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EFFECT OF TICK CONTROL ON MILK REVENUE OF SMALLHOLDER DAIRY FARMERS IN KAPSERET SUB-COUNTY, KENYA

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ABSTRACT
Milk production is a viable economic enterprise in Kenya. It supports the livelihood of approximately four million Kenyans through food provision, income generation and employment. However, milk production per individual animal in Kenya, averaging seven to nine litres/cow/day, is low compared to the world's best at 10,133 litres/cow/year (28 litres/cow/day). This means that Kenya produces an average of 20 litres of milk less per cow per day compared to the world's best. The objective of this study was to determine the effect of tick control on milk revenue of smallholder dairy farmers in Kapseret Sub-county. Primary data was collected using closed and open-ended questionnaires. Spearman's rank correlation was used to show the strength of the relationship between the variables. Multiple regression model was used to assess the effect of tick control on milk revenue. Results were presented in tables, and descriptive statistics such as percentages and frequencies. The results indicated a positive and statistically significant relationship (r=0.263 & p=0.007) between tick control and milk revenue. Tick control practices essentially impacted cows' health, which further influenced the level of milk revenue. The study concluded that tick control influenced milk revenue of smallholder dairy farmers in Kapseret Sub-county. The study recommended that smallholder dairy farmers need to be trained on the best and timely prevention measures of east coast fever. The government can encourage tick control practices by offering subsidized acaricides. This is because cows' health has direct influence on milk production.
Keywords: Correlation, East Coast Fever, Milk revenue, Milk production

INTRODUCTION
Global food security, sustainability of food production and consumption greatly depend on how livestock production is managed as one of the major sources of food (FAO, 2016). The world's dairy sector is fast growing and is projected that milk production will increase by 177 million tonnes by 2025 (FAO, 2017). However, FAO (2019) states that the world's exports of dairy products are forecast to reduce by four percent in 2020, which would likely mark the sharpest year-on-year decline in three decades. The average daily milk production in most dairy farms in Kenya is estimated to be averagely six to seven litres per cow per day, however, this is approximately 70% lower than the level of production of cows in the developed countries (Muraya et al., 2018). This level of production in Kenya is low compared to world's average best of 10,133 litres per cow per year (28 litres per cow per day) (FAO, 2012). With improved management and better feeds and feeding practices, the production potential could be much higher than the milk currently produced per cow per day in Kenya (KDB, 2019). According to Uasin Gishu County Government Report (2018), milk production stands at 5.2 billion litres and is projected that milk production will be at 7.9 billion litres by 2022 despite high expectation of a shortfall. There is need, therefore, to find mitigations of solving the expected shortage.

According to Omunyin et al. (2012), animals that produce milk should be healthy and have an effective health care programme in place. Global trade, increase in population and related growth in milk production have contributed to redistribution of pathogens, vectors and infected hosts because of increased international trade in live animals (FAO, 2019). Ticks are considered one of the biggest public health and veterinary problems in the world especially in animal production that affect milk production in dairy cows (Romero et al., 2011). In Kenya, east coast fever is the main tick-borne disease affecting dairy cattle, forming 41.3% of the total disease in smallholder farms (Omunyin et al., 2012). The main challenges facing the control of the disease include inadequate capacity for sustained disease surveillance and control programs and poor enforcement of existing laws governing disease control (MoALF, 2019). Some of the effects of ticks on animals include stress and weakening of the animal's immune system, losses in milk production, indirect economic losses related to prevention and control costs, increased morbidity and mortality (Eskezia & Desta, 2016). The objective of the study, therefore, was to determine the effect of tick control on milk

revenue of smallholder farmers in Kapseret Sub-County.

METHODOLOGY

The study employed correlation research design. Correlation design enables an observation of two variables or more at the point in time and is useful for describing the relationship between the two or more variables (Ary et al., 2019).

The research design was appropriate since the study aimed at analysing the relationship between variables. The assessment of the magnitude of the relationship was based on the coefficient of determination, p-values and effect size of the coefficient.

