Asian Journal of Agricultural Extension, Economics & Sociology
4(3): 231-246, 2015; Article no.AJAEES.2015.024
ISSN: 2320-7027

SCIENCEDOMAIN *international*
www.sciencedomain.org

Influence of Gender on Farmers' level of Involvement in Bambara Production Activities in Western Kenya

Millicent Oyugi[1], O. M. J. Nandi[2], David Amudavi[1] and Valerie Palapala[3*]

[1]Egerton University Agriculture Extension, Box 536, Njoro, Kenya.
[2]Department of Social Science Education, Masinde Muliro University, Box 190-50100, Kakamega, Kenya.
[3]Department of Biological Sciences, School of Science, Rongo University College, Box 103-40401 Kenya.

Authors' contributions

This work was carried out in collaboration between all authors. Authors OMJN and VP designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors MO and DA conducted the field study, managed literature searches and data analysis. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2015/13504
Editor(s):
(1) Jamal Alrusheidat, Assistant and Consultant to Director general for Extension Education Director of Extension Education Department, National Centre for Agricultural Research and Extension (NCARE), Amman, Jordan.
Reviewers:
(1) Anonymous, Anand Agricultural University, Gujarat State, India.
(2) Olasimbo Motunrayo Apata, Agric. Economics and Extension Services, Ekiti State University, Nigeria.
(3) Gemechu Shale Ogat, Assistant Professor, Department of Rural Development and Agricultural Extension, Institute of Cooperatives and Development Studies, Ambo University, Ambo, Ethiopia.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=870&id=25&aid=7141

Original Research Article

Received 20th August 2014
Accepted 24th September 2014
Published 8th December 2014

ABSTRACT

Aims: The study was conducted to determine the relationship of gender and farmer's involvement in the production activities of Bambara groundnut, the local crop which is intended for production-for-use.
Study Design: Interview and a questionnaire were administered to 120 farmers in two districts. The districts neighbor each other and do share common ecological attributes and therefore, provided sufficient population for the study.
Place and Duration of Study: The study was conducted in 2009 in Mumias and Butere Districts of

**Corresponding author: E-mail: valeriepalapala@ymail.com;*

Western Kenya.
Methodology: Level of involvement of farmers' in bambara production activities was measured by farmers' participation in land preparation, planting, weeding, pest control, harvesting, drying, threshing and winnowing. A production activities index (P.A.I) was computed.
Results: The findings indicate that the significant relationship between gender and participation of farmers in production activities of Bambara groundnut. The study revealed that a majority of the respondents in Mumias were females while those in Butere were males. However, in general, there were more female than male farmers involved in the production of Bambara groundnut in Mumias and Butere Districts. The overall mean age for the farmers was 43.9 years which is similar for the age representation of rural farmers according to most studies. The farmers in the study area practiced agriculture on an average of ¼ an acre. The highest acreage was found to be approximately 16 and 18 acres for Butere and Mumias respectively. On education level, farmers were found to be literate with 51.7% of the farmers having reached primary level, 39.2% secondary level and 4.2% tertiary level which are in contrast with other studies that have established high illiteracy level of among rural farmers. Results of data analysis revealed that involvement level of female farmers was higher than the male farmers in production activities in the two. For Production Activities Index; female farmers' PAI = 2.7 while male farmers' PAI = 1.9.
Conclusion: Results of data analysis revealed that involvement level of female farmers was higher than the male farmers in production activities in the two Districts with female farmers exhibiting a higher level of involvement. Extension agents should make female farmers their priority in trying to revive production of the crop.

Keywords: Bambara; farmers; gender; production activities index.

1. INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L.) Verdc.) is an indigenous underutilized African legume crop grown mainly by local farmers in the whole of Sub Saharan Africa [1] primarily for its seeds [2]. The crop is usually grown in relatively poor soils, and is found in hot, low-lying regions, often with sandy to loam soils. It can be intercropped with maize, sorghum or millet, and is mainly grown at altitudes of 0 - 1550 m [3]. Ethno-botanical surveys have shown that the crop is not being produced in abundant quantities [4]. Moreover, [4] noted that production of this crop is minimal due to limited research interest and extension agents' preference on conventional food crops. In this study the crop refers to a species of groundnut grown mainly in Butere and Mumias Districts where it is referred to as *Mbande* by the local population.

Bambara groundnut is a highly nutritious crop that plays an important role in the people's diet. The seed contains about 63% carbohydrate, 19% protein and 6.5% oil [5] and is consumed in different forms. It can be prepared in a variety of ways [6-11]. Bambara groundnut seed is contained in pod, which usually develops underground. The pod is harvested by pulling or lifting the plant manually or by using a hoe. Sometimes, a single furrow ox-drawn plough is used. The pod is then washed, dried and shelled or stored in Hessian bags or pots. Traditional technologies are still employed in the shelling of bambara groundnut. These include pounding in mortar with pestle, beating with stick on a flat surface and cracking with a stone on top of another stone or a hard flat surface. In spite of the growing importance of bambara groundnut, research efforts have been concentrated on its agronomy and little attention has been paid to the technologies for its production activities including post-harvest handling and processing operations or gender involvement in production activities.

Generally, agricultural activities at the farm level often appear to be gender tasked. Analysis of gender in agricultural activities is essential for gender mainstreaming at all levels, from the formulation of national legislation and policy, to the planning and monitoring of specific interventions [12]. Gender roles however, are the activities ascribed to men and women on the basis of perceived differences. These roles are highly influenced by expectations based on class, age, ethnicity and religion. For instance, an older man will be expected to play a different role in the society from that of a young man [13]. "Division of labour" is a term used in gender literature to mean the roles and tasks assigned to men and women on the basis of perceived gender characteristics and attributes, instead of ability or skills [14]. The information arrived at from gender analysis is useful in understanding different needs of male and female farmers, the

constraints in their farming activities and their capacity to adopt new technologies [15]. The importance of studying the role of gender in relation to bambara groundnut production activities in a rural district in Kenya is therefore quite consistent with the ongoing thinking regarding the issue of gender consideration in food security issues. Engendering Bambara production activities will provide the critical information required by extension agencies to revive productivity of other underutilized food crops.

