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Determinants of utilization of recommended forages and concentrates among smallholder dairy farmers in Nakuru County, Kenya

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Abstract

This paper examined the factors influencing the choice of utilizing the recommended forages and concentrates among smallholder dairy farmers in Nakuru County, Kenya. The study was based on data collected from a sample of 225 smallholder dairy farmers from Nakuru County, Kenya. The statistical programme STATA was used to analyse the data. Probit model result showed that factors including gender, breed types, land ownership, cow live weight, credit use, group membership, production system, herd size, extension contacts, education, and experience significantly affected the choice of utilizing recommended forages and concentrates. The average milk yield is approximately 8 litres per cow per day. This low yield is attributed to challenges such as limited access to quality feeds, limited extension services and financial resources. Therefore, the study recommends the need to improve access to quality feed, agricultural training, and extension services to help smallholder dairy farmers enhance feed efficiency and productivity.

Keywords: Recommended forages, recommended concentrates, smallholder farmers and probit model

1. Introduction

Kenya's dairy sector plays a significant role in the country's agricultural GDP, estimated at 14%, with smallholder dairy farmers contributing 56% of the total milk output. This represents about 1.8 million farmers, which is approximately 80% of all producers. Conversely, large commercial farmers make up the remaining 44% of milk production in the sector (CBK, 2024) ^[8].

In Kenya, Smallholder dairy farmers in various regions utilize a diverse range of feed types and sources to sustain their dairy cattle. Smallholder dairy farmers utilize natural pastures, crop residues, green feeds, hay, agro-industrial by-products, concentrate mixes, and non-conventional feeds such as brewery by-products and liquid brewers' yeast to feed their dairy cattle (Duguma & Janssens, 2016) ^[12].

These farmers employ diverse strategies to address feed shortages, such as improving storage facilities, adding molasses, buying shredding machines, and utilizing non-conventional feeds like local brew waste, bean and pea hulls, and sugarcane tops during scarcity (Simone *et al.*, 2024) ^[28]. Interventions such as treating wheat straw with urea and yeast culture have been explored to improve the nutritional value of feed resources for dairy cattle, showcasing the continuous efforts to optimize feed utilization in smallholder dairy farming systems (Kashongwe *et al.*, 2017) ^[17].

Smallholder dairy farmers in Kenya heavily rely on pasture-based diets for milk production from lactating cows, primarily utilizing grass and crop residues as the main sources of feed. While these pasture-based diets are less expensive than imported grains used in developed-world dairy farming, they are often less nutritious and result in lower milk production compared to mixed ration diets (Florez *et al.*, 2024) ^[13]. To supplement the deficiencies in roughages, efforts have been made to incorporate concentrates like maize bran, cotton seed cake, sunflower seed cake, leaf meals, and mineral-vitamin premixes in the feed mixtures for smallholder dairy cows in Kenya (Nyokabi *et al.*, 2022) ^[23].

In Nakuru County, dairy farmers utilize a diverse range of feed types to optimize cow health and milk production, particularly during feed shortages. The feeding strategies are tailored to the local climate and resource availability, ensuring that dairy cattle receive adequate nutrition throughout the year. Key feed types include Indigenous grasses, Napier grass, Brachiaria, Rhodes grass, Kikuyu grass, fodder sorghum, lucerne, and various supplementary feeds, which are crucial for maintaining consistent milk production. Commercial Concentrates and TMR are used to enhance the diet, with commercial concentrates offering higher crude protein content (Boniface *et al.*, 2019; Nyokabi *et al.*, 2022) [6, 23].

Techniques such as hay and silage preservation are vital for managing feed scarcity. The introduction of drought-tolerant grasses like Brachiaria has been shown to improve milk yield and household income (Kabirizi *et al.*, 2013) [15]. The County Government of Nakuru, Department of Livestock Production, extension services, and other service providers play a crucial role in recommending feed resources and enhancing dairy farming practices among local farmers to enhance productivity. These entities provide guidelines and support based on the specific needs and conditions of the region, ensuring that farmers have access to the best possible feed types and strategies to maintain optimal health and milk production in their dairy cattle (Mucoki *et al.*, 2022) [19].

