

Factors affecting the adoption of bambara nut as a food security crop among sugarcane farmers in Kakamega County, Kenya

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ABSTRACT

Bambara groundnut (*Vigna subterranean*) is referred to as an “underutilized” crop species. Within sugar cane farming communities, bambara ground nut played an important role as a protein source as its protein content (16 to 25%) is comparable, and in some instances, superior to other established legumes, making it a good complement for cereal-based diets. As a legume, bambara groundnut also replenishes nitrogen in the soil through nitrogen fixation, an ability that may be of importance to resource-constrained farmers who may otherwise not be able to afford inorganic nitrogen fertilizers. It is an important crop to incorporate in rotations with cereal crops. The crop is predominantly grown in Kakamega County, Kenya where a larger population of farmers depend on sugarcane as their cash crop. This study examined the socio-economic and institutional factors that influence these cane farmers’ adoption of bambara nut as food security crop. Information was collected from 384 respondents in 2014 and analyzed by Statistical package for social scientists program, version 16. Study findings revealed that sugar cane smallholder farmers’ place of residence (sub-county), age, gender, labour, credit, income and group membership significantly influenced their decisions to adopt bambara nut growing as a nutritional and food security crop at household level. However, sugarcane smallholder farmers’ level of education, land size, marketing and extension service delivery did not significantly influence farmers’ decision to adopt bambara nut growing as a crop that can reduce the hidden hunger of food insecurity at household level in Kakamega County, Kenya. In order for smallholder sugarcane farmers to benefit from this immense potential there is need for deliberate effort by County governments and various interested support agricultural groups to assist in formulating policies and implementing research programmes towards promotion and commercialisation of this crop among smallholder farmers. This would lead to increased smallholder sugar cane farmer’s growing of bambara nut and thus, assist in the fight against hidden hunger and food insecurity at household level among rural poor households in Kakamega County, Kenya.

Keywords: Bambara nut, smallholder, innovation, underutilized crop.

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INTRODUCTION

Bambara nut *Vigna subterranea* (L.) is a neglected “underutilized” crop species in Kenya (Berchie, 2009). The crop has the following growing advantages over other legumes; requires low capital input, fixes nitrogen in the soil, drought tolerant, has a short growing period and crop can give high yields even in less fertile soils. When cooked, bambara nuts can be served as a complete meal as the nuts contain a balanced diet (Baudoin et al.,

2001). Despite being a popular traditional food crop among the smallholder sugarcane farmers who contribute up to 90% of the sugar produced in the country, the amount of bambara nut produced at farm level remain comparatively low (Onyango, 2010; Andika et al., 2010). Hence, understanding factors that influence adoption among smallholder sugarcane farmers ‘will contribute to making bambara nut play a greater role in increasing its

productivity particularly among smallholder sugar cane farmers. Indeed this would ensure nutritional sufficiency and reduce problem of food in security at household level to the most vulnerable members the community in the County (KARI, 2015; Korir et al., 2011; Onyango, 2010).

According to Rogers (2003), adoption of innovations is a sequential process of decision making and occurs in five stages namely: awareness, interest, evaluation, trial and final adoption. This process of adoption among adopters is influenced by a number of factors that include: social, economic, institutional and cultural. Studies indicate that institutional factors that affect farmer adoption of technological innovations include: accessibility to extension services credit facilities and market-availability and distance (Feder et al., 1985). Indeed smallholder sugarcane farmers who have frequent contacts with either company or county extension agents and/or those who are members of community social groups, usually have higher adoption rates than those with fewer or no contacts with extension staff (Wambugu and Mutisya, 2007; Hugo De Groote et al., 2005; Suri, 2005; Jackson et al., 2002). Thus exposure to institutional factors is known to reduce smallholder sugar cane farmers' subjective uncertainty and thus increases likelihood of adoption of new technological innovations (Salasya et al., 2005; Hugo De Groote et al., 2005).