Location of the Study

Kapseret sub-County is located in Uasin Gishu County. The County covers an area of 3,345.2 square kilometers and lies between longitude 340 50′ East and 350 37′ West and latitude 00 03′ South and 00 55′ North. The county borders Trans-Nzoia County to the North, Elgeiyo Marakwet and Baringo Counties to the East, Kericho County to the South, Nandi County to the South West and Kakamega County to the West. According to the 2019 national census; Uasin Gishu County had a population of approximately 1,163,186 people with a population density of 390/ km^2. The County experiences high and reliable rainfall evenly distributed throughout the year. The average rainfall ranges between 624.9 mm to 1,560.4 mm per year with two distinct peaks in April and August. The temperatures range between seven degrees Celsius and twenty-nine degrees Celsius.

Population, Sample Size and Sampling Procedure

The target population in this study was 4,226 smallholder dairy farmers in Kapseret Sub-County. The sample size was drawn from smallholder dairy farmers in the following wards; Ngeria, Megun, Simat, Kipkenyo and Langas. The following formula by (Krecjie & Morgan, 1970) was used to calculate the sample size for the study,

$$n = \frac{X^2 Np(1-p)}{d^2(N-1) + X^2 p(1-p)}$$

$$n = \frac{1.96^2 X4226 X0.8 X0.2}{0.05^2(4226-1) + 1.96^2 X0.8 X0.2} = 232$$

Where: N= Total population,
n= Sample size,
X^2= Table value of Chi-Square with one-degree freedom and at 95% confidence interval, giving 1.96,
p = the proportion in the target population estimated to have characteristics being measured and
d = the degree of accuracy expressed as a proportion (0.05).

Cluster sampling was used to select households proportionate to the population size in Kapseret (Table 1). Kabsaret was grouped into five clusters: Ngeria, Megun, Langas, Simat and Kipkenyo wards. Random sampling was then carried out to select individual smallholder farmers from each of the five clusters.

Table 47: Sample size of farmers

Ward (Cluster)	Number of Farmers	Sample Size
Ngeria	1015	56
Kipkenyo	1005	55
Megun	1011	55
Simat	733	41
Langas	462	25
Total	4226	232

Data Collection and Analysis

Primary data was collected using a structured questionnaire. The data was cleaned, coded before being analysed. Quantitative data was analysed using Statistical Package for Social Sciences (SPSS) version 25 for both descriptive and inferential statistics. In order to effectively analyse the primary quantitative data, descriptive statistics including percentages and frequencies were generated. Spearman's Rank correlation showed the strength of the relationship between variables in the study. Values close to +1 indicated a high-degree of positive correlation, and values close to -1 indicated a high degree of negative correlation. Values close to zero indicated poor correlation of either kind.

The study employed correlation research design. This design enables the researcher to observe two or more variables at the point in time and is useful for describing a relationship between two or more variables (Ary et al., 2018). The research design was appropriate since the study aimed at analysing the relationship between variables. The assessment of the magnitude of the relationship was based on the coefficient of determination, p-values and effect size of the coefficient.

Models

Linear Regression Model

Linear regression analysis showed the relationship between dependent and the independent variable.

Model Specification

The general regression model was:

$Y = \beta_0 + \beta_1 X_1 + \varepsilon$ i

where, Y = Milk revenue (Total milk volume x Price per litre)

β_0 = Constant Term

β_1 = Regression coefficient

X_1 = Tick control practices

ε = Error term

RESULTS AND DISCUSSION

Response Rate

This research mainly used questionnaires as the research tool for a total sample size of 232 farmers in Kapseret Sub-County. Out of the 232 farmers, a total of 220 questionnaires were returned and fit for the analysis, representing a return rate of 94.8% (Table 2). Approximately 80% to 90% questionnaire return rate is appropriate for a descriptive research (Nachmias, 1992).