Agricultural production activities comprise all those tasks that provide economically for the household and the community, including crop and livestock production, handcraft production, marketing, and wage employment. Study by [16] found a significant relationship between gender and gender involvement in the production activities of crops for purposes of household food security. According to this study, levels of involvement by men were conspicuous in land preparation and nursery raising with respect to many arable crops, whereas, the role of women appeared to relate to activities such as weeding, harvesting, threshing, winnowing and storage of crops. The study found that in some cases men and women shared responsibilities in the activities that they performed in the farm; such responsibilities included application of manure and harvesting. In India for instance, activities such as pesticide dusting, ploughing, sowing, manure and fertilizer application and uprooting of seedlings in rice fields were exclusively performed by men whereas women performed such tasks as weeding, carrying head loads, threshing and winnowing [17]. Hence, there is need to identify driving factors to precisely focus attention on the right client within the production activities system for dissemination of practices and technology to boost crop production. For example [16] revealed that education level, age, farm size and access to extension services influenced farmers' involvement in the production of arable crop in Ogun State of Nigeria, whereas there was no relationship found between gender and marital status, purpose of cultivation and their involvement in arable crop production. To the best of our knowledge, there have been no prior studies on gender involvement in production activities of Bambara groundnut.

In this study production refers to all activities related to cultivation of bambara groundnuts in Butere and Mumias districts. The purpose of this study was to establish gender differences on farmers' involvement in production of Bambara groundnut in Butere and Mumias Districts. The objective was to examine gender differences on farmers' involvement in Bambara production activities in Butere and Mumias Districts. The hypothesis tested was: There is no statistically significant gender difference on farmers' involvement in Bambara production activities in Butere and Mumias Districts.

2. MATERIALS AND METHODS

The study was conducted as previously described by [18] and focused on the role of gender in the revival of Bambara groundnut with respect to level of involvement in the activities related to crop production. It focused specifically on the gender roles of male and female farmers and their level of involvement production of Bambara groundnut. Aspects of production activities investigated included; land preparation activities, planting, weeding, pest control, harvesting, drying activities, threshing and winnowing. The study was conducted in Butere and Mumias districts of western Kenya. The districts neighbor each other and do share common ecological attributes and therefore, provided sufficient population for the study.

2.1 Study Population

The study targeted farmers growing Bambara groundnut in Butere and Mumias Districts. The actual numbers of the farmers was not known though field observations and Ministry of Agriculture staff indicated that the crop was being revived on many farms. Although elderly women are predominant in the production, both male and female farmers were involved in small scale production of the crop for subsistence.

2.2 Sampling Procedure and Sample Size

With the help of field Agricultural officers at the District level, a reconnaissance visit was made in the study area to identify 10 farmers growing the crop. These were used as key informants in identifying other farmers growing the crop [4]. From the sampling frame, a representative sample of male and female farmers was proportionately selected from all the divisions. A total of 120 respondents were selected to ensure a useful representation of Bambara farmers in the study area. An interview schedule was administered in the study area to collect primary data from the respondents. Both closed and

open ended questions were included in the instrument. The questions were designed to obtain information on the utilization and conservation of Bambara groundnut. Individualized visits were scheduled with household head members for interviews and data collection.

2.3 Limitations

The survey was limited by the fact that, the sample of respondents was drawn from a single geographical region and the data was limited to the crop production year 2009. Therefore extrapolating these results to other geographic regions will be difficult. The study was carried out with the assumptions that the agro-ecological factors were the same in the study area and that extension services, both public and private and any other facilities in the area were accessible to farmers.

2.4 Data Analysis

Both socio-economic and gender roles in Bambara groundnut production activities was collected and collated. The data was analyzed using ANOVA and regression equation. The ANOVA was used to check whether there exists a significant difference in the means of the computed indices between the males and females. The indices computed acted as a measure of the level of involvement. On the other hand, the multiple regression equation was used to assess relationship of gender and selected socio-economic variables on farmer's level of involvement in production. The hypothesis was tested at significance level α= 0.05. The general form of regression equation used is shown in equation 1;

$$Y_i = \beta o + \beta_i X_i + \ldots + \beta_k X_{ik} + \xi_l \quad (1)$$

Where:

Y_i is the dependent variable (The production activity index)
$\beta_0$is a constant
β_i(i=1,..., k) are model parameters
X_i (i=1,..., k) are independent variables
$\varepsilon_i$random error

The independent variables included gender differences while the moderator variables were age, farm size, occupation, education level, land tenure and access to market. Gender, education level and access to extension services were coded so as to transform them from qualitative to quantitative. Specifically, the variables were measured as follows:

2.4.1 Gender

Gender had two levels namely male and female so in order to use a dummy variable, male was treated as a reference variable while the female was coded as 1 for female respondents and 0 otherwise.

2.4.2 Education

The education level had five categories namely; none, primary, secondary, post-secondary and diploma. The "none" category was treated as the reference variable and hence excluded and therefore four dummy variables were created for the remaining four levels as 1 for the respondents falling in the respective category and 0 otherwise.

2.4.3 Access to extension services

Access to extension services (extension training, Bambara production technologies, farm inputs and credit facilities) was measured by seeking the respondent's easiness of accessing the services was also coded into dummy variables. The options available were not easy, easy and very easy. Here "very easy" was treated as the excluded variable and therefore only two dummy variables were created by coding 1 and 0 as previously described.

2.4.4 Occupation

The variable for main occupation had four main variables, full time farmer, part time farmer, business person/trader and employed (salaried). The "employed (salaried)" category was taken as the reference variable and hence excluded while the remaining three variables were coded as previous.

2.4.5 Land tenure

The land tenure had five levels: Owner with title deed, communal owner without title deed and rented. In this case, the "rented" tenure was the excluded variable thus remaining with four dummy variables which were coded as previous by 1 for belonging to a given category and 0 otherwise.

2.4.6 Access to the market

Access to the market was measured in distance (kilometers) between the respondent's household farm and the nearest market.

The main purpose of "dummy variables" was to allow for the representation nominal-level independent variables in regression analysis since the ordinary least squares regression is more appropriate for non-categorical data thus dummies transforms the categorical data into numerical data which is appropriate for regression analysis.

