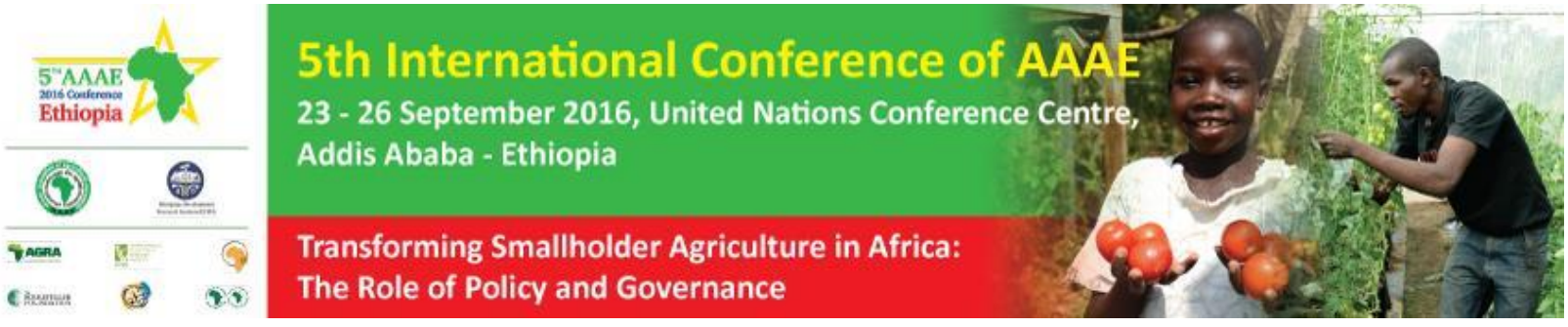

An economic analysis of grain legumes profitability in Nandi County, Kenya

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Invited paper presented at the 5th International Conference of the African Association of Agricultural Economists, September 23-26, 2016, Addis Ababa, Ethiopia

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A Contributed Paper Submitted for Oral Presentation at the African Association for Agricultural Economists (AAAE) Conference in Addis Ababa, Ethiopia
September 23rd – 26th, 2016

Abstract

Grain legumes have great potential for improving smallholder farmers' productivity in Sub-Saharan Africa (SSA) though their potential has not been fully exploited due to critical problems including high insect pests and disease infestation. As part of the process of addressing these challenges, the Collaborative Crop Research Program (CCRP) of the McKnight Foundation in collaboration with Cornell University and Kenya Agricultural and Livestock Research Organization (KALRO) recently introduced crop and soil enhancing strategies in Western Kenya. One of the strategies introduced included use of multipurpose grain legumes species in Nandi County (*Koibem*, *Kapkerer* and *Kiptaruswo* sites). Through this initiative, various legume species including common bean, cowpea, groundnuts, *lablab* and soybean of different varieties are being promoted at the farm level. However, no empirical study has assessed the economic benefits that farmers are likely to obtain if they adopt the legume species. In order to address the aforementioned knowledge gap, the present study sought to evaluate economic profitability from the production of grain legumes. Gross margins and profits were computed from farm-level data gathered from a random sample of 163 legume farmers in the above CCRP sites. Results showed that grain legumes species differed in terms of their gross margins; beans, groundnuts, cowpeas and soybean had positive gross margins while *lablab* had a negative gross margin. Further, the farm-area under grain legumes, age of the farmer, access to extension services and access to credit had significant influence on the amount of gross margin obtained by a farmer. The results point to the need for recruitment of more extension staff at local levels to enhance extension service delivery. Also, there is need for the county government to promote credit awareness and establish credit associations, which can boost farmers' access to credit.

Keywords: Legumes, gross margins, profitability, Kenya.

1.0 Introduction and the Research Problem

Grain legumes play important roles in smallholder farmers' livelihood. From a producer's point of view, integration of legumes in the farm enhances soil fertility and broadens the amount and stability of household income streams (Mhango, 2011). Additionally, on the consumption side, legumes are the cheapest source of protein in a vegetarian's diet and supplement mineral and vitamin requirements (Joshi et al., 2000). However, grain legume production in SSA (Kenya included) is very low due to poor soil fertility, and incidences of pest and diseases (Odendo et al. 2006). Kosura (2013), in the Africa agriculture status report, states that the yields of grain legumes in much of Africa are low (typically less than 1 ton/ ha^{-1}) despite their economic and food security importance. Mutegi and Zingore (2014) noted that the average grain legumes yields have stagnated to about 0.7 ton ha^{-1} against 3 tons ha^{-1} resulting into increased food insecurity in most parts of SSA. The situation is excabated by inadequate access to farm support services and insufficient attention by researchers to multi-functionality of legumes (Kerr et al., 2007). In 2008, the CCRP introduced a grain legumes promotion programme aimed at addressing soil fertility degradation and declining productivity in Western Kenya especially in Nandi County. For such initiatives to succeed, the beneficiaries must fully contextualize the technologies within their farming systems and resource limits, accept and own them, especially when they are introduced by external organizations. However, no empirical study has examined farmers' opinions on the suitability of the legumes introduced and how easy/difficult they find the adoption process.

