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RESEARCH ARTICLE

DIAGNOSTIC STUDY OF BAMBARA GROUNDNUT PRODUCTION, MARKETING, AGRONOMIC PRACTICES FOR FOOD SECURITY AND INCOME IN KAGERA REGION, TANZANIA

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ABSTRACT

The diagnostic study of Bambara Groundnut (BG) (*Vigna subterranean* (L.) Verdc) production, marketing, agronomic practices was conducted in four villages sampled from two districts of Missenyi and Muleba in Kagera region, Tanzania, East Africa. The results indicated that about 93.3% of the farmers involved in BG production were female and children of less than 20 years old. Male (6.7%) were involved in land preparation in so known as assisting their women during cultivation, that means male were indirectly participating in BG production. Age wise the majority (59.2%) had age between 41 to 50, followed by elderly (20.8%) of age >50 who were involved fully in Bambaranut production compared to (20%) of age <41. The results indicated that most BG farmers had attended at least primary education (94%). Bambara groundnut production was mainly in small holding ( $\leq 0.5$ ha) of about (88.3%). The 99% of BG farmers intercrop the bambaranut plants with other crops especially with cassava (*Manihot esculentum*) while (1%) sole plant the crop. Two planting system were identified in Kagera region; Farmers plant BG on ridges along and across the hills in Missenyi and Muleba districts respectively. The yield of BG generally was low (150-400kg ha<sup>-1</sup>) due to lack of improved seeds (89.2%), pests and diseases especially Fusarium wilt (35%), gender imbalance, land tenure system were mentioned as constraints of the production of BG. It was noted that high price of BG of approximately 1.6-2.0\$ kg<sup>-1</sup> compared to beans which costs approximately 0.75-8.00\$ kg<sup>-1</sup> in retail basis. Thus encourages few farmers continue growing BG in the region. However, the informal marketing system was ranked highest in the study areas. Scientific investigation of the formal marketing of BG in Kagera region and Africa in large might be necessary to ensure household income.

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INTRODUCTION

Bambara groundnut (*Vigna subterranean* (L.) Verdc) has been an indigenous African leguminous crop which cultivated in the tropical regions of sub-Saharan Africa for many centuries (Zengeri and Mupamba, 1995). As the global population grows and incomes in poor countries rise, the demand for food put additional pressure on sustainable food production. Agricultural research has been traditionally focused on the few known staple crops such as maize, common beans and paddy. The relatively little has been given to known as minor

(neglected) crops such as Bambara groundnut (*Vigna subterranean* (L.) Verdc). The minor crops considered neglected at a global level were stables at a national or region level Hillocks, et al. (2011). Bambara groundnuts were produced for local consumption, sales and never enter world trade Heller et al. (1995) unlike other legumes crops such as common beans. Bambara groundnuts grow to the ground and the nut was produced underground therefore, it was difficult crop to harvest machinery which discourages large-scale commercialization (Mkandawire, 2007). It is an ideal crop for small scale farmers who harvest by hands. The crop yields reasonably well on poor soils in areas of low rainfall (500-800 kg ha<sup>-1</sup>) and can be grown without fertilizers and chemicals which are costly and often difficult to access in more remote

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areas (Mkandawire, 2007). The BG is useful in crop rotation because it improves soils thus contributes nitrogen at a level compared to other legumes (20-100kg ha<sup>-1</sup>) to the soil (Ncube and Twomlow, 2007). In Tanzania, like in many parts of Africa the crop is usually grown by women and it is given a lower priority within the communities to the allocation of land (Gibbon and Pain, 1985; Mkandawire and Sibuga, 2002; DFID, 2010). The seeds for growing Bambara groundnuts were rarely purchased by farmers. The women were responsible for passing the seeds down through the generations, and storing the dried beans for food security (Kock, 2011). Bambara groundnuts were grown predominantly on the flat but sometimes, on mounds or ridges which may be beneficial in wetter areas as the crop does not tolerate water-logging (Mkandawire, 2007). Like other farmers in Africa, the crop has been intercropped in Kagera region with maize and cassava Ibeawuchi, 2000). The planting in Kagera, region takes place in two seasons August/ September, while harvesting were done 5-6 months later which was similarly reported in Zimbabwe (Mkandawire, 2007).

