeli & Maponya (2014) and Olwande et al. (2015) pointed out that, inadequate accessibility to production and marketing information, higher input, shortage of skilled household labor and distance to local markets had negative effects on the extent of commercialization. Farmers in the study area argued that the various linkages between research, extension and training were not adequate for their dairy activities. This study result agreed with Suttie & Benfica (2014) that agricultural extension services and innovative research in the smallholder dairy subsector had collapsed and was ineffective for sectorial transformation. On average, Kenya expends less than 0.7 percent of agricultural GDP on research in comparison to the developed countries who devote up to 3 percent (Karugia et al., 2009).

The fourth problem experienced by the smallholder dairy farmers was related to input and output market prices. Improved accessibility to input and output resources is a key prerequisite for smallholder dairy transformation. The results indicated that 97.7 percent and 94.5 percent of dairy farmers in Nakuru and Nyandarua counties respectively were dissatisfied with the input and output prices. They argued that input prices were high while the output price was low. Smallholder dairy farmers' in the study area also experienced persistent volatile input and output prices. To be competitive, smallholder farmers need more efficient markets and local based value-addition (Margaret et al., 2015; Ruhangawebare, 2010). Lack of markets for the produce, low market information and technology, high transaction costs, poor agro-ecological conditions, and prevalence of diseases limit agricultural commercialization (Nalubwama et al., 2018; (Hahlani & Garwi, 2014). A study by Hailua et al. (2015) showed that the price of animal feeds, and limitations in land size, were positively affecting dairy production and hence commercialization.

The fifth challenge was poor road network. The results indicated that 78.8 percent and 94.4 percent of the dairy farmers in Nakuru and Nyandarua respectively attested that poor road network was a condition that hindered their operations. The study revealed that on average, most farmers were located three kilometers away from the market and milk collection centers. Farmers reported irregular road maintenance even after the heavy rainy seasons. The roads servicing some areas were also not accessible. This greatly affected dairy inputs availability and delivery of milk. The results of this study are in agreement with Mpandeli & Maponya (2014) who found out that dairy farming effectiveness was affected by poor road infrastructure. Input and output supplies and their prices, market accessibility, veterinary services, and education and information dissemination necessary for dairy farming were all dependent on road infrastructure (Suttie & Benfica, 2014).

#### **IV. Conclusion and Recommendation**

The results of this study led to the following key conclusions. Land, household income and market were key elements in smallholder dairy farming. Smallholders used both own land and leased land for dairy activities. Land defined, the size of dairy stock kept, dairy feed availability and amount of labor required. Household income was also important in smallholder dairy farming. Income determined a farm's capital investment level in addition to farm input purchase, necessary appropriate technology adoption and intensification of dairy production. The study revealed that milk produced by farmers was below the world leaders and was mainly for household consumption and for sales. The average milk sale in Nakuru and Nyandarua counties were relatively low and different. While zero grazing was the most productive system, open grazing was the dominant system. Observation of milk production was generally low although sales were relatively high. Both Counties realized relatively low levels of dairy commercialization. Socioeconomic factors (endowments) which varied in the two counties affected smallholder dairy commercialization level. Results also showed that the majority of the households were planning to continue with dairy production. The few intending to exit dairy farming cited the venture as either being risky, expensive or not profitable. Productivity, infrastructural and institutional related impediments affected smallholder dairy farming.

To improve productivity, the study suggests land policy review to address land related challenges that include accessibility, subdivisions and land use practices. The study also recommends improvement in the quantity and quality of animal feeds. Commercialization and conservation of fodder and concentrates would promote quality assurance systems and standardization of dairy feed. There is need to promote accessibility and reliable veterinary and insemination services.



To improve on the infrastructural impediments, the study suggests improvements in road infrastructure to aid in accessibility of inputs and output markets. There is need to improve electrification in milk producing areas by reviewing the electricity tariffs. Alternative sources of energy e.g. solar, wind and biofuel need promotion to ameliorate the high dependence on electricity. Even though there is need to improve on cold storage facilities, it is also necessary to explore alternative methods of milk preservation.

To improve on the institutional impediments, the study suggests enhancement of financial accessibility models like Collective Action initiatives (e.g. SACCOS). This would reduce hurdles in accessing financial resources. The study also recommended the need of enhanced smallholder dairy entrepreneurial and extension services to improve the farmers' on-farm management ability including dairy hygiene, nutrition and marketing. The study also recommended for technological innovations accustomed to the specific needs of dairy sector and hence the necessity to facilitate county or sub county research agenda.

