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FARMING SYSTEMS AND PRODUCTION CONSTRAINTS OF BAMBARA GROUNDNUT (*Vigna subterranea* L. Verdc.) IN KANO STATE OF NIGERIA

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ABSTRACT

A baseline survey, using Participatory Rural Appraisal (PRA) through structured questionnaires was carried out in seven Local Government Areas (LGAs) of Kano State, Nigeria to determine production status and production constraints to Bambara groundnut (*Vigna subterranean* L. Verdc.) among 150 Bambara groundnut farmers. The local governments were selected purposively based on their importance in Bambara groundnut farming among others. Results revealed that all the respondents were male, married, and were growing Bambara groundnut. Production was largely for home consumption and sell at local markets. Planting materials were local landraces which were grown as pure or mixed seed morpho-types that are diverse in nature due to lack of improved varieties. Common production constraints to producing the crop among the farmers include, lack of improved varieties (71.3%), frequent drought (9.3%), low yields and poor market access were at (4%) each. The lack of improved varieties calls for the improvement of Bambara groundnut landraces for enhanced productivity and solutions to food security issues.

Keywords: Bambara groundnut; Farming practices; Participatory Rural Appraisal; Production constraints

INTRODUCTION

Grain legumes are the principal source of plant protein in tropical Africa among poor families (Massawe *et al*., 2005). Bambara groundnut (*Vigna subterranean* L. Verdcourt) is an under-utilized legume crop which originated in Africa and was cultivated long before groundnut (*Arachis hypogea* L.) (Goli *et al*., 1997). Like cowpea (*Vigna unguiculata* L. Walpers), another popular legume of African origin, Bambara groundnut is grown primarily for human consumption.

In addition to protein, the seed of Bambara groundnut is rich in carbohydrates and oils (Brough *et al.*, 1993). Its content of essential and non-essential amino acids is 33% and 66%, respectively (Amarteifio *et al*., 2010). Bambara groundnut compared favorably with other legumes such as soybean in essential amino acids, namely lysine, methionine and cysteine (Fetuga *et al.*, 1975). The crop is superior to mung bean (*Vigna radiate* L. Wilczek) in vitamin B (Basu *et al*., 2007).

Both fresh pods and dry seeds are used directly or processed to make different kinds of dishes. Fresh pods are boiled and eaten as snack, while dry seeds are processed into flour for the preparation of relish, such as 'Moi-moi' (a form of steamed paste), a traditional food made from soaked dry seeds, and puddled thereafter (Okpuzor *et al*., 2009). In paste form, the product is fried in oil and served with porridge at breakfast. The flour can be mixed with dry baobab leaves into paste, which is wrapped in maize leaves, and further steamed to make a traditional food, '*Tubani*'. Brough *et al*. (1993) and Massawe *et al*. (2005) reported the use of Bambara groundnut seeds in making bread and vegetable milk, respectively. These attributes makes Bambara groundnut a valuable contributor to a balanced diet, thereby alleviating food insecurity, and making an important contribution to reducing protein malnutrition, which is common in rural communities in Africa (Ouedraogo *et al*., 2008; Shegro *et al*., 2013). Bambara groundnut seeds have also been used for the treatment of diarrhoea and stomach ache (Berchie *et al*., 2010).

Bambara groundnut is grown at a subsistence level with limited inputs (Massawe *et al*., 2005), mostly by women who usually intercrop it with cereals and other legumes, such as sorghum, millet, maize and cowpea (DFID, 2002).

Yield of Bambara groundnut vary under farmer management. Baudoin and Mergeai (2001) reported yields between 300 and 800 kg ha^{-1} in Brussels, Belgium. At times yields can be unpredictable due to low inputs (Abu and Buah, 2011), and probably due to prevailing agronomic conditions such as plant population, soil and genotype differences (Goli *et al*., 1997). However, Collinson *et al*. (2000) reported that yields > 3000 kg ha^{-1} can be obtained on research farms, while in Nigeria up to 432.5 kg ha^{-1} was reported on research farm (Toungos *et al*., 2009).

