

Influence of Nutritional Management Practices on Dairy Cattle Productivity among Small Holder Farmers in Kakamega Central, Kakamega County, Kenya

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Abstract: Dairy industry is one of the fastest growing sub-sector in agriculture around the world. In Kenya, dairy industry is a major subsector of agriculture contributing to about 14% of the total agricultural gross domestic product (GDP) with a unique annual growth rate of 4.1% compared to 1.2% of the other agricultural sub sectors. Statistics show that the Kenya dairy industry is mainly driven by the smallholder farmers owning 80% of the total dairy cattle population and producing about 56% of the total milk produced in the country. With the devolved system of government in Kenya the county governments have tried to put measures to empower smallholder dairy cattle farmers with an aim of improving milk productivity in the regions. The county government of Kakamega for instance, in collaboration with NGOs like Rural Outreach Programme (ROP), Send a Cow, Heifer International, One Acre Fund and Smart Dairy Kenya have offered training services and issuing of improved dairy breeds to the smallholder farmers but milk production is still low compared to the demand in the county level and below. Since most of the smallholder farmers in Kakamega own an average of 1-1.5 acres of land it was speculated that feed production and animal nutrition could be the major challenge hindering productivity. The aim of the study therefore was to survey the nutritional management practices employed by smallholder farmers and how they influence on their productivity. The study was carried out in Kakamega central sub county where 400 smallholder farmers were randomly sampled in all the wards to participate in the study. Structured questionnaires, interviews and observation checklists were used in data collection. The collected data were analyzed for descriptive statistics and inferential statistics using SPSS version 20. The result showed significant relationship of nutritional management practices to dairy productivity, with those farmers who adequately fed their animals, provided mineral supplementation, water ad libitum as well as vaccinating and deworming their animal had high milk productivity potential. From the results it was also noted that majority of the smallholder farmers (95%) practice poor nutritional management hence the experienced low milk productivity in the region despite the efforts put in place by the county government.

Key words: Dairy productivity, Feed type, Watering, Mineral supplementation, Vaccination, Deworming

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I. Introduction

Dairy farming is one of the fastest growing sub-sectors in agriculture around the world ¹. The dairy industry is rapidly growing in sub-Saharan Africa with about 85% of dairy cattle population in East Africa alone ^{2, 3}. In Kenya, dairy industry is a major subsector of agriculture contributing to about 14% of the total agricultural gross domestic product (GDP) with a unique annual growth rate of 4.1% compared to 1.2% of the other agricultural sub sectors ⁴. By 2015, the Kenyan dairy industry had approximately 4.3 million dairy cattle with estimate milk yields of 3.4 billion litres which was about 18% of the total milk produced in sub-Saharan Africa and 3% of the global production ^{4,5}.

Statistics show that the Kenya dairy industry is mainly driven by the smallholder farmers owning 80% of the total dairy cattle and producing about 56% of the total milk produced in the country ^{3,6}. A few of this smallholder farmers do intensive dairy farming while a majority of them practice integrated crop dairy production. It is estimated that more than 54 % of the smallholder farmers own I acre or less of land where they practice integrated dairy, crop production ⁴.

Despite the vibrant contribution of the smallholder dairy industry in the country's economy, the sector is still struggling with a number of challenges which include: diseases, inadequate quantity and quality feeds, poor access to breeding, credit facilities as well as market ^{7, 8}. With the devolvement of functions to counties each county has put measures to empower the smallholder dairy farmers by addressing some of the challenges faced by the farmers. For instance, in Kakamega county, there have been varied interventions by various stake holders in the dairy industry within Kakamega county that includes NGOs like Rural Outreach Programme (ROP), Send a Cow, Heifer International, One Acre Fund and Smart Dairy Kenya as well as the Ministry of

agriculture, Livestock and Fisheries⁹. However, very little has been achieved in raising the small holder dairy farms milk production potential and productivity. Basing on the available literature it was hypothesized that the low production could be as a result of nutritional management practices applied by the farmers. This study therefore aimed to find out how the farmers in Kakamega county and specifically Kakamega Central Sub-county manage their dairy cattle nutrition and how they influence their productivity.

II. Materials And Methods

Study Location

The study was conducted within Kakamega Central Sub County of Kakamega County in Kenya. It lies on a geographical location of 0018' N and 34046' E. It has tropical climate and experiences bi-modal type of rainfall with annual rainfall of 2000 mm p.a. The sub county covers a land area of 161.8 Km² and lies within an altitude range of between 1250-2000m above sea level. The area is known to have many smallholder dairy farmers who should be able to meet the consumer demand but this is not the case. The figure below shows the map of this study area.