2. Data collection and Methods

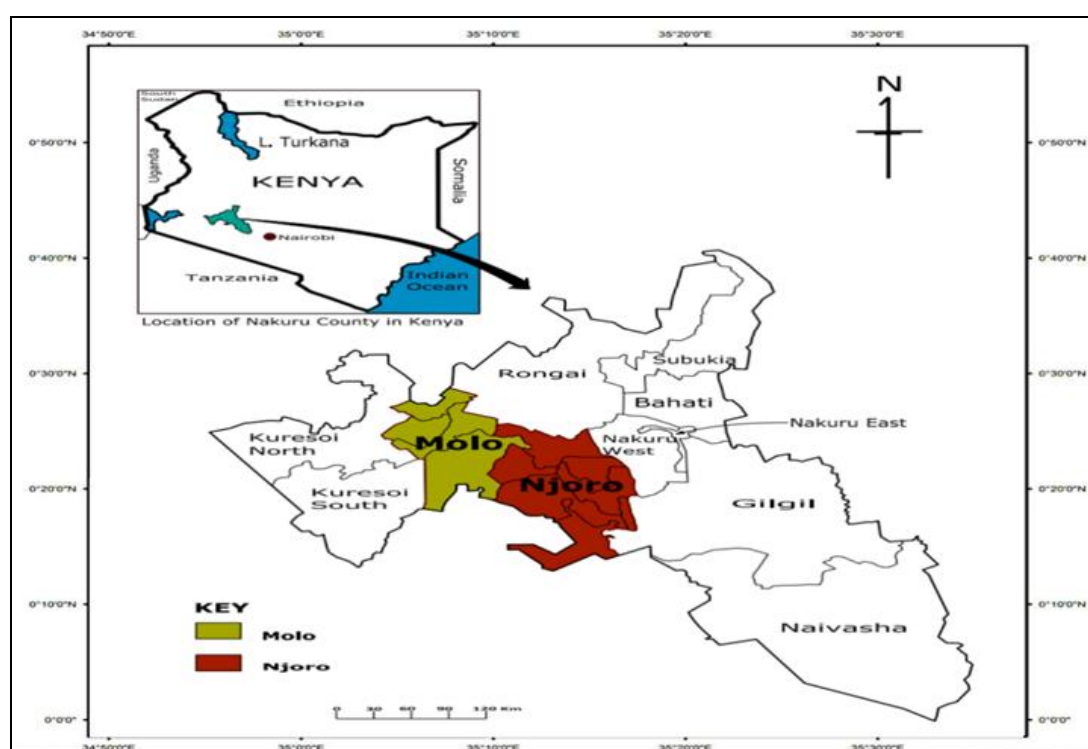
The study was conducted in Njoro and Molo Sub-Counties of Nakuru County in Kenya. Njoro Sub-County lies between Longitude 35° 45' 0 and 36° 10' 0 East and Latitude 0° 15' 0 and 0° 42' 30 South at approximately 1,800 m above sea level. Molo Sub-County is located at approximately Latitude 0° 14' 54.6" South and Longitude 35° 43' 55" East, with an elevation of around 2,500 meters above sea level. It receives 800-1681 mm of rainfall annually and has temperatures ranging from 9-28°C. Molo hosts 30,783 households and 27,375 farm families, with an average landholding of 1.3 ha.

The diverse soil types in Molo, including sandy loams, sandy clays, clay loams, and mollic andosols, are conducive to growing a variety of crops such as wheat, maize, and beans, which can be rotated with fodder crops to support dairy farming. The dairy sector in Njoro and Molo Sub-Counties plays a significant role in supporting the livelihoods of the local communities and contributing to the overall economic development of the region (Nakuru County CIDP, 2020) [10].

Both Sub-Counties of Nakuru County offer significant potential for the dairy sector due to their conducive climatic conditions and soil fertility. In Njoro Sub-County, the variation in altitude and temperature creates a unique environment where dairy farming can thrive all year-round. The volcanic soils provide excellent drainage and nutrient content for pasture growth, essential for high-quality milk production. In Molo Sub-County, the slightly larger average landholdings and diverse soil types allow for the cultivation of a wider range of fodder crops. The relatively higher rainfall in some areas ensures an adequate water supply for both crops and livestock, which is crucial for maintaining healthy dairy herds. With suitable soil types and adequate rainfall levels, Nakuru County, Njoro and Molo Sub-Counties provide conducive environments for cultivating nutritious fodder for dairy animals, enhancing the productivity and sustainability of the dairy sector in these areas (Nakuru County CIDP, 2020) [10]. The two Sub-Counties were purposively selected from Nakuru County for inclusion in the study due to their unique characteristics, particularly their geographical location, milk production levels, diversity of dairy activities, and the prevalence of small-scale dairy production. The two sub-counties undertake the highest concentration of dairy activities in the country, ranging from production, processing, and consumption.