Despite advantages of Bambara groundnut, the crop being under-utilized has not receive adequate research attention (Amadou *et al*., 2001) in contrast to other legumes including groundnut (*Arachis hypogea* L.), cowpea (*Vigna unguiculata* L. Walp.) and mungbean (*Vigna radiate* L. Wilczek) (Drabo *et al*., 1995). Hence, there is partly an urgent need to investigate the production status of the crop among farmers to understand their production systems and production constraints for enhanced productivity. Participatory rural appraisal (PRA) developed by Chambers (1992) was found to be useful in understanding the values between scientists and rural people. The technique requires local knowledge to address among others, existing natural resources and agricultural systems and socio-economic issues in societies needing prompt attention (Chambers, 1997; Loader and Amartya, 1999). The use of PRA approach by Kafiriti (2004) was employed to understand farmers' abilities to diagnose and classify soil, to select rice varieties; and to track the exchange of information between farmers and researchers (Abera *et al*., 2013). Fashola *et al*. (2007) used a PRA approach to assess the adoption of maize varieties among farmers in Ethiopia**,** while Sibiya (2009) and Abakemal *et al*. (2013), and Olupot (2011) applied the technique to determine the most important constraints affecting sorghum and maize production, and to track varietal preferences in Uganda and KwaZulu-Natal, South Africa, respectively. There are a few PRA studies conducted to understand the production status, constraints and utilization of Bambara groundnut in most of its growing ecologies, such as those conducted by Berchie *et al*. (2010) and Akpalu *et al*. (2013) in Ghana, while Alhassan and Egbe (2013) conducted a similar PRA in Benue and Kogi States, Nigeria. There is a need for a well-structured survey using the PRA in order to discover the hidden problems and constraints affecting the production of Bambara groundnut in Kano State of Nigeria. Bambara groundnut is a locally important grain legume, along with groundnut and cowpea,

despite the absence of any improved variety in Kano State. Therefore, this study was conducted to determine production system and production constraints faced by Bambara groundnut farmers through PRA among seven Local Government Areas (LGAs) in Kano State of Northern Nigeria.

MATERIALS AND METHOD

Study Area

The survey was conducted among seven selected local government areas of Kano State, Northern Nigeria during 2012. Kano state is located between latitudes 11^0N to 13^0N and longitudes 8^0E to 10^0E at an altitude of 484 m above sea level. Kano State is located in the Sudan Savannah zone characterized with marginal or short grasses, experiences a single maxima rainy season, which is between May/June to September/October each year, with a mean rainfall of 600 to 650 mm per annum. Mean temperature is between 30 to 35°C in the main (rain) season, and drops to 10 to 15°C in coolest dry season, which is between September and March each year. The soils in Kano are mostly moderately deep to deep and well drained with sandy loam textured surface and sandy clay loam textured subsoil (NEDECO, 1976; IAR, 1994).

Sampling Procedure

Kano State comprise of three agricultural zones (Zone I, II and III) managed by the Kano State Agricultural and Rural Development Authority (KNARDA) with their administrative headquarters located in Rano, Dambatta and Gaya, for Zone I,II and III, respectively. In this study, two local government areas (LGAs) each from Zones I and III, and three LGAs from Zone II were purposively selected based on their importance to Bambara groundnut production in the State. The selected LGAs and their zonal headquarters from which the farmers were interviewed are listed in Table 1. For the successful conduct of the survey, farmers who grew Bambara groundnut were interviewed independently and were identified with the assistance of Agricultural Extension Officers (AEOs) from KNARDA working in the respective LGAs. The AEOs also helped with the conduct of the interviews. The survey was carried out after the farmers had finished harvesting; as such house-to-house interviews were conducted. Twenty questionnaires were issued in each LGA to twenty farmers, except Gwarzo LGA, where 30 questionnaires were issued to 30 farmers. Only farmers who popularly grow Bambara groundnut in the selected villages were interviewed.

Table 1: List of the selected Local Government Areas (LGAs) for the PRA

Zonal Headquarter	LGAs	Zonal Headquarter	LGAs	Zonal Headquarter	LGAs
Zone I (Rano)	Bebeji and Gwarzo	Zone II (Dambatta)	Bambatta, Dawakin-Tofa and Rimin-Gado	Zone III (Gaya)	Gabasawa and Gaya

Data Collection

Data were collected through the use of structured interviews with questionnaires. Twenty questionnaires were issued to 20 farmers in each LGA, except Gwarzo LGA, where 30questionnaires were issued to 30 farmers. Thirty farmers evolved in Gwarzo because there were more Bambara groundnut farmers in the area than in the other local government areas. A checklist of questions was designed to help as guide to obtain the desired information from the farmers, using 15 different variables which include, age of respondent, educational qualifications, years of experience to Bambara groundnut production, production purpose and consumption methods. Others were farming systems and practices engaged by the farmers. Constraints associated with Bambara groundnut production were also recorded. However, the farmers were also encouraged to share their own views to improve the quality of information in the conduct of the survey.

