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Gender Influence on Farmer's Level of Involvement in Utilization and Conservation of Bambara Groundnut

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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 OM and DA conducted the field study, managed literature searches and data analysis. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: To understand the role of gender on Bambara groundnut cultivation with respect to levels of farmers' involvement in utilization and conservation in Western Kenya.
Study Design: A questionnaire was 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 Western Kenya.
Methodology: Level of involvement in Bambara groundnut utilization and conservation activities was measured by farmers' level of participation using Analysis of variance (ANOVA) and multiple regression equation. Aspects of utilization examined included food preparation, selling and social capital. Crop conservation variables analyzed included; seed selection, seed preservation and seed storage. Crop utilization (CUI) and Crop

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conservation (CCI) indices were computed to determine the relationship between gender and level of involvement.
Results: There was significant influence of gender on farmer's level of involvement in the districts. Involvement level of female farmers was higher than the male farmers in production and conservation activities. Overall, there was significant difference in the means of the computed CUI and CCI Indices between males and females. CCI indicated that women participation in conservation activities was higher (2.71±0.477 and 2.54±0.8) than the males (1.8±0.500 and 2.04±0.82) in both Mumias and Butere districts. This confirmed that the females have a higher level involvement in conservation activities than males. Computed CUI indicated considerable difference in means with women having a high index (2.86±0.315 and 2.6±0.713) than males (1.51±0.448 and 1.70±0.587). For both districts, ANOVA for Gender and CUI were significant (F=30.799, p=0.00; F=174.332, p=0.000) as was for CCI (F=46.913, p=0.000; F=6.304, p=0.015).
Conclusion: The high level of involvement of female farmers in the utilization and conservation necessitate consideration of gender role in the transfer of farm technology. Findings provide extension agencies with guidelines for mainstreaming gender roles to target the right clientele by gender in order to enhance the revival and utilization of underutilized crops as an alternative food crop. Agricultural extension agents therefore need to adopt specific models of intervention, approaches and time schedules to enhance the role played by the farmers in revitalizing utilization and conservation of Bambara groundnut. Female farmers should be accorded special attention by extension officers seeking to improve agricultural productivity. Similarly dissemination of innovations to farmers should be appropriate to each gender.

Keywords: Bambara groundnut; gender; utilization index; conservation index.

1. INTRODUCTION

Bambara groundnut (*Vigna subterranea* L. Verdc) is an indigenous African leguminous crop important in semi-arid Africa where it is planted in small holdings [1]. In much of Africa, Bambara groundnut is the third most important legume after groundnut (*Arachis hypogea*) and cowpea (*Vigna unguiculata*) [2]. Nutritionally it is superior to other legumes, and is the preferred food crop of many local people [3]. The seeds command a high market price, with demand far outweighing supply in many areas [4]. Bambara is thought to have migrated to Kenya during the migration of the Bantu from its perceived origin in West Africa [5]. Bambara groundnut is thus an indigenous African crop that is now grown across the continent from Senegal to Kenya and from the Sahara to South Africa. In Kenya Bambara is cultivated and utilized by the bantu communities of Luhya, Kamba and the Giriama.

The great advances in agricultural production over the past 50 years have resulted in a large decrease in diversity of crops and farms [6] and a shift from indigenous food cropsto more exotic and improved crops. This has resulted to our food being obtained from only 20 crops, nine of which are cereals. Further, among the cereals; maize, rice, and wheat account for about 58% of the food produced by the 20 major crops [7]. Local crops intended for production-for-use, are commonly replaced by introduced crops for commercial purposes [8]. For instance, sugarcane has replaced many indigenous crops including Bambara and groundnuts in western Kenya. With changing climate there is need to develop strategies that encourage the cultivation of indigenous crops with high nutritional value and drought resistance.

Conservation is a systematic set of activities involved in selecting and preserving plant or animal species in a given area for use by the future generations [9] while utilization refers to uses to which Bambara groundnut and its products are put. Conservation of cultivated plants such as Bambara groundnuts in home gardens is very crucial because it not only preserves a vital resource for humankind but also provides significant economic and nutritional benefits for the rural poor [10]. Conservation of plant species is part of agro biodiversity involved in agriculture and food production. It is dependent on human action and based on distinct gender roles, particularly in relation to seed saving and selection [11,12]. Agro diversity is defined as, 'the many ways in which farmers use the natural diversity of the environment for production, including not only their choice of crops but also their management of land, water and biota as a whole' [6].