Adoption studies are important and can be utilized to assess impacts of agricultural research and provide information for policy reform (Olwade et al., 2000). According to Feder et al. (1985), adoption is the degree to long term utilization of a new technology, when smallholder sugarcane farmers have complete information on the potential of the technology. Thus, it refers to farmers' full-scale acceptance and integration of the technology. On the other hand, aggregate adoption is defined as the process of diffusion of a new technology within a given geographical region. Factors affecting adoption differ across countries and are specific to a given region (Ariga et al., 2008; Reed, 2007). This study therefore, underscored the need to determine factors that determine adoption bambara nut growing for increased its house productivity that would lead to reduction in cases of food insecurity at household level among smallholder sugarcane farmers in Kakamega County, Kenya.

Despite the wealth of information available on adoption studies in Kenya, there was a paucity of information on factors that influence smallholder sugarcane farmers' adoption of bambara nut as food security crop at household level in Kakamega County. Thus most adoption studies in Kenya have centered mostly on farmer utilization of fertilizer and hybrid seeds in the growing systems of major food crops. An understanding of smallholder sugar cane farmer's factors that affect the adoption of underutilized food crops species particularly Bambara nut could assist to unlock the immense

potential the crop has as a food security crop at household level.

The general objective of the study was asses the socio-economic characteristics of the smallholder sugarcane farmers and evaluate the factors determining their adoption of bambara nut growing as crop that reduce disaster risk of food insecurity and increase income household level in Kakamega County. This would assist to reduce disaster risk of hidden hunger and alleviate poverty at household level in the Kakamega County. The information from this study would be important to: extension workers, policy makers, researchers and stakeholders involved in the promotion of bambara nut and other indigenous crop species in disaster reduction of risk of food insecurity at household level rural in Kakamega County.

MATERIALS AND METHODS

The selection of study site was purposive sampling based on the fact that Bambara growing in Kenya has been limited to sugarcane growing Counties in Western and to a lesser extent, Coast and Nyanza regions (Onyango, 2010). Indeed this is a region where sugarcane is grown by small scale sugarcane farmers since it started growing in Kenya in the early 1900's when it was introduced around Lake Victoria by the Indian labourers engaged in the construction of the Uganda Railway, Kakamega County in Western Kenya, is one of the most densely populated Counties after Nairobi and sugarcane is a major cash crop. It has high poverty levels (48%) and incidences of food insecurity amongst its population are equally high (Onyango, 2010). Thus County in located in the Western Kenya sugar belt whose geographical coordinates are longitudes 34° 45' 0" E and latitudes 0° 17' 0" N of the equator. The County lies within altitude 1250 to 2000 m above sea level, with an average annual rainfall ranging from 1250 to 1750 mm per annum. The average temperature is ideal for both bambara nut and sugar cane growing. The target population in this study comprised of small-scale smallholder sugarcane farmers. Survey research designs were used in this study to generate both qualitative and quantitative data. Purposive sampling technique was used to select the four sugar cane growing Sub-counties which produced high amounts Bambara nuts in the County the previous year. For purposes of accomplishing the objectives of the study, both primary and secondary sources information were used in data collection. Primary data used were collected through structured questionnaire, interview schedule backed with focused group discussion in some cases.

Lists of accessible smallholder sugar cane farmers were generated by the researcher, with assistance of agriculture extension officers at each of the four sugar growing Sub-counties. Then proportionate sampling technique was used to spread the 384 smallholder farmers within these four sugar growing Sub-counties. This was spread as a ratio of: 131 respondents from Kakamega North Sub-county, 127 respondents from Butere Sub-county and 94 and 32 respondents Matungu and Mumias Sub-counties respectively as based on the accessible population. Secondary data from the County Ministry of Agriculture Livestock and Fisheries was used to arrive at the following sugar growing Sub counties: Kakamega North, Mumias Matungu and Butere. Interview schedule was used to gather additional data.

