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Economic Performance of Small Ruminants on Smallholder Farms in Climate Smart Villages of Nyando

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Abstract

Small ruminant production forms an integral part of the livelihoods of smallholder farmers in Nyando. This paper is part of a study to evaluate the impacts of the small ruminants on the incomes of smallholder farmers adopting "Climate Smart" agricultural practices in the counties of Kericho and Kisumu in Nyando. A cross-sectional survey involving 162 households was conducted in 2018 to elicit information on farmer demographic characteristics, resource endowment, flock dynamics, and revenues from small ruminant production. Results from the analyses of the data collated showed that the small ruminants are an important source of revenue for the smallholder farmers. The number of animals owned varied depending on the size of the land owned. Farmers in Kericho tended to have larger land holdings than in Kisumu ($p<0.01$) with concurrently larger flock sizes. The farmers however did not have any information on the optimal number of animals that they should keep on their land. In both counties, better prices were received for larger mature animals than for immature animals. The farmers also tended to sell more female than male animals although they stated that the sale of animals was dependent on the availability of the animals and the anticipated returns. Information on the optimal number of animals to rear with specific resources available is needed for the farmers to be able to continually produce and market sheep and goats at a good price.

Introduction

Climate change as manifested by long periods of drought, high temperatures followed by recurrent floods has become a major challenge to smallholder livestock farmers in Kenya. The changing climatic conditions affect livestock production through increased incidences of disease outbreaks,

elevated temperatures triggering stress in animals, and, water and feed scarcity (IPCC, 2018). Its therefore important for the smallholders to adopt appropriate and practical mitigation strategies against climate change.

Several studies have recognized the role of the small ruminants in provision of food, socio-cultural needs, and income for poor smallholder farmers (De Vries, 2008 , Peacock, 2005, Kumar & Roy, 2013). Coupled with high reproduction rates, adaptability to extreme harsh climate conditions and the ability to utilize a wide variety of feed resources, small ruminants are an ideal livestock species for smallholders in climate constrained environments (Assan, 2014). As an example of the possible change in livelihoods through rearing small ruminants, Nyando was selected by Climate Change Agriculture and Food Security programme (CCAFS) for the implementation of "Climate Smart Agricultural practices" (Ericksen &Thornton, 2011). In 2014, CCAFS in partnership with ViAgroforestry, World Neighbors, Ministry of Agriculture, Livestock and Fisheries and International Livestock Research Institute (ILRI), introduced improved indigenous sheep and goat breeds as one of the interventions in Nyando.

Since 2014 the changes in the characteristics of the smallholder farmers were documented in 2016 by Ojango et al., (2016). There is however limited information on the costs and returns from rearing the small ruminants in the smallholder farms. This paper is part of a study to evaluate the impacts of sheep and goats on the incomes of the smallholder farmers of Nyando. We outline the characteristics of the farmers four years following the introduction of improved sheep and goat breeds, present the gross revenues from the small ruminant enterprises and evaluate the key socio-economic factors influencing them.

Materials and Methods

Study area

This study was carried out in Lower Nyando (Fig 1) located in the plains of Lake Victoria, in Kisumu and Kericho Counties. The area receives bimodal rainfall ranging from 1100mm to 1600mm; maximum and minimum temperatures from19-27°C and 5-12°C respectively (Raburu & Kwena, 2012).
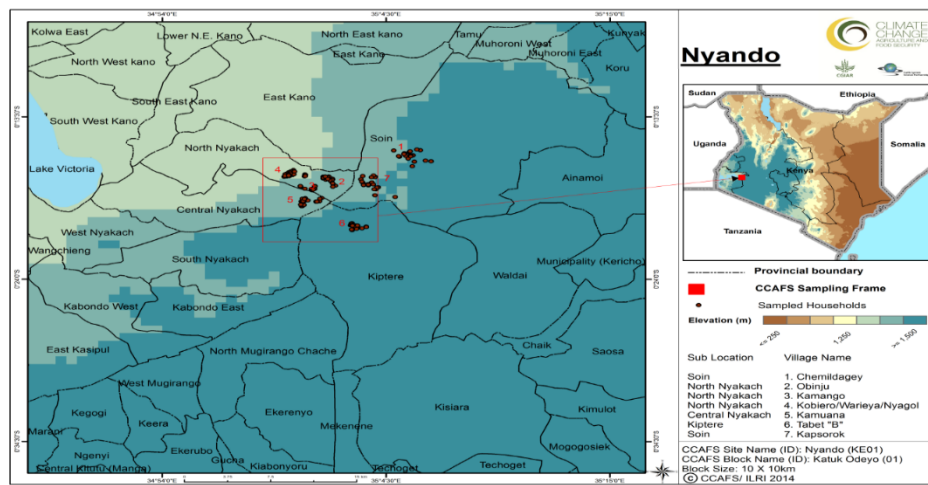