Gender relations are the ways in which a culture or society defines rights, responsibilities and the identities of men and women in relation to one another [13]. An understanding of the roles of men and women in the utilization and conservation of Bambara groundnuts may be useful in formulating appropriate delivery strategies for use by the agricultural extension sector especially in the revival process of neglected indigenous food crops. Women workload has been increasing as a result of men moving to the urban centres for wage employment, resulting in change of diet as women have less time to spend on food preparation. Changing dietary habits can lead to the erosion of women's related knowledge of processing, preparation and storage, as well as to the erosion of plant diversity, family food security and health [11]. Effectiveness of international delivery strategies hinges upon the efficacy of the transfer of technology by extension workers to employ appropriate education methods to better communicate their message to farmers [14]. Although ethno botanical surveys have shown that Bambara groundnut was being produced in abundant quantities [15], in Kenya it is the contrary with current levels of production being lower than those of the past. In fact, it is still considered a delicacy by the communities who use it in Kenya and continues to be inaccessible to the majority due to its prohibitive costs.

In this study, gender refers to the rights, responsibilities and identities of males and females in relation to cultivation of Bambara groundnuts in the study area. Since there is renewed interest by the government of Kenya to re-evaluate and revive orphaned crops due to their value in drought resistance and contribution to food security, this study was designed to assess influence of gender on farmers' level of involvement in Bambara utilization and conservation activities in Butere and Mumias districts of Western Kenya. The importance of understanding the role of gender in relation to Bambara groundnut utilization and conservation in a rural district in Kenya is therefore quite consistent with the ongoing thinking regarding the issue of gender consideration in food security issues.

2. MATERIALS AND METHODS

2.1 Scope of the Study

The study focused on the role of gender in the revival of Bambara groundnut with respect to utilization and conservation. It focused specifically on the gender roles of male and female farmers and their level of involvement in utilization and conservation of Bambara groundnut. Aspects of utilization included food, selling and social capital. Utilization variables included; seed selection, seed preservation and seed storage. The study was conducted in Butere and Mumias districts of western Kenya. The districts neighbour each other and do share common ecological attributes and therefore, provided sufficient population for the study.

2.2 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.

2.3 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 [16]. 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.

2.4 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 following 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.

2.5 Data Analysis

2.5.1 Gender involvement in crop utilization

The crop utilization objective was analyzed using ANOVA and multiple regression equation. Analysis of variance was used to check whether there existed 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 the utilization of Bambara groundnuts. The hypothesis was tested at significance level α=0.05. The general form of the regression equation used is presented in equation 1:

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

Where

Y_i : is the dependent variable (crop utilization index)
β_0 : is a constant
$\beta_i (i=1,..., k)$: are model parameters

X_i (i=1,..., k) : are independent variables
ε_i : random error

The independent variables included gender differences while the model variables were age, farm size, occupation, education level, land tenure and access to market. The variables of gender, education level and access to market were transformed into dummy variables and coded for agreeing with a given category and otherwise respectively.

2.5.2 Dependent variable

Farmer's involvement in utilization was measured by farmers' level of involvement in utilization activities: preparation for food (P.F), extraction for oil (E.O), selling (SE) and social capital (S.C). Each activity was then coded using a 3 point Likert type scale with 3=Involved, 2=occasionally involved and 1=Not involved. Crop utilization index (C.U.I) was computed by summing up all the scores of all the activities to derive the mean score and the higher the C.U.I, the higher the farmer's involvement. The index was computed as shown in formula 2:

$$C.U.I = \frac{P.F + E.O + SE + S.C}{4} \quad (2)$$

2.6 Analysis of Gender Involvement in Crop Conservation

This objective was analyzed using analysis of variance (ANOVA) and regression equation. 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 conservation. The hypothesis was tested at significance level α=0.05. The general form of the regression equation used is presented in Equation 3:

$$Y_i = \beta o + \beta_i X_i + \ldots + \beta_k X_k + \xi_i \quad (3)$$

Where:

Y_i : is the dependent variable (Crop utilization index)
β_0 : is a constant
β_i(i=1,..., k) : are model parameters
X_i (i=1,..., k) : are independent variables
ε_i : is random error

The gender differences was considered independent variable while the model variables were age, farm size, occupation, education level, and land tenure, access to extension services and access to market. The dummy variables from the nominal variables namely gender, education level and access to extension services were used as explained above.