The study area, which includes Njoro and Molo Sub-Counties of Nakuru County, Kenya, is shown in the map (Figure 1) below:

2.1 Study Area



Source: Geography Department, Egerton University

Fig 1: Map of the Study Area

2.2 Research Design and Sampling Technique

This study used a survey design to evaluate determinants of utilization of recommended forages and concentrates among smallholder dairy farmers in the study area. The survey was based on cross-section data with a one-year recall period. Descriptive design refers to the design that is used in describing characteristics of a population or phenomenon being investigated (Ahlstrom *et al.*, 2013) [2]. Besides, the results were generalized to the entire population after obtaining data from the sampled population.

The target population comprised approximately 17,000 smallholder dairy cow farmers in Njoro Sub-County. Molo Sub-County's estimated number of smallholder dairy farmers was approximately 11,159.

In this study, smallholder farmers referred to those farmers who practiced dairy farming on a small scale. Typically, they owned or managed fewer than 5 dairy cows and operated on less than 1 acre of land, often utilizing zero-grazing systems. The study's accessible population was the same as the target population.

Proportionate random sampling was used to select the smallholder dairy farmers to be studied from each of the study areas. In this method, each subgroup represented in the sample was according to its actual share in the total population. Proportionate random sampling also ensured that no sub-population was omitted from the sample and avoided overloading in certain sub-populations (Borg & Gall, 1984). A multistage sampling technique was used to select the respondents. In the first stage, Purposive sampling was used to select Nakuru County among other counties due to its significance in dairy farming in Kenya. In the second stage, Njoro and Molo Sub-Counties were purposively selected within Nakuru County. These sub-counties were selected due to the high concentration of smallholder dairy farmers. The third and final stage consisted of a systematic random sampling of the smallholder dairy farmers in each Sub-County. Two hundred twenty-five (225) respondents were selected from the known population of smallholder dairy farmers in Njoro and Molo Sub-Counties, as shown in Table 1 below.

Table 1: Sample size distribution of the respondents in the study area

Sub-Counties	Number of dairy farm households	Proportion	Sample size
Njoro	17,000	60.371%	136
Molo	11,159	39.629%	89
Total	28,159	100%	225

Source: CDLP, 2023

2.3 Sample Size Selection

The required sample size was calculated based on the formula by Nassiuma (2001) [20], in Equation (1) below:

$$n = \frac{N C^2}{C^2 + (N-1)e^2} \quad (1)$$

Where,

N=the required sample size; N = the target population; C=The coefficient of variation, and e = the standard error value.

Nassiuma (2001) [20] contended that in most surveys, a coefficient of variation in the range of $21\% \leq C \leq 30\%$ and a standard error in the range of $2\% \leq e \leq 5\%$ is acceptable. The study, therefore, used a coefficient variation of 30% and a

standard error of 2%. The highest limit for the coefficient of variation and the lowest limit for standard error was selected to ensure low variability and error minimization.

The sample size was calculated as follows:

$$n = \frac{28,159 \times (0.3)^2}{(0.3)^2 + (28,159-1)(0.02)^2} \quad (2)$$

$N=224.68 \approx 225$. Thus, 225 respondents were used as the sample size for smallholder dairy farmers in Njoro and Molo Sub Counties of Nakuru County, Kenya.

2.4 Data Collection and Analysis

Primary data was collected by interviewing respondents and personally administering questionnaires to smallholder dairy farmers. Semi-structured questionnaires with both open and closed questions were used to collect the primary data. A pilot study was conducted prior to the actual data collection to test the validity and reliability of the questionnaire. The questionnaire was pre-tested with 25 smallholder dairy farmers in Nakuru County, specifically in Molo and Njoro Sub-Counties. The data collected were analyzed using the Probit Model, Cobb-Douglas Stochastic frontier model, and Gross Margin Analysis. STATA software was used to analyse the data.

2.5 Analytical Framework: Probit Model

The study employed a probit model to analyze the factors that influenced the choice of utilizing recommended forages and concentrates among smallholder dairy farmers in Nakuru County, Kenya. Probabilistic models such as the logistic, linear probability model and probit models are appropriate in analyzing factors influencing smallholder dairy farmers' choice of utilizing recommended forages and concentrates. The variable of interest was the choice of the farmer to use the recommended forages and concentrates. The response variable was binary in nature, and therefore, the three models were appropriate. The linear probability model does not bound predicted probabilities between 0 and 1; therefore, it was not considered for this analysis (Wooldridge, 2008) [31].