Furthermore BG has various uses which may enhance the appreciation of the food, nutritional and health values of the seed Okpuzor, *et al.*, (2010). The BG belongs to the group of the seeds perceived (labelled) under-utilized and neglected because it takes time to cook and does not be de-hulled easily Hillocks, *et al.*, (2011). The Bambara groundnuts have several advantages when compared with other legumes crops. According to Adu-Dapaah and Sangwan (2004) the BG is rich in iron and the protein Okpuzor *et al.* (2010) strongly recommended for mass production. Despite its potential lack of detailed research has been reported (Linnemann and Azam-Ali, 1991). Therefore the experiences systematically documented and compared across the project countries to draw out broader lessons and principles for adaptation of Bambara groundnut production for income and food security in Africa.

## MATERIALS AND METHODS

### Location and sampling procedures

The Agro Ecological Zonation system was used in the sites selection. Two districts were selected that is Missenyi and Muleba districts as shown in (Figure 1), from each district, two villages were purposively selected with the consultation of the District Agriculture Irrigation and Cooperative Offices. A total of four villages which were famous in growing bambara groundnuts in Kagera region were selected. The villages were Lukulungo and Kataale in Missenyi district, Buleza and Mayondwe in Muleba district. The villages were the leading bambara groundnuts growing. By using the village register book thirty (30) households were randomly selected from each village. A total of 120 households were selected for the study in the four villages of two districts.

### Data collection and analysis

The data was collected using structured questionnaire and administered to individual farmers in all the villages surveyed. In addition to the structured questionnaire, The Focus Group Discussions (FGDs) were conducted in each surveyed village comprised with some experienced and famous farmers, traders of different ages and gender. The data captured included acreage, production (yields), variety grown, bambara groundnut production practices, cost of production, prices, buyers, production and market constraints. During Focus group discussion by using the checklist included volume traded, prices, sources of stock and substitute products the FGD included traders, retailers and consumers as key informants. The secondary data were collected from the DAICOS's offices of the respective districts and other data from the Naliendele Agriculture Research Institute. The collected data was analysed through Statistical Package for Social Sciences (SPSS).