Table 48: Response rate

Respondents	Sample	Returned	Percent (%)
Ngeria	56	52	92.8
Megun	55	52	94.5
Kipkenyo	55	52	94.5
Simat	41	39	95.1
Langas	25	25	100.0
Total	232	220	94.8%

Gender Distribution

The study sought to establish the gender composition of the smallholder dairy farmers in Kapseret Sub-County. The results were analysed and tabulated in Table 3. The number of male gender smallholder dairy farmers in Kapseret Sub-County was higher than that of the females. This was an indication that male headed household were common in the area of study. This was in contrast with the findings by (Oni et al., 2010) that male and female-headed households had almost equal chance of participating in smallholder farming.

Education Background of Smallholder Dairy Farmers in Kapseret Sub-County

The study sought to establish what levels of education were involved among smallholder dairy farmers in Kapseret Sub-County. The respondents were requested to indicate the highest level of education they attained. From the findings, 96.4% of the respondents had attained at least basic education. A high number of the smallholder farmers had attained the primary level as indicated by 48.2% of the respondents. Only 3.6% of the respondents did not school at all as indicated in Table 3. The results were consistent with findings by (Kosgei et al., 2020) that most of the smallholder household heads were fairly educated which enabled them to fairly adopt dairy cattle milk production technologies.

Dairy Farming Importance

The study went further to determine the importance of dairy farming to the livelihoods of smallholder dairy farmers in Kapseret Sub-County compared to other sources of livelihood earnings. Using the Linkert type questions, farmers were asked to indicate the importance of dairy farming to their household income. The results were analysed and are tabulated in Table 3. Majority of the respondents (98.2%) indicated that dairy farming played a key role in supporting their livelihoods in terms of household income. Eighty percent of the respondents indicated dairy farming practice as very important whereas 18.2% indicated the practice as important. Only 1.8% of the respondents underrated its importance. This meant that a high percentage of the smallholder dairy farmers in Kapseret Sub-County mainly depended on dairy farming as their main source of income for sustaining their livelihoods.

Milk Distribution by Farmers

The study sought to understand how smallholder dairy farmers in Kapseret Sub-County distributed milk produced in their farms. The computed descriptive statistics were as tabulated in Table 3. The results showed that the amount of milk sold by farmers was very high (MN=7.31 and SD=4.570) compared to the amount of milk used by farmers for their home consumption (MN=2.313 and SD=1.113). This meant that dairy farming played a significant role in determining the earnings for improving livelihoods of the smallholder farmers in Kapseret Sub-County. This was consistent with findings by (Kurgat et al., 2019) that farmers carried out dairy farming for commercial purposes which were a clear step towards improving productivity and marketing.

Farmers sold 79% of the milk, while 16% of the milk was for home consumption and 5% of the milk was given out. The relationship between milk volume and prices was negative and statistically significant (p=-.108 & r=0.01). This was similar to findings by (Olwande & Mathenge, 2011) that the prices of milk did not significantly influence the quantity of milk produced. The study established a positive and statistically significant relationship (p=0.98 & r=0.01) between amount of milk produced and the amount of milk sold. This indicated that more milk was sold (supplied) in instances of increased production. This indicated consistency with the normal supply curve.

Table 49: Summary of the dairy farming importance, gender, education level and milk distribution descriptive statistics of smallholder dairy farmers in Kapseret Sub-County (N= 220)

	Frequency (f)	**Percent (%)**
Dairy farming importance among smallholder dairy farmers in Kapseret Sub-County		
Very Important	176	80.0
Important	40	18.2
Not Important	4	1.8
Distribution of gender of smallholder dairy farmers in Kapseret Sub-County		
Male	152	69.1
Female	68	30.9
Education level of the respondents		
Tertiary	45	20.5
Secondary	61	27.7
Primary	106	48.2
None	8	3.6
Descriptive statistics on milk distribution by smallholder dairy farmers in Kapseret Sub-County		
	Mean	Std. Deviation
Amount of milk produced	9.67	5.179
Amount of milk sold	7.31	4.570
Amount of milk consumed	2.313	1.1131

Table 50: Spearman's rank correlation for milk distribution by smallholder dairy farmers in Kapseret

		Volume	**Prices**	**Milk produced**	**Milk sold**
Milk volume	Correlation coefficient	1			
	Sig.				
Milk prices	Correlation coefficient	-.108*	1		
	Sig.	.01			
Milk produced	Correlation coefficient				
	Sig.				
Milk sold	Correlation coefficient			.98*	1
	Sig.			.01	