Logistic regression and the probit model produce similar results, but there are differences in terms on scaling because of the types of distribution on which they are based. Whereas logistic regression relies on logistic distribution, the probit regression model assumes a normal distribution. The study assumed that the data were normally distributed, and therefore, the probit model was more relevant. A probit model was used in the study to analyze the factors that influenced smallholder dairy farmers' decisions of utilizing the recommended forages and concentrates. To meet liquidity requirements for the purchase of inputs such as forages and concentrates, the dairy farmer can either rely on off-farm income or borrow. According to Nielsen & Pedersen (2020), farmers in traditional agriculture always act rationally within the context of available resources and technology. Knowing

that nothing is offered freely, let $P_1, P_2, \dots, P_n$ represent the prices of the feeds, and if household income is equal to its expenditures, then total income can be represented as:

$$Y = p_1 X_1, p_2 X_2, \dots, p_n X_n \quad (3)$$

However, according to the literature, using the recommended feeds depends not only on the farmer's observable

characteristics but also on some unobservable characteristics, which, if not controlled for, can overestimate, underestimate, or report impact where none exists at all. Therefore, the variables that may constrain farmer households' decision to use the recommended forages and concentrates include socioeconomic, demographic, institutional, financial, and market factors (Thirunavukkarasu & Jothilakshmi, 2023) [29]. Therefore, farmers are portioned into two categories: farmers who utilize both forages and concentrates to feed their cows and farmers who utilize forages only. Then, P_{it} can be expressed as follows:

$$p_{it} = f(X_1, X_2, \dots, X_n) \quad (4)$$

Where P_{it} takes the value 1 if a farmer uses both forages and concentrates to feed their cows, P_{it} takes the value 0, if a farmer uses only forages to feed their cows. $X_1, X_2, \dots, X_n$ being the farmer's household characteristics and other factors important to determine the farmer's decision to use the recommended forages and concentrates. We observe the values 0 and 1 of variable P_{it} , there is a latent unobservable continuous variable P^*_{it} that determines the binary censoring, expressing the benefit the smallholder farmer gets from utilizing the recommended forages and concentrates.

Assume P^*_{it} represents the critical decision point for a farmer to use the recommended forages and concentrates. P^*_{it} can be specified as follows:

$$P^*_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_{it} \quad (5)$$

and that $P_{it} = 1$ if $P^*_{it} > 0$ (if a farmer uses both forages and concentrates)

$P_{it} = 0$ if $P^*_{it} \leq 0$, (if a farmer uses only forages)

From (6)

$$P_r(P = 1) = P_r(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_{it} > 0) \quad (6)$$

Farmer i uses both forages and concentrates if $P_{it} > P^*_{it}, P^*_{it} > 0$; farmer i uses only forages if $P_{it} < P^*_{it}, P^*_{it} \leq 0$; The error term is assumed to be normally distributed so that probability that $P_{it} \leq P^*_{it}$ can be computed from the cumulative normal probability function. Thus, the empirical model to be used for the probit model becomes:

$$P^*_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \dots + \beta_n X_n + \varepsilon_{it} \quad (7)$$

P^*_{it} represents the farmer's propensity to utilize the recommended forages and concentrates, $X_1, X_2, \dots, X_n$ are explanatory variables which are the factors influencing to decide to utilize the recommended forages and concentrates, coefficients $\beta_1, \beta_2, \dots, \beta_n$ provide consistent estimates of the explanatory variables and ε_{it} represents the error term normally distributed with constant variance.

The implicit functional form that estimated the factors influencing choice of utilizing recommended forages and concentrates among smallholder dairy is given as follows:

$$Y_i = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Gender} + \beta_3 \text{Educl} + \beta_4 \text{Dfex} + \beta_5 \text{Cw} + \beta_6 \text{Ncbmc} + \beta_7 \text{Lb} + \beta_8 \text{Mp} + \beta_9 \text{Oi} + \beta_{10} \text{Cf} + \beta_{11} \text{Dtm} + \beta_{12} \text{Mdco} + \beta_{13} \text{Exc} + \varepsilon_i \quad (8)$$

Where,

Y_i represents choice of utilizing the recommended feeds

β_0 is a constant, β_1 to β_{13} are coefficients, ε_i is the error term

3. Results and Discussion

Table 2: Probit estimates for factors influencing the choice of utilizing recommended forages and concentrates among smallholder dairy farmers in Nakuru County, Kenya

