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Effectiveness of extension services for food and nutrition security through integrated crop-livestock farming systems: A case study of smallholder farmers in Rarieda Sub County, Kenya

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Abstract

Integrated Crop-Livestock Farming Systems (ICLFS) are globally recognized for their contributions to improving agricultural sustainability. These systems also play a big role in conservation and Climate-Smart Agriculture (CSA) since they reduce greenhouse gas (GHG) emissions, thus assisting in coping with the effects of climate change. This study aimed at evaluating the effectiveness of extension services in achieving food and nutrition security by farmers practicing integrated crop-livestock farming systems. The data were analysed using both descriptive statistics and inferential statistics. The frequency over which farmers receive their extension services indicated that the majority never received them, followed by farmers who annually received extension service. From the findings, mass media and village meetings were statistically significant in extension delivery modes. The results indicated a strong and positive correlation between the extension service provision and performance. The standardized regression coefficients revealed that for every unit increase of extension service increases performance and were statistically significant. Therefore, this study recommends a refinement and improvement of extension services to impact on integrated farming system positively.

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Introduction

The importance of agriculture in the socio-economic development of countries, especially those in Sub-Saharan Africa (SSA), has long been recognized. Agriculture is the dominant contributor to the Gross Domestic Product (GDP) of developing countries and their exports (FAO, 2003; Cervantes-Godoy & Dewbre, 2010). In addition, the bulk of job creation in the rural areas of the majority of countries in sub-Saharan Africa, as is the case with many other developing countries, occurs in the agricultural sector, which is believed to account for generally more than half of the active labour force (FAO, 2003; Cervantes-Godoy & Dewbre, 2010).

Smallholder crop-livestock systems play an important role in sub-Saharan African agriculture because of their real extent, livelihood provision, and impact on ecosystem services (Thornton; Herrero, 2015). In Kenya, the government has promoted several programs to enhance the productivity of small farms where cereals, vegetables, and legumes are grown on the same farm as other enterprises. With regards to benefits of integrated farming systems, a previous study reported the importance of two functions of crop-livestock farming practices (integrated crop-cows farming system) in western Kenya where the number of dairy cows and the quantity of manure used in the farm have a significant influence on crop production (Frederic *et al.*, 2014). The Integrated Crop and Livestock Farming Systems (ICLFS) is the most practiced in Rarieda Sub-County, with sorghum and maize being the main staple food crops in the system. However, proper documentation on the status of the farming system is lacking.

There is a lack of information and data on the types of ICLFS in Rarieda sub-County. Moreover, information on factors and obstacles that policy makers need to be aware of to ensure interventions on adoption and efficient management of ICLFS are also limited. This results in food insecurity, despite most households engaging in ICLFS. Based on this, the study aimed at evaluating the effectiveness of ICLFS in contributing to sustainable food security and the challenges faced by ICLFS-smallholder farmers in Rarieda sub-County. Furthermore, the performance of crops and livestock in an integrated farming system was assessed in this study.

Materials and methods

The study was conducted in Rarieda Sub-County, in Siaya County, which is one of the 47 counties in Kenya. Rarieda sub-County is located in the western part of Kenya, at latitude **0° 12' 6" S** and longitude **34° 20' 18" E.** It is comprised of five administrative units, namely, East Asembo, West Asembo, West Uyoma, North Uyoma, and South Uyoma wards in what was formerly known as Rarieda and Madiany divisions (Asembo and Uyoma, respectively), with a total area covering 403.30 km2. The sub-County borders Lake Victoria to the South

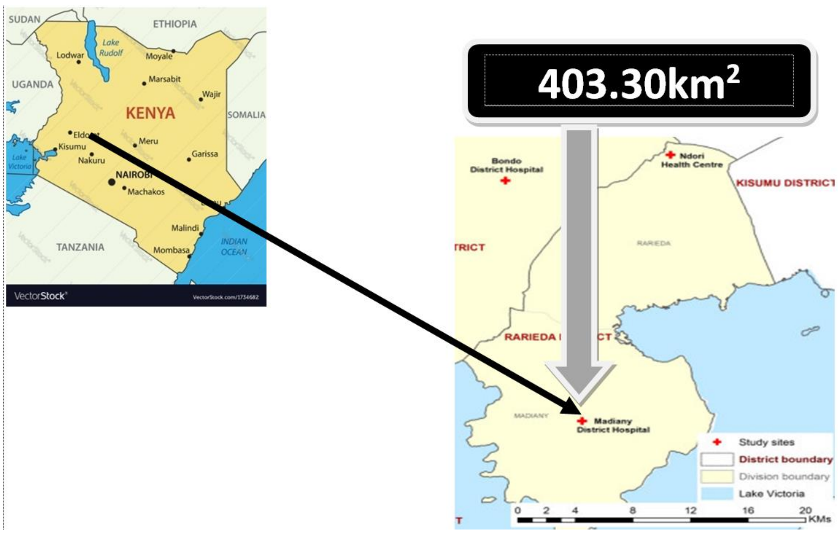

Fig. 1. Map of the study area.