2.4.7 Dependent variable

The *farmer's involvement in production* activities was measured by farmers' level involvement in production activities: Land Preparation (L.P), Planting (PL), weeding (WE), pest control (P.C), harvesting (HA), drying (DR), Threshing (TH) and winnowing (WI). Each activity was then coded using a 3 point Likert type scale with 3=Involved, 2=occasionally involved and 1=Not involved. A production activities index (P.A.I) was thus computed by summing up all the scores of all the activities to derive the mean score. The higher PAI implied the higher level of farmer involvement. The index was computed as shown in formula 2.

$$PAI = \frac{LP + PL + WE + PC + HA + DR + TH + WI}{8} \quad (2)$$

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Bambara Groundnut Farmers

The socio-economic characteristics of the Bambara farmers were analyzed starting with distribution by gender in the two Districts. A total of 120 respondents were interviewed. The analysis revealed that of the respondents in Mumias, 58.2% were females and 41.8% were males, while Butere had 46.2% females and 53.8% females of all the respondents in the District. This shows that the majority of respondents were females in Mumias while in Butere, the majority were males. However, for the two Districts combined, females were more than males in the production of Bambara groundnut; 51.7% and 48.3%, respectively. These findings concur with those by [19] in which such orphaned crops were associated with female farmers. According to these authors female farmers adopted crops highly considered to boost household food security and nutritional enrichment hence their high level of involvement. A similar finding was also reported in the rural Ethiopia by [20] who established more involvement of female farmers in the production. These characteristics were associated with orphan crops [21].

The distribution of the farmers by highest education level per District was considered. The relationship between the Districts was further tested using chi-square test at $\alpha = 0.05$ significance level. The results revealed that the relationship between the District and the education level is not statistically significant p-val = 0.938 > 0.05 (Table 1). However, the majority of the respondents were primary school graduates followed by secondary, post-secondary and then diploma. The farmers who had no basic education were only 5% while none of the respondents held a Bachelors or Post graduate degree (Table 1). In general, those farmers who had attended primary education were 51.7%, secondary education were 39.2%, tertiary education 4.2% and those with no formal education comprised 5% of the farmers (Table 1). Most of the farmers had attended primary school which contrasts with findings reported elsewhere by [19] and [22] which established high illiteracy level of 77.5% and 66.7% among rural farmers, respectively.

The literacy level reported in the present study limit farmer access to extension material, which generally poses challenges in the packaging and delivery of extension messages. The preferences for extension message by rural farmers especially those dominated by women were difficult to establish in the rural areas. In some cases they had strong preference for the woman extension staff while some prefer farmer-to-farmer interactions for the uptake of new practices to improve production, utilization and conservation of crops. Because of the basic literacy level established in the present study, it is important to package extension information to ease transfer of agricultural technology.

The age of the farmers in years and the size of the farm land in acres were also analyzed using the descriptive statistics mainly, the mean, standard deviation, standard error and the minimum and maximum (Table 2). With regard to the mean age; Butere had a higher mean age for the farmers while Mumias had a higher mean for the farm size. The overall mean age for the farmers was 43.9 years. This is similar with the

age representation reported for the rural farmers in Pakistan [19]. Higher productivity was associated with men and female farmers in the productive age class [23]. The age of farmers varied with the oldest farmer being 86 years for Butere and 69 for Mumias while the youngest was 22 years in Butere and 20 years in Mumias. The majority of farmers were above active stage of development and skewed towards the old age. This may have negative impact on the farm size as aged farmers may not have enough strength and acreage of farm to cultivate. Older farmers are generally expected to be more experienced than the younger farmers and if the knowledge they have accumulated is not transferred to the middle and young farmers, there could be risk of erosion of the indigenous knowledge. This knowledge may however, be required for the improvement of production of Bambara groundnut. A significant relationship was established between age and sources of information [24]. In the study it is noted that majority of young farmers highly adopt crops that have higher market returns to generate cash and also diversify their livelihood to adopt options with higher returns leading to conflict between the subsistence and cash crops for most parts of Africa. Further analysis was done using ANOVA to determine whether there was a significant difference in the means of the farmers' ages and farm sizes per District (Table 3).

Generally, most farmers owned average farm size of 2.98 acres (Table 2). The size of farms varied in the two Districts with Mumias farms having an average size of 3.3 acres compared to the Butere's 2.7 acres. The largest farm size was 16 and 18 acres for Butere and Mumias Districts respectively while the smallest farms were 0.25 acres in both Districts. ANOVA results further reveal that the difference in the means of the respondents' ages by Districts was statistically significant at $\alpha = 0.05$ while the difference in the means of the farm sizes by District was not significant; p-val= 0.01 and 0.223 respectively (Table 4).

The majority of farmers had small farm size suggesting a likely constrain on female farmers to expand land for the production of Bambara groundnut. The production was highly dominated by female farmers who lack ownership of land and access to agricultural inputs which often hamper their effort to realize potential and cannot grow crops of their choice. However, those households headed by female farmers had higher acreage of land to cultivate similar to the finding by [25]. Land for cultivation of Bambara groundnut was compressed most likely by the production of sugar cane and reduced acreage due to aged farmers in Butere and Mumias Districts. However, [26] projected substantial increase in the acreage of Bambara production in the future due to the global depression in the prices of sugar and demoralization of sugar cane farmers by the sugar industries over the delayed payment.

Table 1. Distribution of farmers by education level by districts

District	Education level of the respondents					Total
	None	Primary	Secondary	Post-secondary certificate	Diploma	
Mumias	3	29	20	2	1	55
	5.5%	52.7%	36.4%	3.6%	1.8%	100.0%
Butere	3	33	27	1	1	65
	4.6%	50.8%	41.5%	1.5%	1.5%	100.0%
Total	**6**	**62**	**47**	**3**	**2**	**120**
	5.0%	**51.7%**	**39.2%**	**2.5%**	**1.7%**	**100.0%**

Chi-square = 0.806, df = 4, p-val= 0.938

Table 2. Distribution of age and farm sizes by districts

Variable	District	N	Mean	Std. deviation	Std. error	Minimum	Maximum
Age (years)	Mumias	55	40.6182	11.87199	1.60082	20.00	69.00
	Butere	65	46.6000	12.83769	1.59232	22.00	86.00
	Total	**120**	**43.8583**	**12.71028**	**1.16028**	**20.00**	**86.00**
Farm size (acres)	Mumias	55	3.2662	1.93957	0.26153	0.50	8.00
	Butere	65	2.7408	2.62959	0.32616	0.25	16.00
	Total	**120**	**2.9816**	**2.34415**	**0.21399**	**0.25**	**16.00**