Feed types	Coef.	Std. err.	z	P> z
Age (Years)	-0.0015595	0.0134481	-0.12	0.908
Gender (1=Male,0=Female)	0.9081995	0.2260364	4.02	0.000***
Education (Schooling years)	0.0968335	0.0367703	2.63	0.008*
Experience (Years)	0.0333596	0.0119346	2.80	0.005**
Household size (Number)	0.0303624	0.0525844	0.58	0.564
Off farm income (Yes, No)	-0.00000076	0.00000969	-0.79	0.430
Herd size (Number)	-0.2426088	0.1082972	-2.24	0.025**
Land size (Acres)	-0.0630105	0.1792773	-0.35	0.725
Milk prices (ltr per ksh)	0.0169444	0.0140793	1.20	0.229
Land ownership (Yes, No)	0.6213267	0.1907694	2.10	0.036**
Group membership (Yes, No)	-0.5024774	0.2683308	-1.87	0.061*
Extension contacts (Yes, No)	0.1322252	0.0573863	2.30	0.021**
Distance to the nearest market (Km)	0.0291742	0.0676847	0.43	0.666
Credit use (Yes, No)	0.5490943	0.3268324	1.68	0.093*
Cow live weight (Kgs)	0.5962631	0.2964578	1.93	0.054*
Breed types (1=local breed, 0=other breed types)	0.8053476	0.3727718	2.16	0.031**
Production system (1=Manual, 0=Mechanical)	0.4328728	0.2511537	1.72	0.085*
Constant	-6.013237	1.116625	-5.39	0.000

Number of observations=225, Pseudo R² = 0.3904

Prob > chi2 = 0.0000, Log likelihood = -88.18917

LR chi2 (17) = 112.94

Note: The asterisk ***, ** and * Represents 1%, 5%, and 10% significant levels, respectively.

Table 2 shows the results of a probit model analysis of the factors influencing the choice of utilizing recommended forages and concentrates among smallholder dairy farmers in Nakuru County, Kenya.

Gender of the household head had a highly significant influence on the probability of utilizing the recommended forages and concentrates at 1% significance level. Male-headed households had a likelihood of utilizing the recommended feeds of 90.82%. This finding was in line with that of Njiru *et al.* (2023) ^[22], they found that Men were more likely to engage with suppliers and financial institutions, enhancing their ability to procure quality forages and concentrates.

Education was positive and statistically significant at 10% level for the choices of utilizing the recommended forages and concentrates. Households with more education years were more likely to utilize the recommended forages and concentrates. A one-year increase in household members' number of formal schooling resulted in 0.8% likelihood that the household would utilize the recommended forages and concentrates. This implied that better-educated household members were more likely to use the recommended forages and concentrates. Access to this information placed farmers in a better position to negotiate for better feed prices, seek better market opportunities, and meet the required feeding quality standards. This result by Schönleben *et al.*, (2020) ^[26] that education enabled farmers to stay informed about the latest nutritional strategies, such as the use of high-quality forages and concentrates.

Household's dairy farming experience had a positive and significant effect on the choices of utilizing the recommended forages and concentrates at 5% probability level. Meaning that experience had a positive influence on farmers' choices of utilizing the recommended feeds. A one-year change in age would decrease the probability of utilizing the recommended forages and concentrates as indicated by the marginal effects. Experience as a proxy for age also implied that older farmers were less likely to utilize the recommended forages and concentrates than the younger farmers. This result also confirmed that of Akintan *et al.* (2025) ^[4], who found that the more experienced farmers utilized data-driven decision-making, integrating diverse sources to optimize feed formulations, which enhanced productivity and quality.

Herd size was negative and statistically significant at 5% probability level for the use of the recommended forages and concentrates. A unit increase in the size of the herd decreased the probability of utilizing the recommended forages and concentrates by 24.26%. Larger herds may not benefit proportionately from supplementary feeds, leading to reduced utilization of recommended forages and concentrates. Similarly, Scasta & Furquim, (2025) ^[25] indicated that the complexity of managing larger herds can shift focus from intensive feeding strategies to basic herd maintenance, because as the herd size increased, it necessitated simpler feeding regimens to manage labor and resources effectively. They also indicated that as herd size increased, the quality of diet can decline, impacting overall productivity.

Land ownership had a positive and significant influence on the utilization of the recommended forages and concentrates at 5% significance level. The fact that smallholder dairy farmers have land ownership increased the likelihood of utilizing the recommended forages and concentrates by 62%. Most of the landowners diversified and produced recommended forages and concentrates that acted as a fall-back position in case of shocks, unlike those who relied on

family/communal land. Additionally, Secure land ownership reduced investment risk and variability, encouraging farmers to make long-term investments in their operations (Akber *et al.*, 2024) ^[3]. This result corroborated with that of Chavula & Turyasingura (2022) ^[9], who found that insecure tenure can hinder the adoption of risk management strategies, making farmers more vulnerable to external shocks.