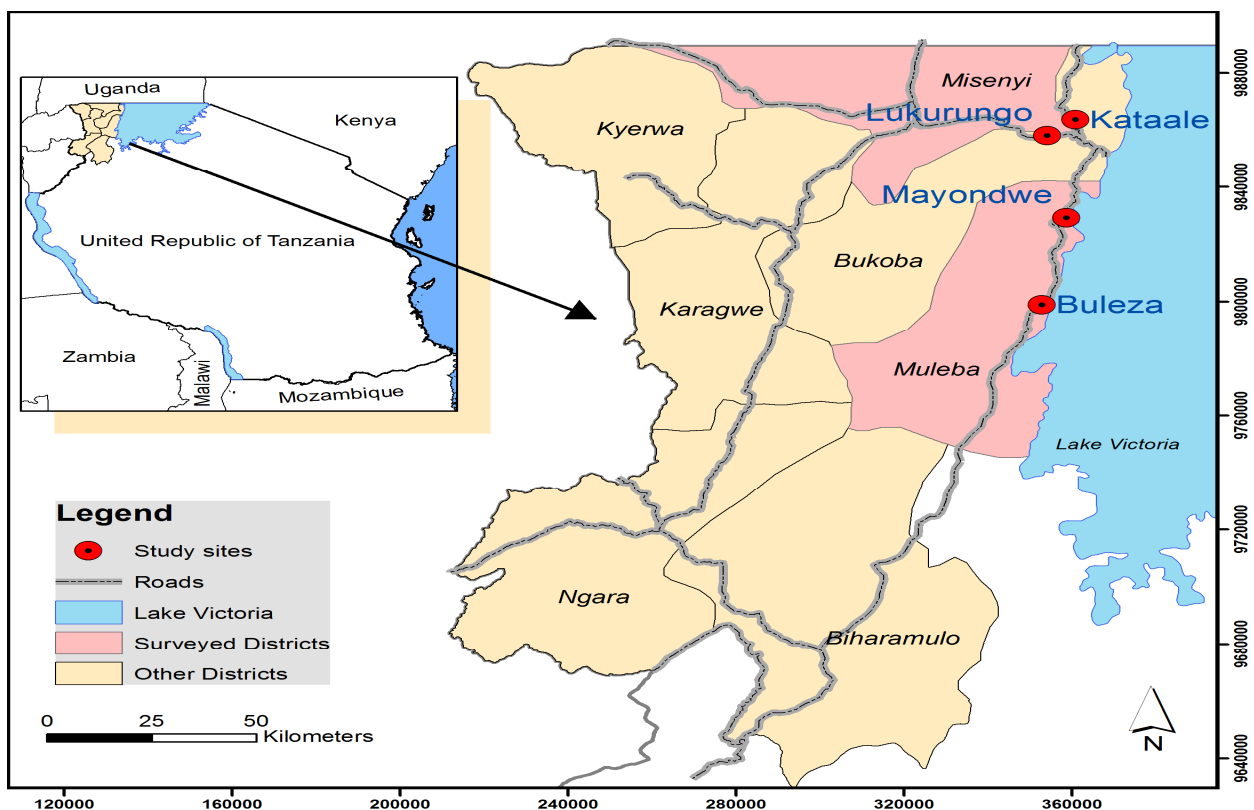


Figure 1. Map showing the study sites of Kagera region. Developed by: G.M; Karwani

## RESULTS

### Distribution of respondents

A total of 120 households participated in the interview and the respondents were mostly females (79.2%) while (20.8%) were males in the study area (Table 1). The average household had engaged fully in farming activities this provided a good platform for data collection. It was identified that women was usually responsible of most leguminous crops such as beans, pigeon peas and other crops of daily home consumption.

**Table 1. Distribution of respondents from the different districts**

Information item	Respondents in the study villages (n=120)				Percentage (%)
	Lukurungo	Kataale	Mayondwe	Buleza	
Female	26	23	22	23	79.2
Male	4	7	8	7	20.8
Total					100.0

### Age of respondents

The study also identified that the majority (59.2%) had age between 41 to 50, followed by elderly (20.8%) who were involved fully in bambaranut production compared 20% of age <41. This could be a result of perception by the majority that the crop is associated with the elderly (Table 2).

**Table 2. Age of respondents with respect to Bambara groundnuts production**

Age	Frequency (n=120)	Percentage (%)
<20	5	4.2
20-30	9	7.5
31-40	10	8.3
41-50	71	59.2
>50	25	20.8
Total		100.0

### Education Qualification of Bambara groundnut Respondents

The results (Table 3) also shows that majority (94%) of the respondents was attained primary school. Education could affect the understanding of adoption of the farming practices of Bambaranut. During focus group discussions, the farmers indicated that the literate people were the ones that broke the cultural barriers (taboos) associated with bambara groundnuts production. In subsequent interventions it would therefore be important to target some literate people to promote bambaranut production especially in areas such as Lukurungo and Kataale in Missenyi district. The bambaranut farmers in these villages have strong beliefs (taboos) that were strongly limiting bambaranut production. It believed that it is women crop and the planting should be along the hills.

**Table 3. Education qualification of respondents**

Education qualification	Frequency (n=120)	Percentage (%)
Informal education	4	3.0
Adult alphabetization	4	3.0
Primary school	112	94.0
Total		100.0

### Gender involvement in Bambara groundnut cultivation

In all the focus group discussions, the respondent agreed and concluded that bambara groundnuts were mostly grown by

women (93.3%) and mostly are of age above 41 years old compared to men (6.7%) who have been involved in land preparation (Table 4). The children have been also engaged in land preparation and some of operation of BG for example field guiding from wild animals (monkeys) and vermin like guinea fowls. During group discussions the participants said that the crop is unpopular with men because it has tedious work. The activities mentioned to tedious for men were earthing up also the crop consume much time from land preparation to harvesting. The crop is believed to be women crop because mainly grown for food, used as relish of which was responsibility of women in home. Support gender involvements in bambaranuts especially men who have been limited involved. Literate could encourage good agricultural practices and discourage the ridges which were constructed along the slope of which associated with the taboos.

**Table 4. Gender involvement in Bambara groundnut cultivation**

Information	Frequency (n=120)	Percentage (%)
Female	112	93.3
Male	8	6.7
Total		100.0

During focus group discussions it was pointed out that some men were involved during land preparation and agreed that the crop was grown by people from income levels. However, they admitted that it depends on individual preference and background. Those families engaged in bambara groundnut they find the crop is very useful and continue growing the crop.