The data was subjected to an SPSS (Statistical Package for Social Scientists, version 16) an analytical spread sheet program. During data analysis, a multiple linear regression model which had only two types of variables thus, independent and dependent

variables were used. These variables (factors) were fitted into a model to ascertain how vectors of the eleven independent variables could relate to the dependent variable (adoption/growing) of Bambara nut as a food security crop at household level in Kakamega County amongst smallholder sugarcane farmers. The Multiple Linear regression:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 \dots b_{11}X_{11} + \text{Error}$$

Where Y = Adoption took Yes if a farmer had adopted or No if farmer does not adopt and a = constant ; $b_1, b_2, b_3, b_4, \dots, b_{11}$ = Beta coefficients representing the relative impact on the predictor variable by each of the eleven independent variables, X1 = Sub-County, X2 = Gender, X3 = Education X4 = Age, X5 = Landsize, X6 = Income, X7 = Labour, X8 = Social Group, X9 = Market, X10 = Extension Service and X11 = Credit.

Based on available literature, these eleven variables were: sub-county, age, gender, farm size, level of education, group membership, on-farm income, labour, access to credit, market and extension services (Rogers, 1985).

RESULTS AND DISCUSSION

Farmer's demographic characteristics

Analyzed results from the four sugar growing sub-Counties showed that the number of respondents in Kakamega North Sub-county was the highest 131 (34.1%). Butere sub-county had 127 (33%) respondents. But Matungu and Mumias Sub-counties had the least number of respondents 95 (25%) and 32 (8.3%) respectively (Figure 1).

Majority of these respondents 54.5% (211) were females while 45.5% (173) were males. These results showed that over (366) 94.3% of the study population had received basic (primary) education and above while only (18) 5.3% of the respondent had not received any basic education. In terms of age, analyzed results revealed that (248) 64.6% of the respondents were in the age set of 31 to 50 years but there were variations among sub counties in this age bracket. In terms of income, analyzed results showed that over (320) 83.3% of the respondents were low income earners (less than Kshs 100, 000 annually). However, there were differences smallholder sugarcane farmers' incomes in and with the sub-counties, for instance, Kakamega North and Matungu Sub counties had higher incidences of respondents who were low income earners 70.54 and 73.5% respectively as compared to Mumias and Butere Sub-counties who had low cases of respondents who were low income earners (16) 50% and (26) 20% respectively of respondents who had low levels of income. Majority (349) 90.9% of respondents had their land sizes measuring less than 5.0 acres. However, only 9% of the respondents had their land sizes above 5.1 acres. Their average family sizes ranged between 5 and 8 persons. Majority (303) 79.0% had labour problems and depended majorly on family members (children and wife) as the source of farm labour.

From Table 1, four factors namely: level of education, land size, marketing and extension service delivery were not statistically significant ($p > 0.05$) in determining smallholder sugarcane farmers' adoption of bambara nut as a food security crop at household level in Kakamega County. These factors did not seem to significantly affect sugar cane smallholder farmers' decision to adoption of Bambara groundnut growing and utilization as a food security crop at household level crop and hence need not be considered when designing agricultural intervention programs for increased adoption of growing Bambara groundnut as a food security crop at household level.

There was insignificant education level and land size, these results can be explained by that fact there were no great variations in respondents' level of education and land sizes within and between and within the sub-counties of farmers growing sugar cane under study. The volume of bambara nut grown at farm level is too little to warrant proper marketing and there had been no provision of any bambara nut related extension service by any institution either.

Farmer location (sub-county)

However, seven (7) other factors were found to be statistically significant. For instance sub-county of respondent's residence had a coefficient of negative 0.138. This implies that any change in the current sugarcane sub county where bambara nut is grown to its introduction in a new sub-county could result in 13.8 % decrease in level of growing of Bambara groundnut as a food security crop at household level. The findings are similar to those reported by Wasula (2014) who established that the sugar zone in which a farmer belongs, negatively influenced the likelihood of adopting improved cane varieties, where the odds of adopting decreased by 0.62. Farmers in any sugar zone are unlikely to adopt the improved cane varieties probably because of their location.