2.6.1 Dependent variable

The farmers' involvement in conservation was measured by farmers' level of involvement in conservation activities: Seed selection (S.S), seed preservation (S.P) and seed storage (S.T). Each activity was coded using a 3 point Likert type scale with 3=Involved,

2=occasionally involved and 1=Not involved. Crop conservation index (C.C.I) was computed by summing up all the scores of all the activities to derive the mean score so that the higher the C.C.I, the higher the farmer's involvement. The index was computed using the equation shown in formula 4:

$$C.C.I = \frac{S.S + S.P + S.T}{3} \quad (4)$$

3. RESULTS AND DISCUSSION

The social and economic 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 indicating that the majority of respondents were females in Mumias while in Butere, the majority were males. However, 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 [17] 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 [18] who established more involvement of female farmers in the production. These characteristics are also associated with orphan crops [19].

Analysis of the distribution of the farmers by highest education level per district and further tested using chi-square test at $\alpha = 0.05$ significance level indicated that the relationship between the district and the education level is not statistically significant p-val = 0.938 > 0.05. 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. 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 (see Table 3). Most of the farmers had attended primary school which contrasts with findings reported elsewhere by [17] and [20], 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 adoption 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. This included the mean, standard deviation, standard error and the minimum and maximum. 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 [17]. Higher productivity was associated with males and female farmers in the productive age class [17]. 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 was 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 agedand young farmers, there could be risk of erosion of the indigenous knowledge. This knowledge may be required for the improvement of production, utilization and conservation of Bambara groundnut. Other studies have established a significant relationship between age and sources of information [21]. 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. Generally, most farmers owned average farm size of 2.98 acres. 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 Mumiasdistricts 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. 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 [22]. 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 Mumiasdistricts. However, other studies 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 [23].

3.1 Crop Utilization

Bambara groundnut utilization was examined by specifically analyzing the aspects of food preparation, sales and a social capital. The specific analyses are presented in the following subsections. The Bambara groundnuts are normally used in food preparation. The research sought to determine the level of gender involvement in food preparation as presented in Table 1. The results reveal that the female farmers were more involved in food preparation than the male farmers in the two districts. There was significant relationship between gender and involvement of the farmer in the preparation of food from Bambara groundnut. Female farmers were more involved in the food preparation and this has remained in their domain. The chi-square test showed a significant relationship between gender and farmers' involvement in food preparation. The male farmers were least involved in Bambara groundnut utilization however food preparation was primary responsibility of female farmers. It suggests that the females were more decisive to make choice of product and Bambara groundnut was priority food crop for household consumption [24].

The analysis of gender involvement in selling is presented in Table 1. The chi-square finding reveals a significant relationship between gender and farmers' involvement in the sale of Bambara groundnut in both Mumias and Butere districts. The result indicates that female

farmers in both districts were more involved in the sale of Bambara groundnut compared to the male farmers. This implies that female farmers control cash from the sale of the Bambara groundnut. The finding concurs with [25], which found more female farmers involved in selling of peanut as snack in the market compared to males.

The study also sought to find out the level of gender involvement in Bambara as a social capital. The frequencies and percentages presented in a cross tabulation were utilized in addition to the chi-square test at 5% significance level (Table 2). The results indicate that in both districts, females were highly involved in utilizing Bambara as social capital compared to males. In addition, the relationship between gender and involvement in Bambara as a social capital was significant at $\alpha = 0.05$ significance level.