### Land use and allocation

#### Land owned by respondents

There have been three land use system in Kagera region which were Kibanja (coffee and Banana), Kikamba (abandoned kibanja) and Rweya the virgin land (common land). The Rweya believed to be marginalized and used for grazing animal and sometimes fetching grass for Kibanja. The Rweya also have been used for Bambara groundnuts cultivation. In recent years the Rweya in Kagera region farming system have become appropriate to individuals. The tensions and disputes arising from competition for available land resources, restriction on access to such resources has negative impacts on the productivity of bambara groundnuts. Table 5 shows that the average land holding size of the respondents was 1-3 hectares (81.7%), the responds with less than 1 hectare were (9.2%), and about (8.4%) had >5 hectares of land.

**Table 5. Total land owned by respondents**

Hectare	Frequency (n=120)	Percentage (%)
<1	11	9.2
1-3	96	80.0
>3	13	10.8
Total		100.0

#### Land ownership by respondents based on gender

About 60% of land was owned by men, the land owned by women was 8.3% but those were widow or separated. 31.7% reported the land ownership being shared both men and women which seem to be an improvement to traditional beliefs which oppress the women (Table 6). The Haya tribe were

dominating in Kagera region and traditionally the women cannot own land.

**Table 6. Land ownership by respondents based on gender**

Information	Frequency (n=120)	Percentage (%)
Female	72	60.0
Male	10	8.3
Both	38	31.7
Total		100.0

### Area under cultivation of Bambara groundnuts by respondent

The land shortages makes the people give first priority to crops that they feel were important and profitable like banana, maize, beans for food and cash crops like coffee and timber trees (pines). The area under cultivation of bambara groundnuts were less compared to the land owned by respondent (Table 7). The Bambara groundnut production was in small holding of (0.06-0.12) as majority falls 42.5%. Only 11.7% of the farmers had more than 0.5 hectare under Bambara groundnut production.

**Table 7. Area under cultivation of Bambara groundnuts by respondent**

Hectare	Frequency (n=120)	Percentage (%)
<0.06	13	10.8
0.06-0.12	51	42.5
0.13-0.24	23	19.2
0.25-0.49	19	15.8
≥0.5	14	11.7
Total		100.0

### Crop husbandry

#### Planting practices

Land preparation was done by hand of the all farmers in the study area. The earthing up practice was also done by 100% to all Bambara groundnut farmers to facilitate the yielding, and they said that it facilitating the pods to become bigger and prevent the crop from sun burn. The pods also were prevented from being exposed to vermin like birds. Another practice was growing the bambara groundnuts on ridges (seedbeds). All farmers practiced ridges construction with different ways from one district to another. In Lukurungo and kataale villages of Missenyi district, the bambara groundnuts were grown in ridges constructed along the hills (50%) which is contrary to the soil and water conservation practices. It was agreed that during focus group discussion that was a taboo which do not allow women to construct the ridges across the hill because abuse the women father in law and may make him impotence. In Mayondwe and Buleza villages of Muleba districts the ridges was constructed across the hill (50%) which were advocated by agricultural experts as shown in the Table 5.

**Table 8. Planting practices**

Practices	Frequency (n=120)	Percentage (%)
Ridges along the slope	60	50.0
Ridges across the slope	60	50.0
Total		100.0

### Constraints of Bambara groundnuts production challenges

#### Seed system

Seed system was one of the important production factors that affects yields of bambara groundnuts. It founded that there is

limited availability and accessibility of improved seeds. Lack of seed (Table 9) was cited by 89.2% of the respondents as one of the challenges facing bambara groundnut production. Poor accessibility of improved seeds or from other sources was found also as the limiting factor to BG production despite only few (10.8%) can at least access the bambara groundnut seeds. The seeds of the crop were found with very few individuals, mostly the elderly.

**Table 9. Availability of the Bambara groundnut in Kagera region**

Seed availability constraints	Frequency (n=120)	Percentage (%)
Accessibility of seeds	13	10.8
Lack of seeds	107	89.2
Total		100.0

Table 10 shows the sources of seeds as planting materials, the use of reserved and recycled seeds by farmers were the main (45.1%), followed by provision of recycled seeds by relatives (33.1%) and purchasing from the local markets (21.1%). The farmers had never accessed the researched Bambaranut seeds (improved seeds) or any information from the researchers on Bambara groundnuts. The lack of seeds also was associated with funds whereby the farmers who do not have funds for purchasing seeds it was difficult to access the seeds from the local markets. It was evident that the seed shortages was a major challenge to most farmers and persuade continuous usage of local varieties in Kagera region.