The economic activities in the sub-County are mainly small-scale subsistence farming, including the rearing of livestock (cattle, sheep, goats, and poultry) and production of crops like maize, sorghum, cassava, potatoes, beans, green grams, groundnuts, cowpeas, and fruits like mangoes and oranges. Other economic activities include fishing and small-scale trade in agricultural produce.

Sampling procedure

The study targeted farmers engaged in integrated crop and livestock systems in Rarieda sub-County. The sub-County has an estimated population of 75,779 according to the Kenya National Bureau of Statistics (2019). Out of the 75,779, 710 small-scale farmers were selected as the target sample for the study. A representation of smallholder farmers within the administrative units was sampled.

A stratified simple random sampling technique based on sub-sector was used. A pre-specified size in each stratum was drawn independently in different strata to make up a stratified sample. Then an Independent Simple Random selection was made in each stratum Nassiuma (2001). This sampling method was used because data needed to be collected from the selected zone representation. The study employed the Causal Research Design, an informal investigation into an issue or topic that looks at the effect of one variable on another (Dudovisky, 2018). The study helped analyse the influence of extension services on the performance of integrated crop and livestock farming systems for food and nutrition security.

Sample Size determination

The sample size was determined according to Mugenda and Mugenda (2003) and Saunders *et al.* (2009) as follows:

n = (z2. p. q) / e2; Where

n: is the minimum sample size required

z: the standard normal deviate that is, 1.96 for 95% confidence level *p:* is the proportion in the target population estimated to have the characteristic, recommended to be 50% if there is no estimate available of the proportion in the target population assumed to have the characteristic of interest.

q: is the proportion not having the characteristic (that is, 1-*p*)

e: is the level of significance or margin of error (set at 5% in this study).

Substituting the data in the formula gave a sample size of 384.

Since the target population of 710 is less than 10,000, a smaller sample size called adjusted minimum sample size was used without affecting the study's accuracy (Mugenda & Mugenda, 2003; Saunders *et al.*, 2009). This was calculated using the following formula:

$n' = n/ (1+ n/N)$

Where,

n' is the adjusted minimum sample size

n is the minimum sample size, as calculated above, that is, 384

N is the total population, that is, 710

Substituting these Fig.s into the formula gave a minimum sample size of 249

Simple Random Sampling was employed in the study to avoid bias and ensure representativeness. The stratified Random Sampling technique categorizes smallholder farmers into different subgroups or strata based on the type of integrated crop and livestock farming, their farm acreage, and administrative area. Then subjects were selected randomly and proportionately. Purposive sampling was used to determine the other stakeholders, including administrators, farmers' representatives, officers from the sub-County agricultural offices, Non-Governmental Organizations, and officers from the National Government. Qualitative and quantitative data were collected through self-administered, structured, and unstructured questionnaires. The questionnaires were validated by pre-testing the questionnaires.

Instrumentation

Data were collected through interviews through one-on-one oral engagement schedules with farmers, agricultural extension officers, and other stakeholders. Questionnaires of both open and close-ended questions were used to capture data on production, challenges, and factors that influence the integration of crops and livestock.

Descriptive design and Survey methods were used for collecting data. The study used test-retest reliability to assess how test scores are consistent from one test to the next. Secondary data was collected using published literature.

Data Analysis

Data were processed and analysed using the Statistical Package for Social Sciences (SPSS) version 20. The analysis was done using both descriptive and inferential approaches. Frequency counts and measures of central tendency, including mean and dispersion using standard deviation, were used for descriptive statistics. On the other hand, chi-square and simple linear regression were applied for inferential statistics. The degree of association and cause-effect influence between the variables was determined. Descriptive and inferential statistics were used in analysing the data. Inferential statistics were used to draw implications from the data. Objectives were achieved by calculating the Pearson product-moment correlation coefficient of the variables to establish a relationship between and among findings. The Pearson's correlation coefficient "r" was calculated using the formula;

$$r = \sqrt{\frac{(\sum xy^2)}{\sum x^2 . \sum y^2}}$$

(Bagchi & Khamrui, 2012)

Results and discussion

Evaluating Effectiveness of Extension Services in Enhancing Food and Nutrition Security

The effectiveness of extension services in achieving food and nutritional security was assessed in this study.

Source of Agricultural Extension Service to Respondents

From the findings, the main sources of agricultural extension services to most farmers are agricultural seminars and workshops with a proportion of 43.0%, followed by the Ministry of Agriculture (MoA) and NGOs, respectively, as shown in Table 1. These were found to have a significant relationship with the integrated crop-livestock farming system. Aker (2011) also found that agricultural seminars and workshops mainly provide information and technological knowledge and skills.