**. Correlation is significant at the 0.05 level (2-tailed); N= 220*

Tick Control Effect on Milk Revenue

The study established that there were factors directly associated with tick control practices. Continuous grazing method was commonly used as indicated by 64.1% of the respondents while 35.9% of the respondents practised rotational grazing. It was also established that the methods of grazing affected the spread of ticks as indicated by 58.6% of the respondents. The spread of ticks was reduced in rotational grazing compared to continuous grazing as indicated by 82.2% of the respondents.

Table 51: Descriptive statistics on tick control practices by smallholder farmers in Kapseret

Tick control	F	%
Method of grazing carried out by the smallholder farmers		
Rotational grazing	79	35.9
Continuous grazing	141	64.1
Did the method of grazing affect the spread of ticks?		
Yes	129	58.6
No	91	41.4
The spread of ticks was reduced in which grazing method?		
Rotational grazing	181	82.2
Continuous grazing	39	17.8
Tick control methods carried out by the smallholder farmers		
Plunge dip	117	52.9
Hand spray	91	41.2
Both plunge dip and hand spray	12	5.9
Frequency of tick control by smallholder farmers		
Once a week	189	85.9
Twice a week	29	13.2
Once in two weeks	2	0.9

This was consistent with findings by Rapiya et al. (2019) that tick infestation showed a decline under rotational grazing in a study carried out in South Africa. The most commonly practised method of tick control was plunge dip as was indicated by 52.9% of the respondents. However, 41.2% of the respondents practised hand spray method while 5.9% of the respondents practised both plunge dip and hand spray methods. Ticks were controlled once in a week by most smallholder farmers as indicated by 85.9% of the respondents. Only 13.2% of the respondents practised tick control measures two times in a week while 0.9% of the respondents carried out tick control measure once in two weeks. The results were in agreement with the findings by Makuvadze et al. (2020) that more than half (53%) of the farmers in Zimbabwe relied on the plunge dip to control ticks while the remaining 47% complemented both plunge dipping and hand spraying methods.

The study further sought to establish how tick control was important in determining increased milk revenue of smallholder dairy farmers in Kapseret sub-County. The study established that tick control was of key importance in dairy farming among smallholder farmers in Kapseret sub-County. This was clearly shown by 100% response that highlighted on the need for tick control whereby 94.1% of the respondents firmly concurred that tick control was very important in determining increased milk revenue. More other 5.9% of the respondents indicated the practice as important. This was in agreement with the findings by Kiptarus (2005) that ticks and tick-borne disease in Kenya hindered the profitability of up to 80% of the animals in the country, and thus reduced farmer's revenues notably. It was also clearly established that tick control methods were a factor to consider in determining milk revenue. This was indicated by 77.8% of the respondents who firmly concurred that tick control methods were very important and 18.6% more agreed that tick control method chosen by the farmer was important in determining smallholder farmers' milk revenue. However, less than four percent of the respondents stated that tick control methods did not necessarily affect milk revenue among smallholder dairy farmers.

Table 52: Descriptive statistics on tick control effect on milk revenue of smallholder farmers in Kapseret

Statement on Tick Control		VI	I	NI	Totals
Importance of tick control in increased milk revenue	F	207	13	0	220
	%	94.1	5.9	0	100
Importance of tick control method in increased milk revenue	F	171	41	8	220
	%	77.8	18.6	3.6	100
Importance of tick control intervals in increased milk revenue	F	183	23	14	220
	%	83.2	10.5	6.3	100

VI- Very Important I- Important NI- Not Important

Tick control intervals, however, was considered a critical measure to consider in achieving increased milk revenue among smallholder farmers in Kapseret sub-County. This was clearly indicated by 93.7% of the respondents who

indicated that there was need to consider the frequency of tick control, where 83.2% of the respondents indicated tick control frequency as very important in determining increased milk revenue. Only 6.3% of the respondents indicated the intervals of tick control was not of importance. Tick control, therefore, was of importance in achieving increased milk revenue among the smallholder farmers in Kapseret sub-County. This was supported by the findings of MoALF (2019) that livestock diseases and pests were among the most serious constraints limiting development of dairy industry, contributing significantly to low productivity of farm animals.