The overall gender involvement in crop utilization by gender per District was analyzed by use of crop utilization index (CUI) as presented in Table 2. In general, there existed a significant relationship between gender and involvement in Crop Utilization activities in the two Districts at 5% significance level. Women seemed to be more involved in crop utilization activities compared to males in both districts. The calculated CUI was further subjected to more analysis using the descriptive statistics presented in Table 3. The CUI was higher for females in both Mumias and Butere compared to the males. This implies that the females had a higher level of involvement in crop utilization activities. The analysis of variance in Table 4 shows that there was a significant difference in the means of the CUI for the females and males in the two districts at $\alpha = 0.05$ significance level. Utilization activities were exclusively female domain and it could be explained by their dominance in production of the crop for household consumption. There was significant relationship between gender and farmer's level of involvement in Bambara utilization activities in Butere and Mumias districts. This implies that female farmers were highly involved in utilization activities than male farmers despite their age, education level, farm sizes and access to the market. The regression model was significant ($P<0.05$) and therefore adequate to explain variation in the Crop Utilization Index (CUI) as presented in Table 5.

3.2 Crop Conservation

Assessment of these activities involved a study of the following main aspects; seed selection for future, seed preservation and seed storage. Table 6 presents the frequencies, percentages and the corresponding chi-square test for the gender involvement in seed selection. The female farmers were highly involved in seed selection activities compared to male farmers in all the two districts. A chi square analysis further revealed a significant relationship between gender and farmers' level of involvement in seed selection activities ($p=0.000$ and 0.001) for Mumias and Butere respectively. Findings by [26] also established similar findings with more involvement of female farmers in the selection of crop varieties. A chi square value further revealed a significant influence of gender on farmers' level of involvement in seed storage activities. Female farmers are known to take upon themselves the responsibility to adopt different preservation technology [27]. As such, women considered Bambara groundnut their crop compared to other cash crops. Involvement of female farmers in seed selection plays an important role in the conservation of genetic diversity driven by their varied preferences. For example, Andean female farmers selected potatoes with characteristics that reflect their cooking requirements [28]. Female farmers were estimated to select and conserve significant proportion of seeds of beans as planting material among smallholders in Rwanda [28].

Table 1. Gender involvement in food preparation and selling by district

District	Gender of respondent	Gender involvement in food preparation			Gender involvement in selling		
		Not involved	Occasionally involved	Involved	Not involved	Occasionally involved	Involved
Mumias	Male	18	2	3	5	17	1
		78.3%	8.7%	13.0%	21.7%	73.9%	4.3%
	Female	0	0	32	0	6	26
		.0%	.0%	100.0%	.0%	18.8%	81.3%
	Total	18	2	35	5	23	27
		32.7%	3.6%	63.6%	9.1%	41.8%	49.1%
		X^2 = 43.727	df = 2	p-val = 0.000		df = 2	p-val =0.000
Butere	Male	25	5	5	11	12	12
		71.4%	14.3%	14.3%	31.4%	34.3%	34.3%
	Female	5	2	23	5	3	22
		16.7%	6.7%	76.7%	16.7%	10.0%	73.3%
	Total	30	7	28	16	15	34
		46.2%	10.8%	43.1%	24.6%	23.1%	52.3%
		X^2 = 25.959	df = 2	p-val = 0.000	X^2 = 10.267	df = 2	p-val =0.006

Table 2. Gender involvement in Bambara as social capital and in crop utilization activities

District	Gender of respondent	Gender involvement in social capital			Crop utilization index		
		Not involved	Occasionally involved	Involved	Not involved	Occasionally involved	Involved
Mumias	Male	17	4	2	14	8	1
		73.9%	17.4%	8.7%	60.9%	34.8%	4.3%
	Female	3	1	28	0	4	28
		9.4%	3.1%	87.5%	.0%	12.5%	87.5%
	Total	20	5	30	14	12	29
		36.4%	9.1%	54.5%	25.5%	21.8%	52.7%
		X^2=33.559	df = 2	p-val = 0.000	X^2 = 40.072	df = 2	p-val = 0.000
Butere	Male	19	9	7	14	18	3
		54.3%	25.7%	20.0%	40.0%	51.4%	8.6%
	Female	5	1	24	4	3	23
		16.7%	3.3%	80.0%	13.3%	10.0%	76.7%
	Total	24	10	31	18	21	26
		36.9%	15.4%	47.7%	27.7%	32.3%	40.0%
		X^2=23.645	df = 2	p-val = 0.000	X^2= 31.456	df = 2	p-val = 0.000