Table 1. Source of extension service to your farm.

		Frequency	Percent	Value	Level of Significance (P-value)
Valid	Ministry of agriculture	31	20.5	27.8	0.000****
	NGOs	26	17.2	17.3	0.001***
	Agricultural seminars and workshops	65	43.0	44.6	0.000****
	Shows and Demonstration	19	12.6	13.7	0.002***
	Other	10	6.6		
	Total	151	100.0		

NS = not significant; * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$; **** $p < 0.001$

Frequency of Agricultural Extension Service

The frequency over which the farmers receive their extension services was also examined. The analysis in Table 2 shows that majority of the respondents never received extension services (31.1%), followed by 29.1% who say they have been receiving the services annually. According to Maoba (2016), most of the farmers in sub-Saharan Africa had not received any agricultural extension services in their region.

Table 2. Frequency of extension services.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Weekly	9	6.0	6.0	6.0
	Monthly	28	18.5	18.5	24.5
	Yearly	44	29.1	29.1	53.6
	Every two years	23	15.2	15.2	68.9
	Never	47	31.1	31.1	100.0
	Total	151	100.0	100.0	

Methods of Extension Service used

Method most commonly used by extension workers to deliver their content was through gatherings organized by the area chief with a proportion of 42.4% followed by mass media (20.5%). All these methods of extension services were found to be statistically significant hence having a great influence on integrated crop livestock farming system (Table 3).

Guatam, (2000) found out that majority of farmers in the sub-Saharan Africa mainly gain their knowledge and skills and information through public gatherings and other forms with more of physical contact.

Table 3. Methods of Content Delivery.

		Frequency	Percent	Value	Significance Level(p-value)
Valid	On-farm visit	30	19.9	122.7	0.000****
	Demonstrations	22	14.6	126.3	0.000****
	Chiefs Meetings	64	42.4	87.7	0.002***
	Mass Media	31	20.5	99.6	0.001***
	Other	4	2.6	96.7	0.001***
	Total	151	100.0		

NS = not significant; * = p < 0.1; ** = p < 0.05; *** = p < 0.01; **** p < 0.001

Effect of Extension Services on Performance of ICLFS

As shown in Table 4, the R Squared for Model 1 is 0.691, indicating that 69.1% of the variation in performance is explained by variation in the independent variable extension service. The results indicated that there is a strong and positive correlation between the extension service provision and performance. This corroborates previous report by Carrer, (2021) who found that agricultural extension services greatly affect performance of the farmers.

Table 4. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.263[a]	.691	.063	.72235

a. Predictors: (Constant), Extension Services

Table 5. ANOVA.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.777	1	5.777	11.071	.001[b]
	Residual	77.747	149	.522		
	Total	83.523	150			

a. Dependent Variable: Performance of ICLFS

b. Predictors: (Constant), Extension Services

The ANOVA results in Table 5 indicated that the effect of extension services on the performance of ICLFS was statistically significant (F =11.071, p=0.001, $p <$ 0.05). The standardized regression coefficients shown in Table 6 revealed that for every unit increase of extension service, the performance of ICLFS (β= 0.199) increases; and was statistically significant (p=0.001, $p<$ 0.05). This shows that extension services were statistically positively correlated with the performance of an integrated crop-livestock farming system.

Table 6. Coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients	t	P-value
		B	Std. Error	Beta		
1	(Constant)	1.698	.154		11.001	.000****
	Extension	.199	.060	.263	3.327	.001***

a. Dependent Variable: Performance of ICLFS

NS = not significant; * = p < 0.1; ** = p < 0.05; *** = p < 0.01; **** p < 0.001.

Conclusion

According to the findings, farmers mainly receive their agricultural extension services through agricultural seminars and workshops, the Ministry of Agriculture, and Non-Governmental Organizations in that order. The major problem here is the frequency of the extension services, which the farmers rarely receive. Those who have had the privilege to access these extension services are mainly through gatherings organized by the local area chiefs and mass media. According to the findings of this research, there is a significant association between the ICLFS and food security among the smallholder farmers in the study site. The ANOVA supported this, which indicated a strong and positive correlation between the extension service provision and performance.

Extension services should be provided extensively and often since most of these extension services are rarely offered; therefore, the extension service providers should develop new strategies for reaching farmers apart from workshops and seminars. This will lead to an increase in performance as farmers will be aware of the activities entailing ICLFS. Agricultural and veterinary services have been devolved to the counties in Kenya, agrarian research funding and training on modern agricultural technologies need to be enhanced and evolved. This would improve the farmers practicing ICLFS access to irrigation facilities, enhanced access to extension services, and provision and training on modern agricultural technologies. These interventions would enhance the performance of ICLFS and mitigate food insecurity in the study area and Lake Victoria Crescent at large, as well as motivate the perception of farmers in adopting these farming systems.

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