Data Analysis

Data collected were analyzed using descriptive statistics (frequencies and percentages) and chi-square analyses using SPSS (2011) IBM Statistics 20.

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents

The demographic characteristics of the respondents in the study area are presented in Table 2, while the summary of chi-square tests on age group among the Bambara groundnut farmers in the seven selected LGAs in Kano State is presented in Table 3. The results showed that all the respondents (100%) were male and married. A total of 90 of the respondents (60%) were between the ages 35-50 years, while 47 above the age of 50 years represent 31.3%. This suggests that more elderly people in the area involved in the production of Bambara groundnut being an old crop. There was a significant ($P< 0.05$) difference in age categories (Table 3), where most of the farmers (60%) stood in the mid-age (36-50 years) group while 31.3% were above 50 years; and the largest contributor to this cohort was 17 farmers of this age group found in Gaya LGA. This indicated that both youths and the elders were involved in the production of Bambara groundnut in the selected LGAs of Kano State. There were relatively more elderly farmers (>50 years) in Bebeji LGA, while in Rimin-Gado LGA none of the Bambara groundnut farmers was observed within the lower 25-35 years age probably because most of the youth were involved in other businesses, may not have realised the local and economic importance of the crop being under-utilized and lacking in improved seeds, or were going to school especially tertiary institutions. Similar observation was made by Alhassan and Egbe (2013) who showed that most farmers in Benue and Kogi States in Nigeria were within the range of 41 to 50 years, whereas Abu and Buah (2011) found 97% of males and 3% of females growing Bambara groundnut were between the ages of 35 to 82 years. Although there is no data, contrary to previous report, all the farmers interviewed in the study area were male.

Table 2: Demographic characteristics of the Bambara groundnut farmers in the study area

Variable		Frequency	Percentage (%)
Gender	Male	150	100
	Female	0	0
Age Category	25-35	13	8.7
	36-50	90	60
	>50	47	31.3
Marital status	Married	150	100
	Not married at all	0	0
	Divorced	0	0
	Widowed	0	0
Educational qualification	Qur'anic	67	44.7
	Primary	37	24.7
	Secondary	33	22.0
	Tertiary	5	3.3
	Mass literacy	8	5.3
Years of experience in Bambara groundnut farming	<5 yrs	12	8
	6-10 yrs	31	20.7
	11-15 yrs	31	20.7
	16-20 yrs	31	20.7
	>20 yrs	45	30

Table 3: Chi-square tests on demographic characteristics of Bambara groundnut farmers across seven selected LGAs in Kano State, Nigeria

Variable	Chi square value	Significance
Age	29.352	0.030*
Educational Qualification	77.006	0.000*
Years of farming experience	32.709	0.110^{ns}

There was a highly significant difference ($P< 0.001$) among the Bambara groundnut farmers interviewed across the study area on their educational qualification (Table3). Most of the farmers (44.7%) had Qur'anic education to primary, secondary, tertiary and mass literacy education in that order, except for Dawakin-Tofa where most of the farmers had secondary school leaving certificates. Most of the Bambara groundnut farmers in Benue and Kogi States had benefitted from modern education (Alhassan and Egbe, 2013), probably due their proximity with southern Nigeria where western education was first introduced during the colonial era. None of the farmers in Bebeji, Gabasawa and Gaya LGs had educational qualification beyound secondary school. The result indicated a wide variation in level of education among the Bambara groundnut farmers. The popularity of Qura'anic education is in connection with the fact that Kano State is primarily dominated by Muslims where acquisition of Qur'anic education is mandatory to every Muslim. Also, while trading and agriculture remain the main occupations practiced by the indigenous people, western education came to the northern part of the country much later than in southern Nigeria. Consequently, some farmers did not have the opportunity to acquire western education during their childhood.

Chi-square response on the assessment of Bambara groundnut production experience among the Bambara groundnut farmers from seven selected LGAs in the study area did not

show any statistical variations (Table 3). This indicated that Bambara groundnut production is a stable farming practice among the farmers, and that the crop remains important with various uses. It was observed earlier that (60%) of the farmers were within the range 36 to 50 years with general farming experience; in addition, most of the farmers in the study area had >20 years of experience growing Bambara groundnut.

Farming Systems, Culture and Practices Engaged by Bambara Groundnut Farmers in the Study Area

Mixed cropping was found to be most practiced by famers in the study area represented by 89 (59.3%) of the respondents (Table 5). It is a common practice that farmers grow legumesin intercrop with cereals such as sorghum, millet and maize (DFID, 2002). However, the bambara groundnut farmers in the study area were observed thaat 95 of the repondents (63.3%) practiced planting of pure seed of under sole cropping (Table 5).