The study further realised a positive and statistically significant relationship (r=0.041 and p=0.00) between the method of grazing and tick control among smallholder dairy farmers in Kapseret sub-County. This meant that the grazing methods they practised influenced the spread and infestation of ticks on their animals. The smallholder farmers practised both continuous/free grazing and rotational grazing within the owners' farm. This was in agreement with findings by Omunyin (2012) that diseases like east coast fever causes high mortality particularly in herds that freely graze, whose exposure to ticks is greater compared to cattle confined within the owner's farm. The positive and statistically significant relationship between tick control and milk revenue (r=0.161 & p=0.017) indicated that tick control influenced increased milk revenue of smallholder farmers in Kapseret sub-County. The results were not much different from the findings in Nandi County by Wangila (2016) which showed that mortality and treatment cost of cows had a significant relationship of (p-value of 0.005 and 0.001), respectively, with economic losses in dairy farming due to east coast fever which is a tick-borne disease.

Table 53: Spearman's rank correlations between grazing method, tick control and milk revenue

		Grazing Method	Tick Control	Milk Revenue
Grazing Method	Correlation coefficient	1		
	Sig. (2-tailed)			
Tick Control	Correlation coefficient	.041*****	1	
	Sig. (2-tailed)	.000		
Milk Revenue	Correlation coefficient		0.161******	1
	Sig. (2-tailed)		0.017	

*. Correlation is significant at the 0.05 level (2-tailed); N= 220

Regression Model Summary

The linear regression model was used to show the relationship between the dependent variable and the independent variable. The linear model significance was evaluated using ANOVA. Regression results indicated that the linear association between milk revenue and tick control has an F value of F=5.731 which is significant with p value p=0.001. This implied that the overall model was significant in forecasting the effect of milk revenue and feed supplements at 5% level of significance. The R2 value of 0.145 meant that approximately 14.5% of the resultant changes in milk revenue among smallholder farmers in Kapseret was explained by feed supplementation. The regression coefficient results for the model revealed that the beta coefficient of the resulting regression model was β_0= 9.631, and β_1= 3.512. Using the value of the coefficients from the regression coefficient, the accepted regression equation took the form: Milk Revenue = $9.631+3.521X_1$, where X_1 was tick control. The study showed that all the independent variables had a positive relationship with the dependent variable. The results stipulated that a unit change in tick control led to 3.512 changes in milk revenue. The findings suggested that tick control had a positive and significant influence on milk revenue of smallholder farmers with P value of .01 at 5% level of significance. This implied that tick control practices had a major impact on milk revenue.

Table 54: Significance of the regression of milk revenue on tick control

		Unstandardized Coefficients		Std Coefficients			
Model		B	Std. Error	Beta	T	VIF	Sig
1	(Constant)	9.631	1941.961		5.672		0.000
	Tick control	3.512	1265.351	.148	2.439	1.012	0.001

Values where p<0.05 were statistically significant)

CONCLUSION AND RECOMMENDATION

The study concluded that tick control practise was very essential in determining cow's milk production. This influenced the level of milk revenue of smallholder dairy farmers. It was also evident that the method and interval of tick control influenced the milk revenue. From the farmers' response, it was indicative that failure to control ticks

resulted to low levels of milk revenue. The study recommended that smallholder dairy farmers need to be trained on the best and timely preventive measures of tick-borne diseases. This will not only help in increasing milk production for better revenues but also reducing the costs that might be associated with treatment of sick cows.

REFERENCES

Ary, D, Jacobs L. C, Irvine, C. K. S., &Walker, D. (2018). *Introduction to Research in Education*. 10th Edition,Cengage Learning.

Eskezia, B. G., Desta, A. H. (2016). Review on the impact of ticks on livestock health and productivity. *Journal forBiology and Agricultural Health*; 6:1-7.