Table 3. Descriptive statistics for crop utilization index

District	Gender	N	Mean	SD	SE	Minimum	Maximum
Mumias	Male	23	1.51	.448	.093	1	3
	Female	32	2.86	.315	.056	2	3
	Total	55	2.30	.772	.104	1	3
Butere	Male	35	1.70	.587	.099	1	3
	Female	30	2.60	.713	.130	1	3
	Total	65	2.12	.785	.097	1	3

Table 4. ANOVA for crop utilization indices across gender by district

District	Source of variation	Sum of Squares	Df	Mean Square	F	p-value
Mumias	Between Groups	24.654	1	24.654	174.332	.000
	Within Groups	7.495	53	.141		
	Total	**32.149**	**54**			
Butere	Between Groups	12.947	1	12.947	30.799	.000
	Within Groups	26.483	63	.420		
	Total	**39.429**	**64**			

Table 5. Regression analysis for crop utilization

Variable	Variable/Dummy	Estimate	Std. Error	T	p-value
Constant	(Constant)	1.754	.607	2.888	.005
Gender	Female	1.065	.108	9.852	.000
Age	age (years)	-.005	.005	-1.115	.268
Education Level	Primary level	-.236	.251	-.942	.349
	Secondary level	-.174	.256	-.680	.498
	Post-secondary level	-.478	.420	-1.139	.257
	Diploma level	.283	.494	.574	.567
Land Tenure	Owner with title deed	-.015	.408	-.036	.971
	Owner without title deed	-.108	.404	-.266	.791
	Communal ownership	.068	.419	.161	.872
Farm size	Farm size (acres)	.030	.024	1.247	.215
Main occupation	F full time farmer	.062	.315	.198	.843
	Part time farmer	.363	.319	1.137	.258
	Business/trader farmer	.184	.365	.506	.614
Access to market	Distance to the nearest local market	.034	.024	1.403	.163

Dependent Variable: Crop Utilization Index, Adjusted R-Square = 49.6%, Regression ANOVA F-test = 9.308, p-val= 0.00

The findings presented in Table 6, it is evident that more females than males were involved in seed preservation activities in both districts with 90.6% and 66.7% of female respondents in Mumias and Butere respectively. Males exhibited low participation with only 13% and 45.5% of male respondents participating in the activity in Mumias and Butere respectively. The results revealed that majority of the female farmers were more involved in seed preservation activities compared to male farmers (Table 6). A chi-square test further revealed a statistically significant relationship between gender and farmers' involvement in seed preservation at $\alpha = 0.05$ for farmers in Mumias (p-val = 0.000) but not for Butere (p=0.209).

With regard to gender involvement in seed storage and crop conservation issues, there were more female farmers than male farmers involved in seed storage activities in both Districts as shown in Table 7. The chi square test further revealed a significant relationship between gender and farmers' level of involvement in seed storage activities for the two districts. Female farmers take upon themselves the responsibility to adopt different preservation technology [19].

The overall involvement in crop conservation activities was analyzed using the crop conservation index (CCI) and the frequencies and percentages in addition to the chi-square analysis are presented in Table 7. There were more female farmers involved in the crop conservation activities than the male farmers in the two districts. The result revealed that crop conservation activities was exclusively a female task and this was attributed to the role women played in the conservation of crop diversity at the farm level. It has been established that female farmers decide on the amount of seed stored and the variety [28]. It also states that the role of women in the selection of seeds begins when the crops come into flower; they observe crop growth throughout whole life cycle to identify and select seeds of the best individual crop [28]. The relationship between gender and overall farmers' involvement in crop utilization was statistically significant at $\alpha = 0.05$ as revealed by the chi-square.