Group membership was negative and statistically significant at 10% level for the utilization of the recommended forages and concentrates. Farmers who belonged to an agricultural group had a lower probability of utilizing the recommended forages and concentrates by 50.24%. This can be attributed to the fact that smallholder dairy farmers may be reluctant to deviate from the group's common practices due to social pressure or a sense of community identity. If others in the group are not adopting these new recommendations, an individual farmer might feel discouraged from doing so, even if they recognize the potential benefits. This finding was also consistent with those of Kamakaula (2024) ^[16], who stated that farmers may perceive new methods as unnecessary or too costly, leading to a reluctance to change. However, this finding was also inconsistent with those of Ayesha *et al.* (2024) ^[5], who reported that Agricultural groups often conducted training sessions and discussions that exposed farmers to improved feeding strategies and practices, leading to higher adoption rates of recommended feeds.

Access to extension service was found to have a positive and significant influence on the utilization of the recommended forages and concentrates at 5% significance level. Smallholder dairy farmers who received extension services were likely to use both recommended forages and concentrates by 13.2%. Extension agents provide advisory services to farmers, which in turn increases their ability to use the recommended feeds such as forages and concentrates. Similarly, Ahikiriza *et al.* (2025) ^[1] reported that extension agents educate farmers on the benefits of improved feed and nutrition, demonstrating best practices through on-farm trials. They also facilitate access to high-quality inputs, which is critical for implementing new techniques.

Credit use was positive and statistically significant at 10% level for the use of the recommended forages and concentrates. A unit increase in credit use increased the use of the recommended forages and concentrates. A possible explanation for this is that credit enabled farmers to invest in recommended feeds, which they might otherwise have been unable to afford due to financial constraints. With access to credit and its use, smallholder dairy farmers can overcome short-term cash flow issues and prioritized long-term improvements in their farming practices. As a result, they were more likely to adopt modern feeding strategies that enhanced milk production. This result conformed to that of Prah *et al.* (2025) ^[24], which showed that the combination of credit access with extension services significantly boosted the effective use of inputs, guiding farmers on best practices.

The results for cow live weight showed a positive and significant influence on the utilization of recommended forages and concentrates at 10% significance level. This indicated that a higher live weight in cows increased the likelihood of utilizing the recommended forages and concentrates by 59.62%. This suggested that a cow with a higher live weight required more energy and protein to maintain its body weight and support milk production, especially if it is lactating. According to Waddell *et al.* (2023) ^[30], the NASEM model indicated that energy needs for lactating cows increase significantly with body weight. The

larger cows have higher dry matter intake (DMI) and metabolizable protein requirements, especially during lactation.

The results for the breed type showed a positive and significant influence on the utilization of recommended forages and concentrates at 5% significance level. This indicated that local breeds are more likely to make efficient use of the recommended forages and concentrates by 80.53% because they are often adapted to the local environment and more suited to traditional, nutrient-dense feeds that are commonly available in the region. According to Shiddieqy *et al.* (2023) ^[27], Local breeds are better suited to metabolize nutrients from indigenous forages, enhancing their performance on locally available feeds.

The results for the production system showed a positive and significant influence on the utilization of recommended forages and concentrates at 10% significance level, indicating that cows in zero-grazing systems are more likely to utilize recommended feeds effectively compared to those in other production systems, which represents 43.28%. This suggested that zero-grazing provided an environment where feed intake is more controlled, and cows have access to a balanced, managed diet of high-quality forages and concentrates that are suited to their nutritional needs. According to Holohan *et al.* (2022) ^[14] and Lavery *et al.* (2023) ^[18], Zero-grazing systems provide a consistent supply of high-quality feeds, leading to improved dry matter intake (DMI) and milk yield compared extensive and semi-intensive grazing systems.

4. Conclusions and Recommendations

The key factors influencing the choice of utilizing recommended forages and concentrates among smallholder dairy farmers in Nakuru County included gender, breed types, land ownership, cow live weight, credit use, group membership, production system, herd size, extension contacts, education, and experience. Given these factors, the study results indicated that there is potential to enhance feed utilization strategies among smallholder dairy farmers to improve milk production efficiency and overall farm profitability. The study also suggested that the government should focus on improving access to quality feed, agricultural training, and extension services to help smallholder dairy farmers enhance feed efficiency and productivity. Additionally, policymakers should support research on cost-effective feeding strategies, facilitate access to financial resources, and invest in infrastructure to ensure sustainable dairy farming.

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6. Author Contributions

- **Flora Gash Kambabazi:** Conceptualisation and design of the research, analysis and interpretation of the results, drafting of the article, review and editing of the intellectual content, and preparation of the final version for publication.
- **George Owuor:** Supervision, verification, and manuscript review and editing.
- **Anthony Macharia King'ori:** Supervision, verification, and manuscript review and editing.