Table 3. ANOVA for age and farm sizes of the respondents by districts

Variable	Source of variation	Sum of squares	Df	Mean square	F	p-value
Age (years)	Between groups	1066.010	1	1066.010	6.927	0.010
	Within groups	18158.582	118	153.886		
	Total	**19224.592**	**119**			
Farm size (acres)	Between groups	8.224	1	8.224	1.503	0.223
	Within groups	645.688	118	5.472		
	Total	**653.912**	**119**			

3.2 Gender Roles in Production Activities

The main production activities that were analyzed in relation to gender involvement included; land preparation activities, planting, weeding, pest control, harvesting, drying activities, threshing and winnowing.

3.2.1 Gender roles in land preparation

The findings indicate that in Mumias, 81.3% of female respondents were involved in land preparation activities compared to the male respondents whose participation was at 69.1% (Table 4). In Butere however, the level of involvement for male and female respondents was almost the same at 74.3% and 73.3% respectively. This implies that in Mumias, land preparation was left mainly to females while in Butere the males were more involved in the land preparation activities compared to females. The gender involvement in land preparation was further analyzed using chi-square test to find out whether there was a relationship between gender and level of involvement by District. The computed chi-square statistics indicated a significant relationship between gender and farmers' involvement in land preparation in Mumias at $\alpha = 0.05$ while for Butere, the difference in participation was not significant (Table 4). The result for Butere is consistent with [21,27], which associated tedious activities of land preparation with male farmers while for Mumias, the result is inconsistent and it likely explains the argument that males are attracted to cash crop (sugar cane) production as per the case of the District [28].

3.2.2 Gender involvement in planting

Gender involvement in planting of Bambara groundnut was analyzed and findings indicated that more female respondents (100%) and (76.7%) for Mumias and Butere Districts respectively were involved in planting activity than male farmers (17.4%) and (62.9%) for Mumias and Butere Districts respectively (Table 5). A majority of men were either not involved or occasionally involved in the planting of Bambara groundnut.

A chi-square test further revealed highly significant relationship (P-val = 0.000) between gender and farmers' involvement in the planting activities in Mumias but not in Butere (p-val = 0.371) (Table 5). Male farmers were least involved in the planting activities compared to males. The female farmers have decisive behavior to adopt crops that meet household nutritional requirement and highly nutritious Bambara groundnut. This characteristic was common to crops that serve vital role for domestic consumption and sustenance of the family food requirements [29]. The finding suggests female farmers in the rural areas were more concerned with activities that ensure survival of their family.

3.2.3 Gender involvement in weeding activities

The results of gendered farmer involvement in weeding activities using the descriptive statistics and the chi-square by Districts indicated that there were more female respondents involved in weeding activities than male farmers in both Mumias and Butere Districts (Table 6). A highly significant relationship between gender and farmers' level of involvement in the weeding activities in Mumias (p-val = 0.000) but not in Butere (p-val = 0.7600). The female farmers were more involved in the weeding activities as they take upon themselves responsibility to weed Bambara groundnut and especially to compliment activities of male farmers involved in the planting activities.

3.2.4 Gender involvement in pest control activities

Analyses on gender involvement in pest control activities indicated that more males (17.4% and 51.4% of respondents in Mumias and Butere respectively were involved in pest control

compared to females (Table 7). The respondent's gender significantly influences farmers' level of involvement in pest control in Butere District but not in Mumias. It is important to note that a greater percentage of farmers were less involved in pest control activities. The low participation of both male and female farmers in the pest control suggests limited use of pest control measures in the production of Bambara groundnut.

Table 4. Gender involvement in land preparation by district

District	Gender of respondent	Gender involvement in land preparation			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	9	2	12	23
		39.1%	8.7%	52.2%	100.0%
	Female	0	6	26	32
		.0%	18.8%	81.3%	100.0%
	Total	9	8	38	55
		16.4%	14.5%	69.1%	100.0%
Chi-square = 15.09		df = 2	p-val = 0.001		
Butere	Male	1	8	26	35
		2.9%	22.9%	74.3%	100.0%
	Female	4	4	22	30
		13.3%	13.3%	73.3%	100.0%
	Total	5	12	48	65
		7.7%	18.5%	73.8%	100.0%
Chi-square = 3.10		df = 2	p-val = 0.212		

Table 5. Gender involvement in planting by district

District	Gender of respondent	Gender involvement in planting			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	9	10	4	23
		39.1%	43.5%	17.4%	100.0%
	Female	0	0	32	32
		.0%	.0%	100.0%	100.0%
	Total	**9**	**10**	**36**	**55**
		16.4%	**18.2%**	**65.5%**	**100.0%**
Chi-square = 40.39		df = 2	p-val = 0.0000		
Butere	Male	7	6	22	35
		20.0%	17.1%	62.9%	100.0%
	Female	5	2	23	30
		16.7%	6.7%	76.7%	100.0%
	Total	**12**	**8**	**45**	**65**
		18.5%	**12.3%**	**69.2%**	**100.0%**
Chi-square = 1.983		df = 2	p-val = 0.371		

Table 6. Gender involvement in weeding activities by district

District		Gender involvement in weeding			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	4	15	4	23
		17.4%	65.2%	17.4%	100.0%
	Female	0	5	27	32
		.0%	15.6%	84.4%	100.0%
	Total	**4**	**20**	**31**	**55**
		7.3%	**36.4%**	**56.4%**	**100.0%**
Chi-square = 25.27		df = 2	p-val = 0.000		
Butere	Male	8	8	19	35
		22.9%	22.9%	54.3%	100.0%

District		Gender involvement in weeding			Total
		Not involved	Occasionally involved	Involved	
	Female	4	2	24	30
		13.3%	6.7%	80.0%	100.0%
	Total	**12**	**10**	**43**	**65**
		18.5%	**15.4%**	**66.2%**	**100.0%**
Chi-square = 5.161		df = 2	p-val = 0.7600		

This may be attributed to low importance given to the crop. The female farmers lack access to farm inputs and a similar neglect was established for those crops whose production was dominated by female farmers [30]. Bambara groundnut, like other orphan crops, was affected due to low investment by female farmers in addition to it receiving little attention from the male counterparts. The latter shift their attention to those crops with high market demands. For a farmer to invest pest control options, it depends on the size of acreage of crop and expected pest density [28].