Food and Agriculture Organization of the United Nations Statistics. (2016). Agricultural outlook 2016-2025.

Food and Agriculture Organization of the United Nations Statistics. (2018). Module 1. Ticks: acaricide resistance: diagnosis management and prevention. Guideline's resistance management and integrated parasite control in ruminants. Rome: *Animal Production and Health Divisions*, 25-77.

Food and Agriculture organization statistics of the United Nations (2017). FAO and the SDGs. Measuring up to the 2030 Agenda for sustainable development. Rome.

Food and Agriculture organization statistics of the United Nations (2020). Overview of global dairy market developments in 2019. Dairy Market review.

Food and Agriculture organization statistics of the United Nations (2012). Milk availability, Trends in production and demand and medium-term outlook, 12-01.

Kenya Dairy Board (KDB) (2019). The Kenya dairy industry: Status and outlook. Presented at the 15th ESADA dairy conference and exhibition Kenyatta international conference centre, Nairobi.

Kiptarus, J. K. (2005). Focus on livestock sector. Supply policy framework strategies, status and links with value addition. *Paper presented at a workshop on Value Access Food and Export Investment, Nairobi, Kenya*.

Kosgei, J. K., Ng'eno, E. K, &Kibett, J. K. (2020). Factors affecting adoption of dairy cattle milk production technologies in Mosop, Nandi County, Kenya. *African Journal of Agricultural Research* 15(1):140-148.

Krecjie, R. V., Morgan, D. W. (1970) Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3):607-610.

Kurgat, E. K., Keror, J. S., Bartilol, M. K., Yego, H. (2019). Determinants of smallholder dairy farmers milk production and supply to market in Uasin Gishu County, Kenya. *International Journal of Research and Innovationin Social Sciences, 3*(4):2454-6286.

Makuvadze, F. T., Hove, T., Makaya, P., Waniwa, E., Nemaungwe, T. (2020). Resistance of ticks on cattle to Amitraz in Zimbabwe. *Tropical Animal Health and Production*, 1-8.

Ministry of Agriculture, Livestock, Fisheries and Irrigation (2019). Draft of National Livestock Policy.

Muraya J., VanLeeuwen, J. A., Gitau, G. K., Wichtel, J. J., Makau, D. N., Crane, M. B., & Tsuma, V. T. (2018). Cross-sectional study of productive and reproductive traits of dairy cattle in smallholder farms in Meru, Kenya, *Livestock Research for Rural Development, 30*(171).

Nachmias, C. F. (1992). Research methods in social sciences. Britain: St. Martin's Press Inc.; 1992.

Olwande, J., & Mathenge, M. (2011). Market participation among the poor rural households in Kenya. *Tegemeo Institute of Agricultural Policy and Development.*

Omunyin, M., Ruto, J., Yegon, M. K., Bii, A. (2014). Dairy Production Constraints in Kericho & Bomet Counties, Kenya: Evidence from Farmers. *Fields International Journals in Science and Research, 3*(12):1246.

Oni, S. A., Maliwichi, L. L., Obaride, O. S. (2010). Socioeconomic factors affecting smallholder farming and household food security. A case of Thulamela local municipality in Vhembe district of Limpopo province, South Africa. *African Journal of Agricultural Research*, 5(17):2289-2296.

Rapiya, M., Hawkins, H. J., Muchenje, V., Mupangwa, J. F., Marufu, M. C., Dzama, K., Mapiye, C. (2019). Rotational grazing approaches reduces external and internal parasite loads in cattle. *Africa Journal of Range Forage Science, 36*(3):151-159.

Romero, H. Q., Castillo, J. A. F., Velarde, F. L., Arellano, M. E. L. (2011). Epidemiology of parasitic deseases in domestic animals. *Veterinary World, 12*(1):48.

Uasin Gishu County Government Report. Agriculture, Livestock development and fisheries in Uasin Gishu County (2018). Available: https://www.uasingishu.go.ke

Wangila, R. S. (2016). Economic Impact of East Coast Fever Infection and Treatment: A case study in Uasin-Gishu and Nandi counties (Doctoral dissertation, University of Nairobi).