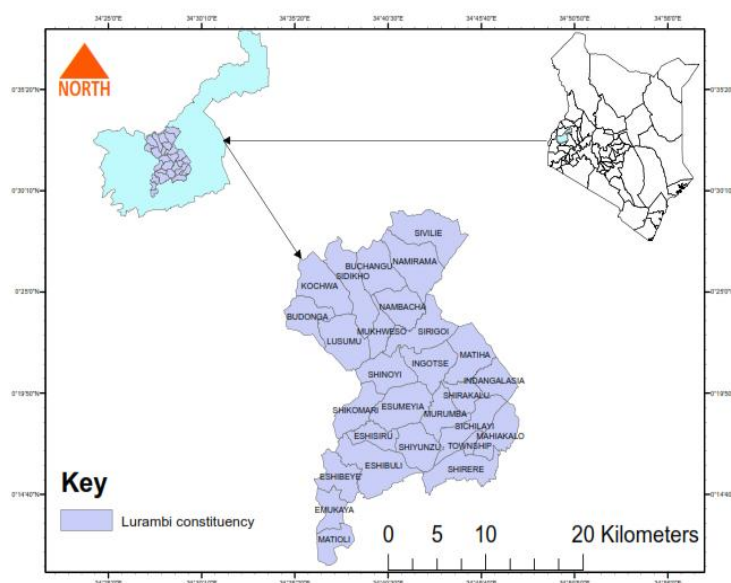


Figure 1: The map of the study Area (Kakamega Central Sub County)

Research Design

Correlational Survey Research Design (CSRSD) was employed to execute this study. The study was classified into wards (Administrative units) and random sampling was used to select the households/respondents to participate in the study. Structured questionnaires, interviews and observations were used to collect the primary data.

Study population and Sample size

According to the census of 2019, Kakamega central population stood at 188,212 people (52,015 households) on a 155.20 sq. km land¹⁰. Out of this population 10,500 households practice smallholder dairy farming and were the target population for the study.

Sample size of the study (400) was calculated using the Yamane's formula for calculating sample size¹¹.

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

where;

n= sample size

N= population

e= Margin of error, taken as 0.05

Data collection

Data on the influence of nutrition management practices smallholder dairy farming productivity was collected by use of structured questionnaires, interviews and observations. The key parameters of the study in which the interviewers were collecting from the smallholder dairy farmers were: feed types categorized into four (ordinary grass only, ordinary grass+ Napier grass, Ordinary grass+Napiergrass+Concentrates, Ordinary

grass+Napiergrass+Hay+ Silage+ Concentrates). Mineral supplementation, watering regime as well as frequency of deworming and vaccination of the animals. These parameters were checked against milk productivity per animal per day.

Data analysis

The collected data were managed on excel and SPSS statistical package (IBM Version 20) used to calculate descriptive means and inferential statistics. Analysis of variance (ANOVA) was used to separate means to get the significant difference at ($p \leq 0.05$). Measures of association (Eta squared) of each parameter to milk productivity was also determined. Simple regression analysis was done to determine the level of impact of the parameters in question to dairy farming productivity.

III. Results

The objective of this study was to determine the influence of nutritional management practices on dairy cattle productivity among small holder farmers in Kakamega Central Sub County Kenya. Parameters checked consisted the nutritional management practices which included the type of feeds (ordinary grass only, ordinary grass+Nappier grass, Ordinary grass+Nappier+ Concentrates, Ordinarygrass+Nappier+Hay+silage+Concentrates), others were watering regime, mineral supplementation, deworming of the animals as well as vaccination.

The results indicated significant difference on the effects of different feed types on cattle productivity in terms of milk production ($p < 0.05$). Animals that received a mixture of ordinary grass, Napier, silage, hay and concentrates had significant average high production (21 ± 1.47 liters per head per day) compared to animals that were only fed on ordinary grass (3 ± 0.11 liters per head per day). Animals fed with ordinary grass, Napier grass and concentrates and those that received ordinary grass and Napier grass came second and third respectively (Table 1).

Table 1: Average milk production Per animal per Day under different feeding regimes

Types of feeds	N	Average Milk Production Per Day Per Animal $\bar{x} \pm SE$
Ordinary Grass	224	$3 \pm 0.11d$
Ordinary grass+Nappier	104	$7 \pm 0.27c$
Ordinary grass+Nappier +concentrates	52	$12.2 \pm 0.46b$
Ordinary grass+Nappier+ Hay+Silage+Concentrates	16	$21 \pm 1.47a$
F 3,396		454.034
P Value		<0.05

Means with the same letters within the columns per feed type not significantly different ($p > 0.05$, F test).