*Figure 1:Map of Nyando showing Study sites Source***: (Mango *et al.*, 2011)

Household sampling and data collection

We conducted a cross-sectional survey of the communities in the CCAFS areas where climate smart agricultural practices were being implemented in communities grouped as "climate smart villages" in 2018. All the 162 households involved in the sheep and goat improvement program participated in the survey.

A detailed questionnaire was used to obtain information from the farmers through enumerators engaged by the CCAFS project. The data were collected using the "Open Data Kit" (ODK) information technology platform (https://opendatakit.org/). Information was obtained from either the head of the household, spouse or a household member above 18 years of age. The questionnaire

captured information on farmer demographic characteristics, resource endowment, flock dynamics, revenues from various animal categories and socio-economic factors affecting revenues in small ruminant production. Information from households was verified at the community level through joint focus group discussions (FGD).

Data analysis

Analysis to characterize sheep and goat production systems was carried out using the statistical package of STATA (Acock, 2005). The analyses entailed generating descriptive statistics on farmer demographic characteristics and key resources available for sheep and goat productivity; sheep and goat flock characteristics and the dynamics in the flocks owed. The impact of different socio-economic factors within the systems on the revenues from the production of small ruminants was evaluated using a regression model incorporating effects of gender and education level of the household head, and the land and flock sizes.

Results

Characteristics of farmers in Nyando

The demographic characteristics of the sampled households are presented in Table 1. There were more household headed by men in both Counties with the ratio of male: female household heads differing significantly (P<0.01) between the Counties (Table 1). Majority of the families (68.7%) were headed by people older than 45 years with the average household size being 4.9±1.7 in Kericho and 4.1±2.3 in Kisumu. The education levels achieved by household heads were higher in Kisumu than in Kericho County (P<0.01), with a greater proportion having at least secondary education. The integration of crops, livestock and poultry production was the core economic activity for the household heads in the two Counties (Table 1). Off-farm activities such as non-agricultural formal employment and business activities served as an alternative economic activity.

Table 1 : Demographic characteristics of households in Kericho and Kisumu

County	Kericho (N=77)		Kisumu (N=85)	
Gender of household head	**Female**	**Male**	**Female**	**Male**
Proportion of households (%)	11.7%	88.3%	37.6%	62.4%
Age group of the household head (%)	**Proportion within gender groups**			
Elder (>45 years)	66.7%	54.4%	78.1%	75.5%
Middle aged adult (21-45 years)	33.3%	45.6%	21.9%	24.5%
Education level of the household head (%)				
Non-formal education	77.8%	32.4%	31.3%	1.9%
Primary and Secondary education	22.2%	54.4%	65.6%	79.2%
Tertiary Education	0.0%	13.2%	3.1%	18.9%
Economic activities of the household head (%)				
Agriculture (Crop, Livestock and Poultry)	88.9%	97.1%	93.8%	73.6%
Alternative activities	11.1%	2.9%	6.2%	26.4%

Land and flock ownership

Sheep and goat flock sizes owned by the farmers owning different sizes of land are presented in Table 2. The land holdings were significantly larger in Kericho with an average size of 2.2±0.2 ha than in Kisumu 1.9±1.7 ha (P<0.01). There was also a greater proportion of farmers (28%) with land holdings larger than 2 ha in Kericho than in Kisumu (3%) (Table 2).

Table 2:Average flock size by the size of the land holding in Kericho and Kisumu

	KERICHO		KISUMU	
Size of land holding	Proportion of households (N=77)	Average of flock size	Proportion of households (N=85)	Average of flock size
<1 ha	3.2%	7.0±1.0	41.7%	15.0±1.0
1-2 ha	68.8%	16.0±1.0	55.3%	28.0±2.0
>2 ha	28.0%	28.0±1.0	3.0%	18.0±1.0

The number of sheep and goats owned increased relative to the size of the land holding in both counties. More farmers (53.5%) owned more than 10 animals in Kericho than Kisumu (49.3%). The number of animals owned by the farmers in the two counties was higher than that reported for the same farmers in 2015 by Ojango *et al*., (2016).