**Table 10. Source of planting seeds of Bambara groundnut by respondents**

Source of planting materials	Frequency (n=120)	Percentage (%)
Reserved seeds and recycled seed	54	45.1
Recycled seed from elderly/friends/neighbours	40	33.1
Local markets	26	21.1
Total		100.0

### Pests and diseases

The table 11 below shows the pests and diseases that farmer experiences in the areas in which the study was carried out. The diseases affecting bambara groundnuts were Fusarium wilt (35%), leaf spots (25%), stem rot (12.5%). The vermin, monkeys were reported to have caused major attack by 13.3%. The termites were reported by 8.4% of the respondent while aphids were reported in few cases and not taken as serious case.

**Table 11. Pests and diseases in Bambara groundnut production**

Pest and diseases	Frequency (n=120)	Percentage (%)
Fusarium wilt	42	35.0
Stem rot	15	12.5
Leaf spots	30	25.0
Termites	10	8.4
Monkey/guinea fowl/ small ruminants	16	13.3
Bruchids	7	5.8
Total		100.0

### Extension services for Bambara groundnut farmers

From the study (Table 12), the majority (94.2%) had accessed the extension services. However, during focus group

discussions the farmers reported that they did not receive any information on bambara groundnuts production. The extension services provided were for other crops such as banana and coffee. The farmers they did not bother to ask any information regarding bambara groundnuts from the visited extension workers. About 5% at least met researchers but were researching for Banana Xanthomonas Wilt (BXW) in Lukurungo, Kataale, Bureza villages while in Mayondwe the researchers were introducing the fresh orange sweet potatoes.

**Table 12. Source of extension services**

Source of extension services	Respondents in the study villages (N=30)				Freq.	Percentage (%)
	Lukurungo	Kataale	Mayondwe	Buleza		
Extension officer	28	30	28	27	113	94.2
Researcher	1	0	2	3	6	5.0
Socio media (Radio/TV/Posters/Bronchures)	1	0	0	0	0	0.8
Total						100.0

### Bambaranut production challenges

Despite of the main challenges of bambara groundnuts production by the farmers in Kagera region identified, other challenges pointed out during focused group discussions were; Land shortage and fragmentation (land tenure system). There were shifting of planting of trees and other crops of the marginal land (rweya) used for BG production. Lack of knowledge on different products to boost the production and misconception of younger farmers towards the crop that were traditional crop (old fashioned). Poor harvest and post harvest techniques of the crop. Farmers use hand to harvest crop, of the crop, it was tedious work and caused farmers to sell their produces at low prices. They pointed also on climate change impacts which have lead to serious outbreak of pests and disease and dry spells.

### Bambara groundnuts marketing

Marketing includes all services involved in moving the commodity from the point of production to point of consumption. It comprises all functions and agencies that perform activities that were necessary in order to profitably exploit opportunities in the market. Bambara groundnuts were sold in the following forms, fresh mature pods (65.8%), dry grains (11.7%) and dry pods (22.5%) as indicated in (Table13). Bambara groundnut was grown by local people, mostly for home consumption while the surplus may be sold to individuals in the village at local markets. Seed size and color were important factors in determining the prices and marketing of bambara groundnuts.

**Table 13. Forms of selling Bambara groundnuts by respondents**

Information	Frequency (n=120)	Percentage (%)
Fresh (green) mature pods	79	65.8
Dry grains	14	11.7
Dry pods	27	22.5
Total		100.0

During focus group discussions it was found that 94 respondents (82%) used green bambaranut for home consumption and only 26 respondents (18%) sold green or dried bambara groundnuts. Therefore the marketing system of 26 respondents which were 18% (Table 14) found that 27% of the respondent sold bambara groundnuts to people within the

village while 62% of the respondents sold bambara groundnuts to informal retailers or vendors while another 11% of the respondents sold bambara groundnuts at an open market to traders who believed to be middle men or brokers. There is no formal market for bambara groundnuts, the survey shows that the most for traders and wholesales were men. The women were involved in cultivation and not selling to the end user.