3.2.5 Gender involvement in harvesting activities

There were more females in both Districts (100% and 76.7% of respondents in Mumias and Butere respectively) involved in the harvesting activities (Table 8). The results of chi-square test further reveals a highly significant difference in the level of involvement of female and male farmers in the harvesting activities in Mumias while in Butere the difference was in the levels of involvement were not significant at $\alpha = 0.05$ significance level. The female farmers were relatively more involved in the harvesting compared to their male counterparts. The latter involvement was however low compared to the female farmers because Bambara groundnut was considered for household consumption. A similar finding was reported in India which rated involvement of female farmers in harvesting activities at 60% [31].

3.2.6 Gender involvement in drying activities

Female farmers were more involved than their male counterparts in the drying activities of Bambara groundnut (Table 9). A chi-square test further revealed a highly significant difference in the farmers' level of involvement by gender in the drying of Bambara groundnut for the two Districts. The higher percentage of female farmers indicates that women were highly involved in drying activities compared to their male counterparts in both Districts. Most of the time female farmers were at home to dry Bambara groundnut as male farmers were engaged in the off farm activities or spend significant time on-farm. The female farmers were targeted at early age by their mother, mother-in-law and older women of household members to assume the role of drying crops in the homestead during their childhood development.

3.2.7 Gender involvement in threshing activities

The chi-square test revealed that there was a significant relationship between gender and involvement level of farmers in the threshing activities in the two Districts (Table 10). The female farmers were highly involved in threshing activities compared to male farmers in both Mumias and Butere Districts. The threshing activities were the realm of female farmers unlike other crops dominated by male farmers.

Table 7. Gender involvement in pest control by district

District	Gender of respondent	Gender involvement in pest control			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	13	6	4	23
		56.5%	26.1%	17.4%	100.0%
	Female	8	21	3	32
		25.0%	65.6%	9.4%	100.0%
	Total	**21**	**27**	**7**	**55**
		38.2%	**49.1%**	**12.7%**	**100.0%**
Chi-square = 8.419		df = 2	p-val = 0.015		
Butere	Male	10	7	18	35
		28.6%	20.0%	51.4%	100.0%

District	Gender of respondent	Gender involvement in pest control			Total
		Not involved	Occasionally involved	Involved	
	Female	13	3	14	30
		43.3%	10.0%	46.7%	100.0%
	Total	**23**	**10**	**32**	**65**
		35.4%	**15.4%**	**49.2%**	**100.0%**
Chi-square = 2.12		df = 2	p = 0.347		

Table 8. Gender involvement in harvesting by district

District	Gender	Gender involvement in harvesting			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	16	0	7	23
		69.6%	0%	30.4%	100.0%
	Female	0	0	32	32
		.0%	0%	100.0%	100.0%
	Total	**16**	**0**	**39**	**55**
		29.1%	**0%**	**70.9%**	**100.0%**
Chi-square = 31.40		df = 1	p-val = 0.000		
Butere	Male	6	9	20	35
		17.1%	25.7%	57.1%	100.0%
	Female	5	2	23	30
		16.7%	6.7%	76.7%	100.0%
	Total	**11**	**11**	**43**	**65**
		16.9%	**16.9%**	**66.2%**	**100.0%**
Chi-square = 4.396		df = 2	p-val = 0.111		

Table 9. Gender involvement in drying by district

District	Gender of respondent	Gender involvement in drying			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	20	0	3	23
		87.0%	0%	13.0%	100.0%
	Female	3	0	29	32
		9.4%	0%	90.6%	100.0%
	Total	**23**	**0**	**32**	**55**
		41.8%	**0%**	**58.2%**	**100.0%**
Chi-square = 33.10		df = 1	p-val = 0.0000		
Butere	Male	17	9	9	35
		48.6%	25.7%	25.7%	100.0%
	Female	5	0	25	30
		16.7%	.0%	83.3%	100.0%
	Total	**22**	**9**	**34**	**65**
		33.8%	**13.8%**	**52.3%**	**100.0%**
Chi-square = 22.83		df = 2	p-val = 0.0000		

3.2.8 Gender involvement in winnowing activities

The results revealed a significant gender difference in the involvement level of farmers in the winnowing activities (p-val 0.000) (Table 11). Female farmers were highly involved in winnowing activities than their male counterparts. The finding suggests winnowing activities were more of a female's activity and concurred with [32,33]. The involvement of female and male farmers in the winnowing activities comprised of 93.5 % and 22.4%, respectively (Table 12).

A significant gender difference existed in the involvement level of farmers in the winnowing activities. There was more involvement of female farmers in the winnowing activities than the male farmers. The findings suggest winnowing activities were more of a female's activity and concurred with [32,34]. However, the finding deferred with the case reported in India by [31] in

which these authors rated involvement level of female farmers in the winnowing activities of rice as low as 33%. Nonetheless, when functions of crop shift from food to cash crop the gender role is also expected to changes with male farmers taking an active role in the activity previous dominated by female farmers.