Flock dynamics

The sheep and goat flock sizes in Nyando expanded and contracted during specific periods of the year through the natural process of birth of young animals or when animals were either sold or died. Over twelve months (November 2017- October 2018), the farmers reported a total of 79 and 169 new animals in their flocks in Kericho and Kisumu respectively. Most new animals were born into the flocks, 87% and 99% in Kericho and Kisumu respectively, while 13% and 1% of the animals were either bought or received as gifts by the farmers in the two counties respectively.

In the FGD, farmers mapped the main breeding and lambing/kidding seasons for their sheep and goats as illustrated in Figure 2. A higher proportion of farmers (60%) reported the birth of young animals in the drier months of December-January, March, July and August in Kericho, while in Kisumu the main season of birth was from March to June.
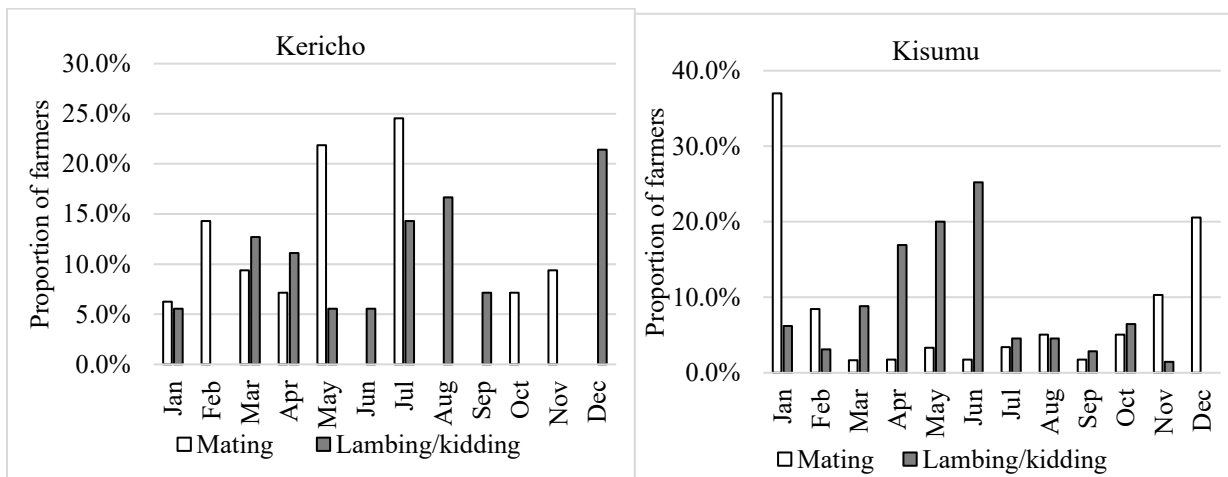

Figure 2: Mating and lambing/kidding season for small ruminants in Kericho and Kisumu