In the Western region of Kenya, women and children are the ones who work in the farms while the men provide financial support to procure farm inputs.

Gender

On the basis of gender, its coefficient was positive 0.134 meaning with properly packaged Bambara agronomic information, gender could contribute to 13.4% increase in adoption of bambara groundnut growing by smallholder sugar cane farmers in Kakamega a crop that could reduce the hidden hunger and food insecurity at household level. Similar findings were recorded by Oyungi et al. (2015) who found out that there was difference in gender involvement in production activities in bambara nut farming in Mumias and Butere districts of

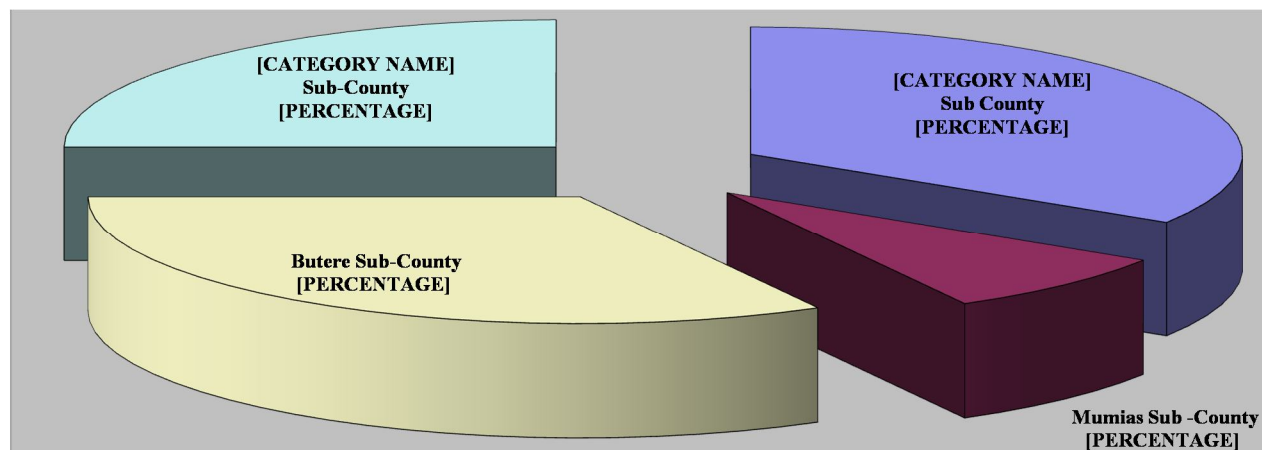


Figure 1. Distribution of smallholder sugarcane farmers per Sub-County in Kakamega County, Kenya. N = 384.

Table 1. Determinants of smallholder sugarcane farmers adoption of Bambara groundnut growing as a food security crop at household level in Kakamega County, Kenya (n = 384).

	Coefficients (beta)	S.E	t-value	P-value
Intercept	.766		4.336	.000
Subcounty	-0.138	0.018	-2.711**	.007
Gender of farmer	0.134	0.045	2.578*	.010
Education level	0.072	0.022	1.463	.144
Farmer's age	-0.115	0.022	-2.191*	.029
Land size	0.055	0.032	1.026	.306
On-farm income	-0.133	0.018	-2.409*	.016
Labour availability	0.213	0.054	4.346**	.000
Social group	0.096	0.016	1.830**	.0068
Marketing problems	-0.008	0.045	-.151	.880
Extension service	0.027	0.046	.487	.626
Credit facilities	0.106	0.056	1.990*	.047

Intercept 0.766, Sample size 384 ($\chi^2_{170, .01} = 50.80$).

Kenya.