Table 10. Gender involvement in threshing by district

District	Gender of respondent	Gender involvement in threshing			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	19	0	4	23
		82.6%	0%	17.4%	100.0%
	Female	3	0	29	32
		9.4%	0%	90.6%	100.0%
	Total	**22**	**0**	**33**	**55**
		40.0%	**0%**	**60.0%**	**100.0%**
Chi-square = 29.90		df = 1	p-val= 0.000		
Butere	Male	15	9	11	35
		42.9%	25.7%	31.4%	100.0%
	Female	5	2	23	30
		16.7%	6.7%	76.7%	100.0%
	Total	**20**	**11**	**34**	**65**
		30.8%	**16.9%**	**52.3%**	**100.0%**
Chi-square = 13.38		df = 2	p-val= 0.001		

Table 11. Gender involvement in winnowing by district

District	Gender of respondent	Gender involvement in winnowing			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	18	0	5	23
		78.3%	.0%	21.7%	100.0%
	Female	0	0	32	32
		.0%	.0%	100.0%	100.0%
	Total	**18**	**0**	**37**	**55**
		32.7%	**.0%**	**67.3%**	**100.0%**
Chi-square = 37.227		df = 1	p-val = 0.000		
Butere	Male	21	6	8	35
		60.0%	17.1%	22.9%	100.0%
	Female	4	0	26	30
		13.3%	.0%	86.7%	100.0%
	Total	**25**	**6**	**34**	**65**
		38.5%	**9.2%**	**52.3%**	**100.0%**
Chi-square = 26.84		df = 2	p-val = 0.000		

Table 12. Gender involvement in production activities index

District	Gender of respondent	Production activities index			Total
		Not involved	Occasionally involved	Involved	
Mumias	Male	7	14	2	23
		30.4%	60.9%	8.7%	100.0%
	Female	0	3	29	32
		.0%	9.4%	90.6%	100.0%
	Total	**7**	**17**	**31**	**55**
		12.7%	**30.9%**	**56.4%**	**100.0%**
Ch-square = 37.227		df = 1	p-val= 0.000		
Butere	Male	5	15	15	35
		14.3%	42.9%	42.9%	100.0%

District	Gender of respondent	Production activities index			Total
		Not involved	Occasionally involved	Involved	
	Female	4	2	24	30
		13.3%	6.7%	80.0%	100.0%
	Total	**9**	**17**	**39**	**65**
		13.8%	**26.2%**	**60.0%**	**100.0%**
Chi-square = 26.864		df = 2	p-val= 0.000		

3.2.9 Assessment of gender involvement in bambara production activities

The overall assessment of gender involvement was done by use of production activities index (Table 12). The results indicated that gender was a significant factor in the Bambara production activities in the two Districts with females exhibiting a higher level of involvement in the activities than male farmers. The finding concurred with [19] who established more involvement of female farmers in the production activities of food crops. The female farmers in the two Districts had a higher PAI than the male farmers (Table 13). This finding indicates that female farmers had higher level of involvement in the production activities than the male farmers. Despite some activities, especially land preparation requiring heavy labor generally provided by male farmers, production of Bambara groundnut remains the domain of female farmers.

The analysis of variance was further used to find out whether a significant difference in farmers' involvement existed in the overall production activities by gender. The dependent variable was the production activities index (PAI) while gender difference was considered to be the independent (factor). The results indicate a significant difference in the means of PAI by gender in the two Districts under study at $p<0.05$ (Table 14). This implies that in Butere (p-val = 0.013) and Mumias (p-val = 0.000), gender significantly influences farmers' involvement in Bambara production activities. The findings differed with production of crops traditionally sold for cash [35]. In this case male farmers were significantly involved and dominated the production.

Further analysis was done via a regression model to find out the relationship between the various indicator variables' contribution to the PAI. The independent (predictor) variables included gender of the respondents, Education level, land tenure, farm size, and main occupation, accessibility to market and accessibility to extension services. Specifically, the variables for age in years and farm size in acres were used directly while the remaining predictors were transformed into dummy variables. The dummies were coded as explained earlier. The regression was statistically significant at $\alpha = 0.05$ as shown by the regression ANOVA (Table 14).

This implies that the combination of the studied independent variables significantly affects the production index (Table 15). The results indicate a significant relationship of gender on the production activities. The finding concurred with the previous study by [16,33,34]. The authors established marked distinction in the role of gender similar to the production of Bambara groundnut. These authors found that the crop was mainly grown for food. Female farmers have greater responsibility in the production of Bambara groundnut more than the male farmers who neglect and associate the crop with women as they pursue crops with greater market potential. These authors identified access to the market as key underlying factor for involvement of the male farmers in the production activities. In this study, the farm size in acres also significantly influenced the production of Bambara. The model adequacy was analyzed using the adjusted R-square which was at 25.3% implying that the model only explained 25.3% of the dependent variable (PAI). Further, the regression ANOVA was used to measure the significance of the regression (predictor variables combined) on the dependent variable (Table 15).

These findings have implications for the agricultural extension agents, policy-makers and development partners. The agriculture extension agents need to: (i) Adopt interventions that can enhance the role played by the small scale farmers in the revitalization of Bambara groundnut, particularly female farmers by adopting time schedules and technologies that are appropriate for male and female farmers and (ii) Treat and cater for male and female farmers as separate clientele with different needs in Bambara cultivation activities. Since female farmers exhibit higher level of involvement, extension agents should make them their priority in trying to revive production of the crop;

ensuring the innovations and information are appropriate for each gender in order to boost Bambara farmers' ability to produce enough food and earn adequate income or maintain their household members.

The Research agencies need to: (i) Conduct research in the development of high yielding, drought, disease and pest resistant varieties and methods of increased productivity aimed at both household consumption and commercial purpose and (ii) Conduct research to come up with pest and disease control measures that are effective, affordable and accessible for Bambara farmers; a majority of the farmers in the study area don't use pesticides because appropriate pesticides are not available on the shelves and the ones available are either too expensive or ineffective. Unavailability of pesticides is one main reason that has discouraged most farmers from cultivating the crop due to great losses when the crop is attacked.

Table 13. Descriptive statistics for production activities index by districts

District		N	Mean	Std. deviation	Std. Error	Minimum	Maximum
Mumias	Male	23	1.6467	0.48945	0.10206	1.13	2.75
	Female	32	2.7656	0.18716	0.03309	2.13	3.00
	Total	**55**	**2.2977**	**0.65418**	**0.08821**	**1.13**	**3.00**
Butere	Male	35	2.1750	0.56653	0.09576	1.13	3.00
	Female	30	2.5625	0.64973	0.11862	1.00	3.00
	Total	**65**	**2.3538**	**0.63221**	**0.07842**	**1.00**	**3.00**

Table 14. ANOVA for gender and production activities index

District	Source of variation	Sum of squares	Df	Mean square	F	p-value
Mumias	Between groups	16.753	1	16.753	139.687	0.000
	Within groups	6.356	53	0.120		
	Total	**23.109**	**54**			
Butere	Between Groups	2.426	1	2.426	6.600	0.013
	Within groups	23.155	63	0.368		
	Total	**25.580**	**64**			