The descriptive statistics for the CCI is presented in Table 8. The results indicate that female farmers had higher CCI than their male counterparts. The findings suggest that female farmers had higher level of involvement in the conservation activities (mean index of 2.71 and 2.54) than the male farmers (1.8 and 2.04) in both districts. Thus, the crop conservation activities were exclusively a female task and this was attributed to the role women played in the conservation of crop diversity at the farm level. It has been established that female farmers decide on the amount of seed stored and the variety [18]. In fact, the role of women in the selection of seeds begins when the crops flower, they observe crop growth throughout whole life cycle to identify and select seeds of the best individual crop. Similarly, female farmers were associated with the conservation of underutilized species [26]. However, this does not necessarily meet a larger proportion of household food demand but those species entirely used by specific communities to complement diets. For example, female farmers grow different crops from men and these crops were identified as "women's crops". These included groundnuts, pumpkins, leafy vegetables, cowpeas, cucumbers and sweet potatoes [29], which has the effect of raising farm biodiversity and enhance household resilience to food insecurity. The NBSAP of Bhutan recognized that under-used species contribute substantially to household food and livelihood security. It was reported that these crops were often managed and harvested by female farmers [30].

There was statistically significant relationship between gender and the level of farmer involvement in Bambara conservation activities in the two districts. That is, the difference in the means for the Crop Conservation Index (CCI) was statistically significant (Table 9). This finding depicted high level of involvement of female farmers in the utilization and they highly dominated. In order to find out the difference in the means of CCI, the ANOVA presented in Table 10 was used. In conservation, it is also noted that women play an important role. In Brazil for instance, it's been recorded that women as the primary health care providers in the family, know more medicinal uses of plants than men do. In this respect, middle aged to elderly women constitutes cognitive repositories of traditional ethno-medical knowledge whereas younger women and men show little interest in learning the identities and uses of local plants [12].

Table 6. Gender involvement in seed selection and preservation for future by district

District	Gender involvement in seed selection for future				Gender involvement in seed preservation		
	Gender of respondent	Not involved	Occasionally involved	Involved	Not involved	Occasionally involved	Involved
Mumias	Male	5	15	3	3	17	3
		21.7%	65.2%	13.0%	13.0%	73.9%	13.0%
	Female	3	0	29	0	3	29
		9.4%	.0%	90.6%	.0%	9.4%	90.6%
	Total	8	15	32	3	20	32
		14.5%	27.3%	58.2%	5.5%	36.4%	58.2%
		X^2=36.119	df = 2	p-val = 0.000	X^2=33.345	df = 2	p-val = 0.000
Butere	Male	14	8	13	15	4	16
		40.0%	22.9%	37.1%	42.9%	11.4%	45.7%
	Female	6	0	24	7	3	20
		20.0%	.0%	80.0%	23.3%	10.0%	66.7%
	Total	20	8	37	22	7	36
		30.8%	12.3%	56.9%	33.8%	10.8%	55.4%
		X^2=14.169	df = 2	p-val = 0.001	X^2=3.130	df = 2	p-val = 0.209

Table 7. Gender involvement in seed storage and overall involvement in crop conservation activities by district

District	Gender of respondent	Gender Involvement in Seed Storage			Crop Conservation Index		
		Not involved	Occasionally involved	Involved	Not involved	Occasionally involved	Involved
Mumias	Male	15	5	3	6	15	2
		65.2%	21.7%	13.0%	26.1%	65.2%	8.7%
	Female	3	13	16	3	0	29
		9.4%	40.6%	50.0%	9.4%	.0%	90.6%
	Total	18	18	19	9	15	31
		32.7%	32.7%	34.5%	16.4%	27.3%	56.4%
		X^2 = 19.500	df = 2	p-val = 0.000	X^2 = 39.090	df = 2	p-val = 0.000
Butere	Male	13	5	17	12	10	13
		37.1%	14.3%	48.6%	34.3%	28.6%	37.1%
	Female	6	0	24	6	1	23
		20.0%	.0%	80.0%	20.0%	3.3%	76.7%
	Total	19	5	41	18	11	36
		29.2%	7.7%	63.1%	27.7%	16.9%	55.4%
		X^2 = 8.439	df = 2	p-val = 0.015	X= 11.827	df = 2	p-val = 0.003

Table 8. Summary of descriptive statistics for crop conservation indices in Mumias and Butere

District	Gender	N	Mean	SD	SE	Minimum	Maximum
Mumias	Male	23	1.80	.500	.104	1	3
	Female	32	2.71	.477	.084	1	3
	Total	55	2.33	.662	.089	1	3
Butere	Male	35	2.04	.820	.139	1	3
	Female	30	2.54	.800	.146	1	3
	Total	65	2.27	.843	.105	1	3