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7. References

1. Ahikiriza E, Huylenbroeck VG, Lauwers L. Increasing agricultural productivity with targeted extension and advisory services: Lessons from Ugandan dairy farming. *Afrika Focus*. 2025;2(1):1-14. <http://dx.doi.org/10.1163/2031356x-20240209>
2. Ahlstrom D, Bruton GD, Zhao L. Turning good research into good publications. *Nankai Business Review International*. 2013;4(2):92-106. <http://dx.doi.org/10.1108/20408741311323317>
3. Akber N, Paltasingh KR, Mishra AK, Goyari P. Land ownership security, farm investment, and investment risk in Indian agriculture: Evidence from nationally representative survey. *Journal of Agricultural and Applied Economics*. 2024;56(2):278-296. <https://doi.org/10.1017/aae.2024.9>
4. Akintan OA, Gebremedhin KG, Uyeh DD. Linking animal feed formulation to milk quantity, quality, and animal health through data-driven decision-making. *Animals*. 2025;15(2):162-164. <https://doi.org/10.3390/ani15020162>
5. Ayesha I, Harahap G, Cahya DL. Effect of farmer group empowerment and agribusiness training program on productivity and income of coffee farmers in West Java. *West Science Interdisciplinary Studies*. 2024;9(2):81-107. <https://doi.org/10.58812/wsis.v2i09.1302>
6. Boniface SN, Ombiro OJ. Evaluation of nutritive value of feeds and feed ration ingredients from different interventions used by dairy farms in Kenya. *International Journal of Veterinary Sciences and Animal Husbandry*. 2019;4(5):26-31. <https://www.veterinarypaper.com/pdf/2019/vol4issue5/PartA/4-5-6-766.pdf>
7. Borg WR, Gall MD. Educational research: An introduction. *British Journal of Educational Studies*. 1984;32(3):274-282. <https://doi.org/10.2307/3121583>
8. Central Bank of Kenya (CBK). Agriculture sector survey report, 2024. <https://www.centralbank.go.ke/2024/02/09/agriculture-sector-survey-of-january-2024/>
9. Chavula P, Turyasingura B. Land tenurial system influence among smallholder farmers' climate smart agriculture technologies adoption, Sub-Sahara Africa. *International Journal of Food Science and Agriculture*. 2022;6(1):8-16. <https://doi.org/10.26855/ijfsa.2022.03.003>
10. County Integrated Development Plan (CIDP). County integrated development plan 2021-2022, Nakuru County, 2020. <https://repository.kippra.or.ke/bitstream/handle/123456789/3529/Nakuru-ADP-2021-2022-.pdf?sequence=1&isAllowed=y>
11. County Directorate of Livestock Production. Heliyon. 2023;9(9):e20210. <https://doi.org/10.1016/j.heliyon.2023.e20210>
12. Duguma B, Janssens GPJ. Assessment of feed resources, feeding practices and coping strategies to feed scarcity by smallholder urban dairy producers in Jimma town,