The primary modes of outflow of animals from the flocks in both Counties was through sales of live animals (90.0%) followed by deaths (7.7%). Monthly sales for sheep and goats in the two Counties in 2018 as mapped by the farmers in the FGD are illustrated in Figure 3.
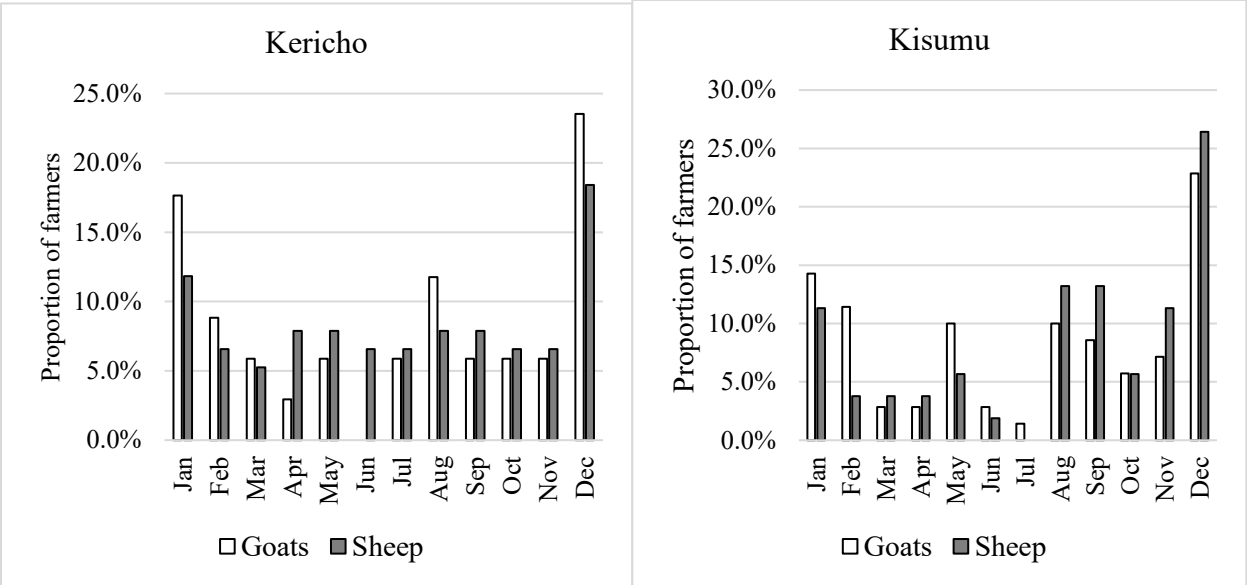
Figure 3: The proportional distribution of sheep and goats sold by farmers in Nyando over 12 months in 2018

In both counties, sales of animals were highest in the month of December-January, coinciding with the festive season of Christmas and the beginning of the new school year in January. The farmers noted that these were times when demands for cash were highest in their households. It was however noted in the FGD that the best prices for animals were obtained in the months of April and December.

Revenues from small ruminant production

The proportion of animals of different age categories sold by the farmers in 2018, their average sales price and revenues per animal in Kericho and Kisumu Counties are presented in Table 3 and 4.

Table 3:Proportion of animals sold, the average price per animal and total revenues segregated by species in Kericho

	KERICHO					
	Proportion of all Sheep sold (N=8)	Average price/ Sheep (Ksh)	Total revenues /Sheep sold (Ksh)	Proportion of all Goats sold (N=61)	Average price/goat (Ksh)	Total revenues /goats sold (Ksh)
Mature females	0.0%	4,000.0		42.6%	7,000.0	182,000.0
Immature females	0.0%	3,500.0		9.8%	4,000.0	24,000.0
Castrates	37.5%	8,000.0	24,000.0	11.5%	20,000.0	140,000.0
Immature males	62.5%	3,000.0	15,000.0	0.0%	8,000.0	0.0
Mature males	0.0%	7,000.0		29.5%	15,000.0	270,000.0
Lambs/kids	0.0%	2,000.0		6.6%	3,000.0	12,000.0
Sub-Total revenue			**39,000.0**			**628,000.0**
Total revenues						**667,000.0**

Table 4: Proportion of animals sold, the average price per animal and total revenues segregated by species in Kisumu

	KISUMU					
	Proportion of all Sheep sold (N=16)	Average price/ Sheep (Ksh)	Total revenues /sheep sold (Ksh)	Proportion of all Goats sold (N=60)	Average price/ Goat (Ksh)	Total revenues /goat sold (Ksh)
Mature females	43.8%	5,000.0	35,000.0	40.0%	6,000.0	144,000.0
Immature females	6.3%	3,500.0	3,500.0	13.3%	4,500.0	36,000.0
Castrates	0.0%	7,000.0	0.0	3.3%	5,000.0	10,000.0
Immature males	31.3%	4,000.0	20,000.0	13.3%	4,500.0	36,000.0
Mature males	18.8%	7,500.0	22,500.0	30.0%	8,000.0	144,000.0
Lambs/kids	0.0%	2,500.0	0.0	0.0%	3,000.0	0.0
Sub-Total revenue			**81,000.0**			**370,000.0**
Total revenues						**451,000.0**

1 USD≈100Ksh

In Kericho, 74% of the animals sold were female animals, while in Kisumu 58% were male animals. The prices were higher for larger mature animals than for young animals. Concurrently, male animals attracted higher market prices than the female animals (Tables 3&4). Better prices were also offered for castrates and mature male animals. During the FGD, farmers stated that they rarely sold lambs and kids although, if the need arose and the mother was the only available animal for sale while the kid/ lamb was un-weaned, they would have to sell the kid/lamb with the mother at a low cost.