Other nutritional and non-nutritional factors that supplement feeds were also assessed and result showed mineral supplementation, watering regime, frequent deworming and vaccination had significant impacts on dairy cattle productivity ($p < 0.05$, Table 2, 3). The results showed that farmers who provided mineral supplementation and provided water to the animals ad libitum had a higher average milk production compared to those that did not. The results also indicated that farmers who dewormed and vaccinated their animals had improved production compared to those who did not (Table 3).

Table 2: Average milk production per animal per day as affected by the indicated factors

	Mineral Supplement		Vaccination		Deworming (every 3month)	
	N	$\bar{x} \pm SE$	N	$\bar{x} \pm SE$	N	$\bar{x} \pm SE$
Yes	216	$7 \pm 0.76a$	224	$7 \pm 0.73a$	232	$7 \pm 0.69a$
No	184	$5 \pm 0.43b$	176	$4.4 \pm 0.42b$	168	$5 \pm 0.54b$
F 1,398		5.069		8.103		3.927
P Value		0.027		0.005		0.05
Eta squared		0.049		0.07		0.039

Yes=Practice was done, No= The practice was not done, Means with the same letters within the columns per treatment are not significantly different ($p > 0.05$, F test).

Table 3: Impact of watering on average milk production per animal per day

Watering	N	Average milk production
		$\bar{x} \pm SE$
Once	48	$4 \pm 0.65b$
Twice	216	$5 \pm 0.48b$

Thrice	64	7±0.94ab
AD LIB	72	9±1.77a
F 3,396		4.574
p Value		0.005
Eta squared		0.125

Means with the same letters within the columns per treatment are not significantly different ($p > 0.05$, F test).

Simple regression analysis was done to find out the impact of nutritional management practices on dairy cattle productivity. The results indicated that proper nutritional management comprising of sufficient feeds, watering, mineral supplementation and frequent deworming and vaccination significantly influence dairy cattle productivity by about 95% (R-square 0.951, $p < 0.05$, Table 4)

Table 4: SimpleRegression analysis on nutritional management practices on Dairy cattle productivity.

Model Summary									
Model	R	R Square	Adjusted Square	R Std. Error of the Estimate	Change in R Square	F Change	df1	df2	Sig. F Change
1	.975 ^a	.951	.948	1.061	.951	362.333	5	394	.000

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	2038.348	5	407.670	362.333	.000 ^b
1	Residual	105.762	394	1.125		
	Total	2144.110	399			

a. Dependent Variable: Average production

b. Predictors: (Constant), Deworming (every 3month), Mineral supplement, Feedtype, Vaccination, Watering

IV. Discussion

The main aim of the work was to find out the reason behind the low milk productivity among the smallholder farmers in Kakamega County despite the Counties intervention strategies. It was hypothesized that the low productivity could be due to nutritional management practices undertaken by small holder farmers in Kakamega Central, Kakamega County. The results showed that smallholder farmers who provide proper nutritional practices to their dairy animals had a higher average milk productivity per cow compared to those farmers who did little in terms of providing proper nutritional practice to their animals. The study findings corroborate the findings by¹² whose case study also found a direct association between nutritional management practices and dairy cattle productivity. Animal nutrition is a composite term taking into account both feeds and animal health and greatly impacts on productivity¹³. This is clearly depicted in the current study as those farmers that provided the animals with proper feeding, vaccination and deworming had higher yields compared to those that did not. According to¹⁴ mineral supplementation is very important in maintaining the productivity and boosting the immune system of the dairy cattle to disease. It was also noted that water availability affected animal's productivity by about 12%. This is in support to the findings by^{14, 15} which showed that provision of quality water to the animals ad libitum is directly associated to milk production. Studies have shown that water is the most essential element provided to dairy animals as it sustains life and optimize growth, lactation, and reproduction of dairy cattle. Water also is required for digestion and metabolism of energy and nutrients; transport and circulation of nutrients and metabolites to and from tissues¹⁵.

V. Conclusion

With the research findings in respect to the objective of the study, the low milk productivity in Kakamega Central is attributed to the fact that majority of the small holder dairy farmers (95%) practice poor and medium quality nutritional management practices for their dairy cattle, with only 5% of the smallholder dairy cattle farmers doing good nutritional management practices for their animals. To boost the milk productivity individual farmers should ensure that they provide good quality nutrition to their animals as this will always lead to improved yields. In as much as the County governments have tried to empower the smallholder farmers by providing improved breeds they should follow up to ensure proper care is provided to the farmers. The smallholder farmers who own an average of 1.5 acres of land should be trained on better ways of fodder conservation and preparing sufficient and good quality feeds for their animals even in those small pieces of land. The County governments should also come up with mechanisms of ensuring frequent vaccination of the animals in the regions as diseases have proved to be a major challenge affecting dairy productivity.

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13-17