Previous studies on grain legumes have focused on agronomic issues such as effects to soil fertility and yield improvement by breeding (Mburu, 2004; Macharia et al., 2011). However, agronomic results alone do not provide complete picture when assessing a given technology (Onyango, 2010). More insights from economic analysis and understanding of farmer perceptions are essential to enable comprehensive evaluation of technologies (Odendo et al., 2006). Also, other aspects concerning legumes such as farmers' production objectives, markets and consumer preferences are also of importance (Ojiem et al., 2006). It is against the aforementioned background that the present study sought to assess economic profitability of grain legume species and investigate factors that explain the level of profits generated from the grain legumes.

2.0 Methodology

2.1 Sampling and Data Collection

The study was undertaken in Nandi county located in the Rift Valley region of Kenya. It occupies a total area of 2884.5 square kilometers, with arable land of 206,959 hectares. Temperatures range from 15^0C to 26^0C and rainfall of between 1200mm and 2000mm per annum. Nandi county has two rainy seasons; the long rains between March and June and the short rains between October and early December and the dry spell usually experienced from end December to March. Climate change, however is gradually beginning to take toll in the county. Signs of this include floods, unusually heavy rainfall with hailstones, rise in temperature, and

change in rainfall patterns among others (Nandi County Integrated Development Plan 2013–2017). With an estimated population of about 753,000 (2009 National Census), the area is mainly characterized by subsistence agriculture and livestock rearing (Nandi County Integrated Development Plan 2013–2017). The main staple food is maize and beans and in addition they also consume finger millet, sorghum, sweet potatoes, bananas and vegetables while the key cash crops are tea, sugarcane and coffee.

Household survey data was collected through face-to-face interviews during the long rain season in 2015. Face-to-face interviews guarantee high response rates besides enabling clarification of survey questions in interviews (Bennett and Birol, 2010). Semi-structured questionnaires used in the survey captured information on input costs, yields per acre, market price and data on socioeconomic characteristics. Selection of the study sites was purposive; focusing on sites where the CCRP activities were being implemented considering the level of soil fertility. The three study sites included: Kiptaruswo (medium fertility site), Kapkerer (low fertility) and Koibem (high fertility site). A list of farmers growing grain legumes and had participated in the CCRP was made. A random sample of 163 farmers were chosen through probability proportionate to size sampling technique.

2.2 Empirical Model Estimation

Gross margin analysis and multiple regression model (Gujarati, 2003 pp 257-258) were used in the analysis. Gross margin was used as a proxy for grain legume species profitability. In analyzing farm profitability, gross margin has been suggested as the best method due to its simplicity and accuracy (Ahmad, 2004). It serves as the unit of analysis in evaluating the economic performance of an enterprise and gives an indicator of the feasibility of an enterprise and its potential contributing to household income (Masvongo et al., 2013). Gross margins are usually computed per year or per cropping season (Zulu, 2011). The gross margins were computed as the difference between total revenues and total variable costs. The subsequent step involved multiple regression estimation to investigate possible determinants of the gross margins. Data was analyzed using the STATA version 13 software. Results from the analysis are presented in the next section.

3.0 Results and Discussion

3.1 Descriptive Measures

Table 1 presents the descriptive statistics of the variables used in this paper. The average age of the farmers interviewed was 49 years similar to the findings by Samboko (2011). Zulu (2011) further states that older farmers have more experience and hence they may obtain higher yields compared to farmers with fewer years of experience thus have higher gross margin and hence more profitable. Nearly three-quarters of the households are headed by men. The study further shows that the mean land size owned was 2.1 acres with area under grain legumes covering approximately only 0.1 acres. Land ownership influences agriculture productivity, hence profitability, since farmers who do not own land can be unwilling to develop and maintain the

land (Randela, et al. 2000). The small land holding is attributed to intense population pressure in the region (Conelly and Chaiken, 2000). This therefore results in small sizes of land devoted to farming. On average, two-thirds of farmers were members of farmer groups. Involvement of farmers in farmer groups can be attributed to benefits such as easy access to credit. Ngugi et al. (2007) found that farmers who were organized into groups earned greater income compared to those who did not. Distance to the main market was used as a proxy for access to input and output market for grain legumes. Closer markets reduce transportation costs and tracking time, hence motivate the farmers to improve production (Masuku and Xaba, 2013).

Table 1: Sample Characteristics for Grain Legume Farmers in Nandi County, Kenya

	Mean	**Std deviation**
Socio-economic factors		
Age of farmer (years)	49.88	11.22
Formal education of farmer (years completed)	9.07	3.60
Farming experience (years)	20.82	11.90
Average household size	6.73	2.58
Land size owned (acres)	2.14	1.45
Distance to the input and output market (Km)	5.06	3.79
Area under grain legumes (acres)	0.20	0.12
Gender (% male-headed households)	72.40	
Institutional and Policy factors		
Group membership (% households)	56.60	
Access to credit (% households)	65.60	
Extension contact over the last 12 months (% households)	53.30	

Source: Computed from survey data (2015).