Table 4: Farming systems, culture and practices engaged by farmers

Variable	Category	Frequency	Percentage (%)
Farming system	Sole cropping	61	40.7
	Mixed cropping	89	59.3
Production culture	Pure seed: sole	95	63.3
	Sole seed: mixtures	40	26.7
	Inter-crop: mixtures	15	10

Table 5: Chi-square tests on farming systems engaged and constraints to Bambara groundnut farming across seven selected LGAs in Kano State, Nigeria

Variable	Chi square value	Significance
Farming system practiced	59.317	0.001*
Culture and Practice	132.5	0.001*
Production Constraints	58.2	0.002*

Farming systems practiced by the Bambara groundnut growers in the study were highly significantly different between respondents ($P< 0.001$) (Table 5). Most of the farmers across the study area preferred mixed cropping to sole cropping across the study area. Mixed cropping is a common practice as a means of crop escape and assured harvest especially in times of drought or flooding. However, sole cropping was more important in Gwarzo LGA, probably due to differences in cultural cropping systems (Table 4). Alhassan and Egbe (2013) reported that 30% and 66% of farmers in Benue and Kogi States grew Bambara groundnut as sole crop or as an intercrop, respectively.

The culture of Bambara groundnut production revealed highly significant ($P< 0.001$) differences among the LGAs by the Bambara groundnut farmers (Table 5). Among them, pure seed (63.3%) and seed mixtures (26.7%) were more popular than intercropping Bambara groundnut with cereals (Table 4). Conversely, inter crop of seed mixtures of Bambara groundnut was realised in Gabasawa LGA among 15 respondents probably due to diversity of the location of the location. Most farmers in Dambatta, Dawakin-Tofa and Rimin-Gado (all in Zone II) practiced sole and pure seed culture, probably because these LGAs are located in similar agro-ecology, and partly due to the location of one of the big markets in Kano State, the Dawanau Agricultural Market sited in the Dawakin-Tofa LGA

where seeds are frequently available. The influence of the presence of agricultural stakeholders in and around the localities as well as farmer-to-farmer interaction may have played a role in orienting the farmers to the demands of customers and vendors for pure seeds. It was understood that even the 'pure seed' practice *per se* was not pure in term of all possible variations, due to variable seed coat colours, seed eye colours and hilum patterns common with Bambara groundnut landraces (Mohammed *et al.*, 2016). This means that the farmers' selection was not adequate for use in breeding program.

Production Constraints to Bambara Groundnut Production in the Study Area

Farmers' constraints associated with Bambara groundnut production in the study area varied significantly ($P< 0.05$) (Table 6). Out of the nine constraints identified, lack of access to seed of improved varieties was considered to be the most important constraint which accounts to 71.3% (Table 5). This was followed by drought (9.3%), low yields (4%) and low market prices (3.3%), in that order. Less important constraints were weeds, and leaf and pod pests and diseases. Farmers' views on these constraints could be due to lack of research attention (Ntundu *et al*., 2004) that would have led to the production of improved varieties and subsequently, solve most of the related limitations that hinder production and productivity of the crop. Drought was considered to be less important among the Bambara groundnut farmers in Benue and Kogi States of Nigeria (Alhassan and Egbe, 2013), probably because these two States fall within the southern Guinea Savannah that receives more rainfall than Kano State, while Kano falls in the far Sudan Savannah zone of Northern Nigeria that receives less rainfall than Benue and Kogi States.

Table 6: Constraints associated with Bambara groundnut production in the study area

Variable		Frequency	Percentage (%)
Production constraints	Lack of improved variety	107	71.3
	Poor germination	6	4
	weeds	1	0.7
	Leaf pests	6	4
	Pod pests	3	2
	Pod diseases	1	0.7
	Drought	14	9.3
	Poor yield	6	4
	Low market price	6	4

CONCLUSION

The present study is likely to be the first baseline survey conducted among the Bambara groundnut farmers in Kano State, Nigeria. During the survey, only farmers actively growing Bambara groundnut were chosen for the interview. It was observed that large numbers of the respondents who were interviewed had Qur'anic education and were 100% male with little exposure to Western education. The Important production constraints faced by the farmers include a lack of improved varieties, drought, low yields and limited market access and poor market prices. These problems may not be unconnected with lack of sufficient genetic enhancement of the crop that limits the production and release of

desirable planting materials to the growers. Hence the need for genetic enhancement of Bambara groundnut is imperative for improved production practices and higher yields.

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