**Table 14. Marketing of Bambara groundnut**

Information	Frequency (n=26)	Percentage (%)
People within the village	7	27.0
Retailers (vendors)	16	62.0
Wholesales	3	11.0
Total		100.0

### Bambara ground nuts market challenges

Table 15 shows the major market challenges contributing to the low production of the Bambara groundnuts. During focus group discussion, the participants pointed out the prices of bambara groundnuts (grain) at the local market that despite of high price of approximately 1.6-2.0\$ kg-1 compared to beans which costs approximately 0.75-8.00\$ kg-1 in retail basis and that has been revealed that low price was not a big problem. Lack of market information (91.7%) was a major constraint and leads the Bambara groundnut to remains underutilized.

**Table 15. Bambara groundnut market constraints**

Information	Frequency (n=120)	Percentage (%)
Lack of market information	110	91.7
Low price of BG	3	2.5
Long distance to the market	1	0.8
Lack of crop collection points	6	5.0
Total		100.0

## DISCUSSION AND CONCLUSION

The study showed that 93.3% of the farmers involved in BG production were female and children of less than 20 years old. The reported by Mkandawire and Sibuga (2002) and DFID (2010) also shows that female were engagement more in bambara groundnuts production. The 99% of BG farmers intercrop the bambaranut plants with other crops especially with cassava (*Manihot esculentum*) while (1%) sole plant the crop. The continued reliance on intercropping by farmers might be due to the reasons advanced by Norman (1967). The report indicated that it was relatively more profitable to grow crops in mixtures. Also Ibeawuchi (2007), Rashid *et al.*, (2007) reported that farmers intercrop due to a number of factors ranging from climatic conditions and efficient use of land

resources, risk management and high economic returns. Two planting system were identified in Kagera region; Farmers plant BG on ridges along and across the hills in Missenyi and Muleba districts respectively. The yield of BG generally was low (150-400kg ha<sup>-1</sup>) this was revealed by the report presented at the workshop in Zimbabwe (Heller et al., 1997), estimate the average yield in the smallholder sector at around 500 kg ha<sup>-1</sup>. It was noted that high price of BG of approximately 1.6-2.0\$ kg<sup>-1</sup> compared to beans which costs approximately 0.75-8.00\$ kg<sup>-1</sup> in retail basis. Thus encourages few farmers continue growing BG in the region. This might be contrary to the most substantial effort to develop BG (Mayes et al., 2009) that there was insufficient demand of BG in the formal market. However, the informal marketing system was ranked highest in the study areas. Marketing of bambaranut seem to be dominated by men and no formal market that discourages the farmers. There have been no intervention to promote bambara groundnuts in terms of the products and services. Both farmers and extension workers in separate interviews suggested programs and deliberate policies to promote bambara groundnuts. The Bambara groundnut seemed to be the important crop of the "Haya" tribe who dominates in Kagera region. Haya tribe believe that the delicious food should be served with Bambaranuts. They have a proverb which says that "even if you can't eat to neighbour but the dish served with bambaranuts do not hesitate to eat" that implies of deliciousness of the Bambara groundnuts served dishes. The traditional beliefs and taboos were identified as barriers to Bambara groundnut production. For Example; the farmers of Muleba districts believed that the BG as women crop and children.

Therefore men were reluctant and never engaged in BG production. The men believe that the crop requires much attention and it has tedious work of construction of ridges, weeding and earthing up. The farmers of Missenyi district, they do construct the ridges along the hill because of the taboos. They believe that by constructing the ridges across the hill will make women's father in-law impotence. The taboos and traditional beliefs on bambara production should be discouraged by extension services. The crop seed system was found to be poor with many constraints. Farmers had lived with the seeds and varieties for many years from passing their seeds from one generation to another with the same production practices. The Bambara groundnuts were neglected and underutilized crop in Tanzania. Little research and extension services have been undertaken on crop and no measure to effect the results on production, marketing to the farmers. The bambara groundnut varieties released have not up-scaled, thus farmers continue to grow the crop in a substance way. In order to boost Bambaranut production it recommended that the varieties developed or researches done were necessary to satisfy farmers demand to boost their yields and fight against pests and diseases. There also need to look the whole Bambara groundnut value chain from the production to end consumer. It thus important to provide some research and extension services in areas of improved varieties, harvest and post harvest handling, storage and marketing if the farmers were to reap great benefits from cultivating the crop.

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