3.2 Comparison of Gross Margins from Various Legumes

The results of the gross margin analysis for the grain legumes species evaluated are shown in Table 2. The results of the study showed that beans was the most grown grain legume while cowpeas was the least grown. About 56 percent of farmers had positive gross margins while the rest reported losses from the production of grain legumes. Out of five species of grain legumes studied, four had positive gross margins and one had negative gross margins. On average, beans had the highest gross margins while lablab had the least. High gross margins for beans can be attributed to high utilization of inputs such as fertilizer and manure during production. However, negative gross margins in *lablab* can be attributed to intensive labor needed in its production since not only its grains are utilized as food but its leaves are also majorly utilized as vegetables

in the area. The findings in this study on the average gross margins are similar to those in other studies (see for example, Mogendi, 2010; Samboko, 2011; Zulu, 2011) that generally showed that production of grain legumes was a viable smallholder farm enterprise.

Table 2: Comparison of Legume Gross Margins

Variable	Beans (n=124)	Groundnuts (n=56)	Soybeans (n=43)	Cowpeas (n=16)	Lablab (n=25)
Ave. total earnings/acre	**34,562**	**44,550**	**22,446**	**17,002**	**20,589**
Average labor cost/acre	11,927	22,468	17,110	6,653	16,410
Average fertilizer cost/acre	2,524	2,023	1,374	546	2,241
Average seed cost/acre	2,575	6,448	2,294	4,489	3,773
Average pesticide cost/acre	713	71	0	0	68
Ave. production cost/acre	**17,739**	**31,010**	**20,778**	**11,688**	**22,492**
Ave. gross margin/acre	**16,823**	**13,540**	**1,668**	**5,313**	**-1,903**

Note: the averages are in Kenyan Shillings. For ease, land size was measured in acres rather than the usual hectares due to small land sizes owned in the area.

3.3 Determinants of profitability

Results in Table 3 indicate that area under grain legumes and access to credit was significant in explaining gross margins at 1 percent level. Age and access to extension services were also significant at 10 percent level. The negative relationship between area under grain legumes and gross margin in this study is consistent with Hazell et al. (2010) findings that large farms have a tendency to yield low returns per hectare of land compared to small farms. This could be attributed to the fact that increasing area under grain legumes must be accompanied by increase in production costs since more inputs are needed. However, age was positively related to gross margin, which is consistent with the findings of Ugwumba (2010), which indicated that higher age among farmers had a positive impact on profitability of the farms. In contrast, the results by Mishra et al. (1999) and Muhammad-Laval et al. (2012), showed that higher age among farmers had a negative impact on profitability of the farms. The coefficient of access to credit was significant ($p < 0.01$) and positively related to profitability. This is plausible and accords with the observations og Fischer and Qaim (2012). The results further suggest that access to extension services increased the gross margins. This could be attributed to farmers with access to extension services receiving trainings on best practices on crop production, hence improving their skills about the crop.

Table 3: Determinants of Legume Gross Margins

	Coefficient	Std error	p-value
Socio-economic variables			
Constant	14.19	1.4959	0.000***
Ln area under grain legume	-0.6373	0.1502	0.000***
Age of farmer (years)	0.03526	0.0199	0.079*
Household size	-0.0078	0.0852	0.362
Gender	-0.2226	0.5059	0.661
Formal education of farmer (years completed)	-0.7217	0.0666	0.280
Distance to the input and output market for grain legume	-0.0254	0.0584	00.664
Institutional and policy variables			
Credit access	2.913	0.4449	0.000***
Extension contact	0.7998	0.4591	0.084*
Group membership	0.1789	0.4693	0.704

Note: Dependent variable is logarithm of gross margin; N = 161; R-squared =37%; F (9,151) = 9.87; Prob > F=0.000.
Statistical significance levels: *10%, **5% and *** 1%, respectively.
Source: Computed from survey data (2015).

4.0 Conclusion and Policy Implications

This study has examined profitability of grain legumes and factors influencing profitability. It was noted that four out of the five legumes studied were profitable. The results point to the need for recruitment of more extension staff at all levels closer to farmers such as at sub county levels for effective extension delivery and involvement of non-government organizations (NGO) to increase access of extension services to farmers. Also, there is need for the County government to promote credit awareness and establish credit associations which can play a major role in increasing small farmers' access to credit. It would be beneficial to increase effort in the development of markets for grain legumes. Value addition of grain legumes should also be considered. For instance, soybean is rich in proteins; hence it can be used to make porridge flour. Grain legumes such as cowpeas can also be processed into other forms that would make it more attractive and palatable too much of the population, however this would require more research. Therefore there is an urgent need for research on various aspects of grain legumes such as consumer preferences.

Acknowledgements
We are very grateful to the McKnight Foundation for funding data collection for this paper.

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