Goats fetched better prices than sheep and contributed to most of the revenues earned from small ruminant production in both Counties. Lower revenues were accrued from sheep in Kericho (6%) than in Kisumu (18%).

Impact of socio-economic factors on returns of small ruminants in Nyando

The impact of the household socio-economic factors on revenues from sheep and goats combined reflected through the regression analyses are presented in Table 5. Education level of the household head and the type of small ruminant kept (sheep or goat) significantly affected returns from the enterprise in Kericho and Kisumu. Revenues from goats were also higher than those from sheep in both counties.

The gender of the household head, their level of education and small ruminant species kept contributed to a significant proportion of the variation in revenues as other variables fitted in the model though not significantly improved the R^2. The goodness to fit for the model was 0.35 and 0.41 for Kericho and Kisumu respectively.

Table 5: Socioeconomic factors affecting revenues from small ruminants in Nyando

Fixed effects	Kericho		Kisumu	
	df	Prob>F	df	Prob>F
Gender of the hh	1	***	1	***
Level of education of hh	2	***	2	***
Size of land holding owned	2	ns	2	ns
Species type	1	***	1	***
Flock size	3	ns	3	ns

Discussion

Demographic characteristics of the farmers have not changed since last reported by Ojango et al. (2016). Most of the households were headed by men. Agriculture comprising crop, livestock and poultry farming formed the main economic activity for farmers in Nyando as also reported as the main means of livelihood to farmers in developing countries by Mozumdar, (2012). Farmers with non-formal education earned more revenues because they tended to sell more animals from their flocks.

There was a 40% increase in the number of sheep and goats in flocks of the smallholder farmers o Nyando compared to the numbers reported in the same area in 2015 by Ojango et al. (2015). Despite the larger flock sizes, the livestock keepers did not have any specific optimum flock size for their land holdings.

The flocks mainly increased in number through reproduction of the animals on the farms. Studies form rural smallholder farmers in Ethiopia also reported animal births and sales to be the main source of flock inflows and outflows respectively (Talore et al. 2018 , Tadesse et al. 2014). The farmers in Nyando did not have any specific breeding and selling season but depended on the random reproduction within their flocks. This could result in a lower survival rate of young animals born during dry seasons of the year when feed resources are scarce. Other studies have reported

the season of birth to be a key factor influencing mortalities in kids and lambs (Ahmed et al. 2010; Sharif & Al-Ani, 2005). The sale of animals in Nyando was determined by the financial needs of the households rather than the market demand and price. Through the FGD, highest market prices were reported to occur during the Easter and Christmas celebrations. Legesse *et al*., (2007) in a study on marketing practices for small ruminants in Ethiopia also reported peak sale times for sheep and goats during the festive seasons. As indicated in the study on the markets in Nyando by Muigai et al.,(2019), interventions to help improve the incomes from sheep and goats for the farmers should emphasize the need to manage reproduction and feeding of their animals in order to have animals in good condition for the peak marketing seasons.

The increased availability of animals for sale in Nyando meant that farmers seeking to improve their flocks could to choose from more animals and negotiate the prices. If the farmers could manage the reproductive cycle of their animals in order to rear and avail more animals for sale at the beginning of the dry season, they would be able to sell animals in good condition and receive higher revenues.

The price of animals sold in Nyando depended on age, sex and body weight of the animal, and, the season. Though it would be desirable to retain their female animals for breeding, the farmers sold them if there was no other animal ready for sale at the time of need. The practice of selling more female animals from the flocks was also reported in the earlier study by Ojango et al., 2015. It is however important to determine the minimum viable breeding population that the farmers need to retain in order to economically produce sheep and goats as part of their farming enterprise.

Conclusion

Small ruminants play an important role in the economy of smallholders in Nyando. However, lack of proper management practices and information on market trends has led to suboptimal returns. Farmers should aim at selling their animals when prices are better in the months of April and December. In preparation for marketing the farmers should strive to attain good growth rates in order to increase their returns. There is great need for smallholder farmers to have an optimal breeding plan for their sheep and goat population. The farmers also need to know the optimal flock size that they should keep based on their resource endowment as this would enable them to better manage their environment and accrue benefits from their sheep and goat enterprises.

Acknowledgement

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