Table 15. Regression analysis for PAI

Variable	Variable/dummy	Estimate	Std. error	T	p-value
Constant	(Constant)	1.938	0.607	3.191	0.002
Gender	Dummy for female	0.692	0.108	6.378	0.000
Age	Age (years)	0.001	0.005	0.297	0.767
Education level	Dummy variable for primary level	-0.304	0.252	-1.207	0.230
	Dummy variable for secondary level	-0.354	0.258	-1.371	0.173
	Dummy variable for post-secondary level	-0.310	0.427	-0.727	0.469
	Dummy variable for diploma level	-0.235	0.495	-0.476	0.635
Land tenure	Dummy variable for the owner with title deed	0.218	0.413	0.527	0.599
	Dummy variable for the owner without title deed	0.101	0.409	0.247	0.806
	Dummy variable for communal ownership	0.181	0.421	0.430	0.668
Farm size	Farm size(acres)	-0.048	0.024	-1.970	0.047
Main occupation	Dummy for full time farmer	0.286	0.321	0.892	0.374
	Dummy for part time farmer	0.248	0.326	0.760	0.449
	Dummy for business/trader farmer	0.160	0.372	0.429	0.669
Access to Market	Distance to the nearest local	0.019	0.024	0.792	0.430

Variable	Variable/dummy	Estimate	Std. error	T	p-value
	market				
Access to extension services	Dummy extension not easy	-0.033	0.164	-0.204	0.839
	Dummy extension easy	-0.108	0.165	-0.654	0.514

Dependent variable: Production activities index, adjusted R-square = 25.3%, regression ANOVA F-statistic = 3.503, df = 16, p-val= 0.000

Government of Kenya needs to consider policies that favor increased involvement of agriculture extension agents in providing services for the farmer' protection and use of this indigenous crop. This may encourage participation of more farmers in its production thereby preventing it from becoming extinct and also maintaining the role it plays in both food and as a livelihood strategy of farmers in the study area. Other agricultural development partners need include: (i) Since the mean age of most Bambara farmers was 43.9 years, it calls for consideration of the middle aged famers during transfer of knowledge since they can effectively harness both agricultural extension skills and the indigenous technical knowledge equipped with the older generation required to raise productivity of Bambara groundnut in the study area. (ii) To adopt group based approaches since they are suitable for transfer of knowledge as the middle aged farmers learn from those experienced but aging farmers; this is due to the assumption that group based approaches promote interaction and sharing of experiences among the group members.

To advance more findings, future research may consider the following: First, to find out if the findings of this study are consistent, to continue the research on a larger-scale that takes into account many regions with diverse economic, social and cultural differences. Second, a comparative study of regions that grow cash crop and non-cash crop may also be considered and finally, considering the need to fully revive production of this crop in the study area, future research should undertake studies to identify incentives and constraints under which men and women work in order to get information that can be used for tailoring planned interventions that eventually lead to overall improved productivity.

4. CONCLUSION

In view of the data analysis and results the following conclusions were made: Gender is a critical factor that influences participation of male and female farmers in production of Bambara groundnut. Second in Mumias District, the level of involvement of farmers by gender in production activities was highly significant with female farmers exhibiting higher participation than males in all the activities; a factor that could possibly be attributed to males being attracted to cash crops such as sugarcane which is the main cash crop in the area while women continuing its cultivation since it plays a role in the household food security. In Butere, the difference in participation in the production activities is only evident in certain activities universally associated with women, namely; drying, threshing and winnowing. This can be explained by the absence of a major cash crop in the area whereas Bambara is gaining popularity in Butere District as an alternative cash crop there by attracting full participation of males and while females participates fully because apart from it being a cash crop in the area it plays a major role in the household food security. Last, in pest control however, no significant difference could be established since farmers do not use pesticides in producing the crop. Both genders exhibited very low participation in pest control measures. This clearly reveals total neglect of the crop. Despite the effort being put by the farmers in trying to revitalize this crop, no interventions have been made by any development agents to help farmers in the study area in revitalizing productivity of the crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hammer K, Heller J, Engels J. Monographs on underutilized and neglected crops. Genetic Resources and Crop Evolution. 2001;48:3-5.
2. Azam-Ali SN, Massawe FJ, Mwale SS, Basu S, Cornelissen R. Can Bambara groundnut become a major world crop? In: Proceedings of the International Bambara