Table 9. Summary of ANOVA for Crop Conservation Indices

District	Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Mumias	Between Groups	11.112	1	11.112	46.913	.000
	Within Groups	12.553	53	.237		
	Total	23.665	54			
Butere	Between Groups	4.142	1	4.142	6.304	.015
	Within Groups	41.390	63	.657		
	Total	45.532	64			

Table 10. Regression Analysis for Crop Conservation Indices

Variable	Variable	Estimate	Std. Error	T	p-value
Constant	(Constant)	2.344	.760	3.086	.003
Gender	Female	.747	.139	5.367	.000
Education level	Primary level	-.029	.307	-.093	.926
	Secondary level	.110	.312	.354	.724
	Post-secondary level	.010	.508	.020	.984
	Diploma level	-.089	.607	-.147	.884
Marital status	Married	-.513	.416	-1.233	.221
	Widowed	-.789	.441	-1.790	.076
Land Tenure	Owner with title deed	-.389	.500	-.778	.438
	Owner without title deed	-.478	.498	-.960	.339
	Communal ownership	.050	.513	.098	.922
Farm size	Farm size (acres)	.049	.030	1.654	.101
Main occupation	Full time farmer	.373	.264	1.411	.161
	Part time farmer	.312	.272	1.148	.254
	Employed/salaried farmer	.392	.453	.865	.389
Access market	Distance to the nearest local market	.021	.030	.710	.479
Accessibility to extension services	Extension Not Easy	.023	.200	.117	.907
	Extension Easy	-.307	.203	-1.514	.133

Dependent Variable: Crop Conservation Index, Adjusted R-square = 35.7%, Regression ANOVA F value = 3.021, p-val= 0.000

The regression analysis was further employed to analyze the relationship between the CCI and several other independent variables observed (Table 10). The nominal variables were

transformed into dummy variables to facilitate the analysis using the regression model after coding. The results indicate that the gender of a farmer highly influences variation in the CCI in the presence of other predictor variables. The independent variables contributed to around 35.7% of the dependent variables. The regression was also statistically significant at $\alpha = 0.05$ significance level.

During the Rio Earth Summit Declaration of 1992, it was noted that rural people's roles, as food producers and food providers link them directly to the management and sustainable use of agro biodiversity [31]. Further, through daily work, they have accumulated knowledge and skills concerning their ecosystems, local crop varieties, agricultural systems and the nutritional values of various underused plants. They have also become adept at maintaining their own scarce resources, however, men and women act differently, because of their socially ascribed roles; therefore they have different sets of knowledge and needs. This calls for attention on how male and female farmers can contribute differently at the farm level. Experience shows that agricultural, environmental and related policies and programmes do not differentiate between male and female farmers. Therefore, they often fail to recognize the differences between men's and women's work, knowledge, contributions and needs. This has significant consequences for biodiversity as well as for gender equality [32]. In view of the above literature review, the connection between gender and the production, utilization and conservation cannot be understated.

These findings have implications for the agricultural extension agents, policy-makers and development partners: First, 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 (2) 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. Second, 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 purposes and (2) 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. Third, governments 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: (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. (2) 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.

4. CONCLUSION

Gender is a critical factor that influences participation of male and female farmers in utilization and conservation of Bambara groundnut. In Mumias District, the level of involvement of farmers by gender in these activities was highly significant with female farmers exhibiting higher participation than males. This 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 continue with the cultivation of Bambara since it plays a role in the household food security. In Butere, the difference in participation in the activities is only evident in those activities universally associated with women including; food preparation while the men participated in activities associated with social capital like seed selection. This observation can be attributed to the gaining popularity of Bambara as an alternative cash crop in the absence of a major cash crop like Mumias. 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.

5. RECOMMENDATION

The findings are based on the inherent limitations of the study. First, since the study covered only two districts in the western Kenya region and this makes it difficult to claim the applicability of the findings to the larger regions with different economic, social and cultural differences. To find out if the findings of this study are consistent, it will be necessary to continue the research on a larger-scale taking into account many regions with diverse economic, social and cultural differences. Second, 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. A comparative study of regions that grow cash crop and non-cash crop may also be considered.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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