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### [1]. References

- [2]. ACET. (2015). Promoting sustainable rural development and transformation in Africa – Kenya Country Report. Accra: African Center for Economic Transformation.
- [3]. Bebe, B. O., Rademaker, C., Lee, J. Van Der, & Tonui, C. (2015). Executive summary Sustainable growth of the Kenyan dairy sector – A quick scan of robustness, reliability and resilience.
- [4]. Bingi, S., & Tondel, F. (2015). Recent developments in the dairy sector in Eastern Africa. Towards a regional policy framework for value chain development. Briefing Note No. 78, (78).
- [5]. Chamberlin, J., Jayne, T.S. (2009). Has Kenyan Farmers' Access to Markets and Services Improved? Panel Survey Evidence, 1997–2007. Working Paper Series No. 37/2009. Nairobi: Tegemeo Institute of Agricultural Policy and Development.
- [6]. FAO (Food and Agriculture Organization of the United Nations). (2011). Dairy Development in Kenya. by H.G. Muriuki. Rome.
- [7]. Hahlani, C. ., & Garwi, J. (2014). Operational Challenges to Smallholder Dairy Farming : The Case of Mayfield Dairy Settlement Scheme in Chipinge District of Zimbabwe. *Humanities And Social Sciences*, 19(1), 87–94.
- [8]. Hailua, G., Manjireb, K., & Aymut, K. (2015). Crop commercialization and smallholder farmers' livelihood in Tigray region , Ethiopia. *Journal of Development and Agricultural Economics*, 7(9), 314–322. <https://doi.org/10.5897/JDAE2015.0649>.
- [9]. Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2010). The future of Small farms: Trajectories and policy priorities. *World Development*, 38(10), 1349-1361. <http://dx.doi.org/10.1016/j.worlddev.2009.06.012>
- [10]. Karugia, J., Wanjiku, J., Nzuma, J., Gbegbelegbe, S., Macharia, E., Massawe, S., Kaitibie, S. (2009). The impact of non-tariff barriers on maize and beef trade in East Africa. *East*, (29), 1–16. Retrieved from <http://ageconsearch.umn.edu/bitstream/51672/2/598.pdf>.
- [11]. KDB. (2015). Kenya Dairy Board Annual Report and Financial Statements for the year ended 30 June 2014. Kenya Dairy Board (KDB)
- [12]. Margaret, N. M., Margaret, N., & Wellington, M. (2015). Gender and age analysis on factors influencing output market access by smallholder farmers in Machakos County, Kenya. *African Journal of Agricultural Research*, 10(40), 3840–3850. <https://doi.org/10.5897/AJAR2014.9368>.
- [13]. Mathenge, M., Place, F., Olwande, J., and Mithöfer, D., (2010). Participation in Agricultural Markets among the Poor and Marginalized: Analysis of Factors Influencing Participation and Impacts on Income and Poverty in Kenya. Tegemeo Institute. Egerton University, Kenya.
- [14]. Mpandeli, S., & Maponya, P. (2014). Constraints and Challenges Facing the Small Scale Farmers in Limpopo Province, South Africa. *Journal of Agricultural Science*, 6(4), 135–143. <https://doi.org/10.5539/jas.v6n4p135>.
- [15]. Nalubwama, S., Kabi, F., Vaarst, M., Kiggundu, M., & Smolders, G. (2018). Opportunities and challenges for integrating dairy cattle into farms with certified organic pineapple production as perceived by smallholder farmers in Central Uganda. (2009).
- [16]. Odero-Waitituh, J. A. (2017). Smallholder Dairy Production in Kenya: A Review. *Livestock Research for Rural Development*, 29(7). <http://www.lrrd.org/lrrd29/7/atiw29139.html>.
- [17]. Olwande, J., Smale, M., Mathenge, M. K., Place, F., & Mithöfer, D. (2015). Agricultural marketing by smallholders in Kenya: A comparison of maize, kale and dairy. *Food Policy*, 52, 22–32. <https://doi.org/10.1016/j.foodpol.2015.02.002>.
- [18]. Ruhangawebare, G. K. (2010). Factors Affecting The Level Of Commercialization Among Cattle Keepers In The Pastoral Areas Of Uganda. IDEAS Working Paper Series from RePEc, (November).
- [19]. Suttie, D. R., & Benfica, R. M. S. (2014). Fostering Inclusive Outcomes in African Agriculture: Improving Agricultural Productivity and Expanding Agribusiness Opportunities through Better Policies and Investments, 1–12.
- [20]. USAID. (2018). Policy Brief Enhancing Investment Attractiveness in Kenya'S Dairy Sector. Retrieved from [www.feedthefuture.gov](http://www.feedthefuture.gov)
- [21]. USAID-KAVES Dairy Value Chain Analysis - Fintrac, (USAID, October 2014)

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