Age

Then on the basis of age, its coefficient was negative 0.115. These results showed that any unit increase in age resulted in 11.5% reduction in growing and utilization of bambara groundnut among smallholder sugarcane farmers as a crop that could reduce the disaster risk of food insecurity at household level. Thus as smallholder sugar cane farmers become older, they are less likely able to adopt as they become less energetic and risk averse. Indeed, study results showed that over 64.6% of the respondents across the four sugar growing sub-counties were in the age set of 31 to 50 years. Since there was no much difference in the age bracket among the respondents in the four sugar growing sub-counties,

study results showed that there is no significant association between farmer's age and adoption of Bambara groundnut as a crop that could reduce the disaster risk of food insecurity at household level.

Farm income

Similarly on annual earnings on-farm income the coefficient and t-value of annual farm income were negative 0.133. This inverse relationship implied that a unit increase in annual farm income resulted to 13.0% decrease in adoption decision to Bambara groundnut as a crop that could reduce the disaster risk of food insecurity at household level. Indeed over 83.3% of the respondents in the study area were low income earners (less than Kshs 100,000 annually). These results agree with the findings of Palapala et al. (2016) who found

income to positively influence smallholder sugarcane adoption of Bambara growing Western Kenya.

Accessibility to credit, membership of social groups and labour availability

Accessibility to credit had a coefficient of 0.106 while the t-value was positive 0.990. The positively significant relationship at $p < 0.05$ implies that credit availability could increase the probability of adoption of Bambara groundnut as a crop that could reduce the disaster risk of food insecurity at household level by only 10%. Similarly labour availability and membership in social organizations can also influence adoption of agricultural innovations; study results gave their positive coefficients as 0.213 and 0.96, respectively. This implies that unit increase in labour availability and respondents' membership in social organization could have a 21.3 and 9.65% increased probability of adoption of Bambara groundnut as a crop that could reduce the disaster risk of food insecurity at household level. These results were similar to those recorded by Palapala et al. (2016) who found out that membership in social groups provided the much social need of the smallholder sugar cane farmers can adopt Bambara farming practices and this improves diffusion and facilitates collective approach to problems and solutions. Thus availability of labour increases chances of adoption of a given technology. Indeed, none of the respondents had received bambara nut related credit facilities. Similar results were recorded by Teklewold et al. (2006) who found availability of credit facilities to have positively influenced adoption of poultry technology by relaxing the binding capital constraints that smallholder sugarcane farmers face during initial investments or helps to finance the variable costs associated with growing of improved poultry breeds.

CONCLUSIONS

Among sugarcane farmer's, bambara groundnut is a food crop with a great potential to improve nutrition and boost food security crop at household level and contribute significantly to the general rural economic development. However, smallholders sugarcane farmers' Subcounty of residence, farm income and age were factors that negatively influenced smallholder sugar cane farmers' adoption of Bambara nut growing as a crop that could reduce the disaster risk of food insecurity at household level. But labour, membership to social group, gender, farm size and respondents' access to credit positively influence adoption of Bambara nut growing as a crop that could reduce the disaster risk of food insecurity at household level. Four factors namely: land size, level of education, marketing and provision of extension service did not seem to have any significant influence on smallholder sugar cane farmers' adoption of Bambara nut

growing as a crop that can reduce disaster risk of food insecurity at household level in Kakamega County.

RECOMMENDATIONS

If smallholder sugar cane farmers were to benefit from the immense potential Bambara nut crop has there is need for the Ministry of Agriculture Livestock and Fisheries in Kakamega County together with National government to develop programs and deliberate policies that can address promotion of growing and utilization of bambara nut among sugar cane smallholder farmers as a food security crop at household level. This can be achieved through building on factors that positively increased promote adoption of Bambara growing and reducing or removing factors that negatively influence adoption of the crop and other related "neglected" crop species as a crop that could reduce the disaster risk of food insecurity at household level amongst smallholder sugar cane farmers in Kakamega County and indeed in the sugarcane belt in, Kenya.

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