- Ethiopia. *Journal of Agricultural and Food Sciences*. 2016;5(1):17-19.
<https://doi.org/10.1186/s40064-016-2417-9>
13. Florez JF, Karimi P, Paredes JJ, Ángel NT, Burkart S. Developments, bottlenecks, and opportunities in seed markets for improved forages in East Africa: The case of Kenya. *Grassland Research*. 2024;3(1):79-96.
<https://doi.org/10.1002/qlr2.12073>
 14. Holohan C, Mulligan FJ, Pierce KM, Somers J, Walsh NA, McDonald M, *et al.* A comparison of grazing v. zero-grazing on early-lactation dairy cow performance. *The Journal of Agricultural Science*. 2022;16(2):127-136.
<https://doi.org/10.1017/S0021859622000089>
 15. Kabirizi J, Zziwa E, Mugerwa S, Namagembe A. Dry season forages for improving dairy cattle production in smallholder dairy systems. *Tropical Grasslands*. 2013;4(1):212-214.
[https://doi.org/10.17138/tgft\(1\)212-214](https://doi.org/10.17138/tgft(1)212-214)
 16. Kamakaula Y. Sustainable agriculture practices: Economic, ecological, and social approaches to enhance farmer welfare and environmental sustainability. *West Science Nature and Technology*. 2024;2(02):47-54.
<https://doi.org/10.58812/wsnt.v2i02.964>
 17. Kashongwe OB, Mwangi LW, Bebe BO, Matofari JW, Huelsebusch C. Influence of on-farm feed formulations and hygiene interventions on milk yield and quality in smallholder dairy farms in Kenya. *International Journal of Agricultural Extension*. 2017;5(2):11-17.
<https://www.cabidigitallibrary.org/doi/pdf/10.5555/20173314654>
 18. Lavery A, Gordon AW, White A, Ferris CP. Performance of dairy cows offered either zero-grazed grass or grass silage prepared from the same sward. *Animal*. 2023;17(11):101003.
<https://doi.org/10.1016/j.animal.2023.101003>
 19. Mucoki SW, Nkurumwa AO, Maina SW. Effectiveness of the Nakuru farmers' call center in linking farmers to agricultural extension stakeholders in Nakuru County, Kenya. *International Journal of Agricultural Extension*. 2022;10(3):491-498.
<https://doi.org/10.33687/ijae.010.03.4415>
 20. Nassiuma DK. *Survey sampling: Theory and methods*. Nairobi University Press, 2001.
<https://erepository.uonbi.ac.ke/bitstream/handle/11295/63034/Survey%20sampling.pdf>
 21. Nielsen MM, Pedersen CM. Agricultural decision-making: A behavioural perspective. *Chemical Reviews*. 2020;118(17):8285-8358.
<https://doi.org/10.7146/politica.v52i2.130805>
 22. Njiru N, Galiè A, Wanyoike F, Tawanda M, Boonabaana B, Bisikwa J, *et al.* Exploration of gender dynamics in the production and marketing of forage technologies in Kenya. *Frontiers in Animal Science*. 2023;4(1):13-29.
<https://doi.org/10.3389/fanim.2023.1113243>
 23. Nyokabi NS, Luning PA, Phelan JE, Creemers J, Lukuyu B, Bebe BO, Oosting SJ. Intra-annual variation in feed and milk composition in smallholder dairy farms in Kenya. *NJAS: Impact in Agricultural and Life Sciences*. 2022;94(1):137-155.
<https://doi.org/10.1080/27685241.2022.2135391>
 24. Prah S, Asante BO, Dagbatsa GH, Wongnaa CA, Etuah S, Ng'ombe JN. Modeling the impact of input credit access on farm performance and food nutrition: Insights from smallholder rice farmers in Ghana. *Journal of Agribusiness in Developing and Emerging Economies*. 2025;17(2):123-138.
<https://doi.org/10.1108/JADEE-03-2024-0105>
 25. Scasta JD, Furquim FF. Increasing cattle herd size or density in C3 grass legume meadows reduces dietary quality. *Animals*. 2025;15(2):230-248.
<https://doi.org/10.3390/ani15020230>
 26. Schönleben M, Mentschel J, Štřelec L. Towards smart dairy nutrition: Improving sustainability and economics of dairy production. *Czech Journal of Animal Science*. 2020;65(5):187-231.
<https://doi.org/10.17221/16/2020-CJAS>
 27. Shiddieqy MI, Prihandini PW, Pramono A, Irmawanti S, Anggraeny YN, Tiesnamurti B, *et al.* The effect of cattle breed and forage-concentrate ratio on fecal methane and nitrous oxide emissions. *Polish Journal of Environmental Studies*. 2023;32(3):17-34.
<https://doi.org/10.15244/pjoes/161184>
 28. Simone SK, Tiruneh S, Asres A, Chanie D, Deribe B. Dairy farmers' perception on dairy cattle feeds and feeding system: Brewery by-product utilization practice at Kombolcha Regiopolitan City, Ethiopia. *Turkish Journal of Agriculture-Food Science and Technology*. 2024;12(6):885-892.
<https://doi.org/10.24925/turjaf.v12i6.885-892.6699>
 29. Thirunavukkarasu D, Jothilakshmi M. Modelling the factors affecting the adoption of compound feed in dairy animal feeding. *Advances in Agriculture*. 2023;21(2):93-116. <https://doi.org/10.20944/preprints202307.0592.v1>
 30. Waddell JC, Cabezas-Garcia E, Reed KF. Comparison of predicted nutritional requirements of two feeding systems for dairy cattle implemented in a Monte-Carlo simulation model of herd dynamics. *Journal of Animal Science*. 2023;101(3):285-286.
<https://doi.org/10.1093/jas/skad281.341>
 31. Wooldridge JM. Instrumental estimation of the average treatment effect in the correlated random coefficient model. *Advances in Econometrics*. 2008;21(2):93-116.
[https://doi.org/10.1016/S0731-9053\(07\)00004-7](https://doi.org/10.1016/S0731-9053(07)00004-7)

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