Groundnut Symposium, Botswana College of Agriculture, Botswana. 2003;323-352.
3. Linnemann AR, Azam-Ali SN, Bambara groundnut (*Vigna subterranea*) In: J. T. Williams, (Ed.) Pulses and Vegetables. London. Chapman and Hall. 1993:278-282.
4. International Centre for Underutilized Crops. Global Newsletter on Underutilized Crops; 2009. Retrieved March 27, 2009, Available: http://www.soton.ac.uk/icuc
5. Goli AE, Bambara groundnut. Bibliographic review in Bambara groundnut *Vigna subterranea (L.) verd*c. Promoting the conservation and use of Underutilized and Neglected crops. Proceedings of the workshop on conservation and improvement of Bambara groundnut *(Vigna subterranea (L.) verdc.).* Heller J, Begemann F, Mushonge J. (eds.). 1997;14–16. Harare Zimbabwe; IPGCPR and IPGRI, Rome; 1995.
6. Linnemann AR. Cultivation of bambara groundnut in Northern Nigeria. Tropical crop communication.1988;15:1 – 14.
7. Linnemann AR, Cultivation of bambara groundnut *(Vigna subterranean (L.) verdc.)* in Western province, Zambia. Report of field study of tropical crops. Department of Tropical Crop Science. Wageningen Agricultural University, the Netherlands; 1990.
8. Brough SH, Azam-Ali SN, Taylor AJ. The potential of Bambara groundnut *Vigna subterranea*) in vegetable milk production and basic protein functionality systems. Food Chemistry. 1993;47:277-283.
9. Atiku AA. Bambara groundnut processing and storage practices in North Eastern Nigeria. Postgraduate seminar paper, Department of Agricultural Engineering, University of Maiduguri, Maiduguri, Nigeriap; 2000.
10. Tanimu B, Aliyu L. Bambara groundnut, country report: Northern Nigeria. In Bambara groundnut. *Vigna subterranea (L.) verd*c. Promoting the conservation and use of underutilized and neglected crops. Proceedings of the workshop on conservation and improvement of Bambara groundnut *(Vigna subterranea (L.) verdc*.). Heller J, Begemann F, Mushonge J. (eds.); 1995. Harare Zimbabwe; IPGCPR and IPGRI, Rome; 1997.
11. Mungate D. Opening address. In Bambara groundnut. *Vigna subterranea (L.) verd*c. Promoting the conservation and use of underutilized and neglected crops. Proceedings of the workshop on conservation and improvement of Bambara groundnut *(Vigna subterranea (L.) verdc*.). Heller J, Begemann F, Mushonge J. (eds.); 1995. Harare Zimbabwe; IPGCPR and IPGRI, Rome; 1997.
12. Temba E. Gender perspectives in development: Gender analysis in planning and women empowerment. Research and Publication Department, Mzumbe University; 2004.
13. Bravo-Baumann H. Capitalization of experiences on the contribution of livestock projects to gender issues. Working Document, Bern, Swiss Agency for Development and Cooperation; 2000.
14. Beard VA. Individual determinants of participation in community development in Indonesia. Environment and Planning C: Government and Policy. 2005;23:21–39.
15. Lister Ruth. Inclusive citizenship, gender and poverty: Some implications for education for citizenship. Citizenship Teaching and Learning. 2008;4(1):3-19.
16. Fakoya EO, Adereti FO, Apantaku SO. Gender Involvement in Arable Crop Cultivation and its Contributions to Household Food Security in Ogun state. Research Journal of Social Sciences. 2006;1(1):1-4.
17. Thakur S, Varma SK, Goldey PA. Perception of drudgery in agricultural and animal husbandry operations: A gender analysis from Haryana State, India. Journal of International Development. 2001;13:1165-1178.
18. Oyugi M, Nandi OMJ, Amudavi D, Palapala V. Gender Influence on Farmer's level of involvement in Utilization and Conservation of Bambara Groundnut. Asian Journal of Agriculture, Extension and Environment Sciences. 2014:3(6):721-739.
19. Sangir A, Hassan MZY, Javed A. Gender Participation in Crop Production Activities. Journal of Agriculture & Social Science. 2005;1(4):343–345.
20. Ogato GS, Boon EK, Subramani J. Gender Roles in Crop Production and Management Practices: A case study of three rural communities in Ambo District, Ethiopia. Journal of Human Ecology. 2009;27(1):1-20.
21. Adebayo K, Lamboll R, Westby A. Social implications of the development of cassava postharvest systems in Africa. Expert Consultation at the Natural Resource

Institute. University of Greenwich, United Kingdom; 2009.
Available:http://www.nri.org/projects/GCPMD/files/2 Adebayo paper.pdf
22. Rasheed S. Women participation in decision making process regarding agricultural business and family matters: A case study in Tehsil Gojra. M.Sc Rural Sociology (Thesis) University of Agriculture, Faisalabad–Pakistan; 2004.
23. Sasvari A, Aguilar L, Khan M, Schmitt F. Guidelines for Mainstreaming Gender into National Biodiversity Strategies and Action Plans. Gland, Switzerland: IUCN. 2010;8:97.
24. Chaudhry S. The investigation into attitude of rural women towards exchange marriages: A case study in District Jhang. M.Sc. Thesis Rural Sociology, Univ. of Agric., Faisalabad; 2004.
25. Adeleke OA, Adesiyan OI, Olaniyi OA, Adelalu KO, Matami HM. Gender Differentials in the Productivity of Cereal Crop Farmers: A Case Study of Maize Farmers in Oluyole Local Government Area of Oyo State of Nigeria. Agricultural Journal. 2008;3(3):193-198.
26. Chianu Jonas N, Vanlauwe B, Mahasi JM, Katungi E, Aketch C, Mairura FS, Chianu, Justina N and Sanginga, N. Soybean situation and Outlook analysis; the case of Kenya. TSBF-CIAT, AFNET. 2008;68.
27. FAO. *Gender*: The key to sustainability and food security, SD Dimensions; 1997. Retrieved March 20, 2009. Available:http://www.fao.org/sd/
28. Foti R, Govere I, Mutandwa E, Mugenzi, P. Mlambo N. Determinants of participation in pest management groups by smallholder cotton producers in Zimbabwe; International NGO Journal. 2009;4(5):203-206.
29. Carr ER. Men's Crops and Women's Crops: The Importance of Gender to the Understanding of Agricultural and Development Outcomes in Ghana's Central Region. Elsevier Journal of World Development. 2007;36(5):900-915.
30. Quisumbing AR. Male-female differences in agricultural productivity: Methodological issues and empirical evidence. World Development. 1996;24(10):1579–1595.
31. Mata G, Sasvari A. Integrating gender equality and equity in ABS governance through a rights-based approach. In: Campese J, Sunderland T, Greiber T, Oviedo G. (Eds). Rights-Based approaches: Exploring issues and opportunities for conservation. Bogor, Indonesia: CIFOR, IUCN and CEESP; 2009.
32. Amri E, Kimaro C. The role of gender in management and conservation of seed diversity of crops and varieties: A case study in Bariadi, Tanzania. Journal of Agricultural and Environmental Science. 2010;8(4):365-369.
33. Meinzen-Dick R, Lauren P, Stephan D, Jessica A. Gender and collective action: A conceptual framework for analysis international research workshop on 'Gender and Collective Action'. Chiang Mai, Thailand; 2005.
34. Meinzen-Dick R, Quisumbing A, Behrman J, Jenzano PB, Wilde V, Noordeloos M. Engendering Agricultural Research. Paper presented at the 2010 Global Conference on Agriculture and Rural Development. Montpellier, France; 2010.
Available:http://www.slideshare.net/IFPRIGender/engendering-agricultural/
35. Petermann A, Quisumbing AR, Behrman J, Nkonya E. Understanding gender differences in agricultural productivity in Uganda and Nigeria. Background paper prepared for the 2010 FAO State of Food and Agriculture; 2010.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=870&id=25&aid=7141