



## CHALLENGES IN THE SUPPLY CHAIN OF AFRICAN YAM BEAN (*SPHENOSTYLIS STENOCARPA* HOCHST EX A. RICH) IN NIGERIA: STAKEHOLDERS' PERSPECTIVES



Oluwafemi Daniel Amusa<sup>1,3\*</sup>, and Omoche Adewa Ojobo<sup>2</sup>

<sup>1</sup>Department of Cell Biology and Genetics, University of Lagos, Nigeria

<sup>2</sup>Department of Botany, Federal University of Agriculture Makurdi, Nigeria

<sup>3</sup>TETFund Centre of Excellence for Biodiversity Conservation and Ecosystem Management (TCEBCEM), University of Lagos, Nigeria

Corresponding author: odamusa@unilag.edu.ng

Received: December 14, 2023 Accepted: March 28, 2024

### Abstract:

The supply chain is a critical part of the value chain concerned with food delivery from producers to end users. It is pertinent to understand challenges within the supply chain of the African yam bean (AYB), an underutilised and neglected crop of high potential. The study thus assessed marketers, a vital aspect of the stakeholders of the supply chain to ascertain key challenges facing the supply line of the AYB. A structured questionnaire was administered to a total of 100 respondents comprising supply chain stakeholders, who were randomly sampled in the Wurukum market, Makurdi LGA, Benue State. Responses were presented as frequencies and percentages in the study. The study revealed major challenges affecting the AYB supply line including scarcity of grains and tubers, bad road network, inadequate purchasing power of grains and tubers, unfavourable weather conditions, damage to grains and tubers in storage, and lack of good quality seeds. Hence, apart from the intervention of agronomists and breeders to provide high-yielding quality seeds, there is still a need for both the State and Local government intervention to provide basic amenities to mitigate these effects on the AYB supply chain.

### Keywords:

African, yam, bean, grains, *Sphenostylis stenocarpa*, stakeholders, supply chain, tuber

### Introduction

With the recent economic recession and its effect on food security including food production, food availability, as well as food and nutritional security, there is a need for re-strategizing agricultural production and production practices if we are to meet with SDG zero hunger goal. The discovery and utilization of untapped potential genetic resources within the minor crop gene pool such as the African yam beans (AYB) could proffer a solution to the impending hunger circumstances in a developing country like Nigeria.

The African yam bean, *Sphenostylis stenocarpa* (Hochst ex A. Rich) Harms, originated in Ethiopia and is distributed throughout the Guinea Savanna of west tropical Africa from Ivory Coast through Northern Ghana, Nigeria, and Cameroon eastward to Sudan and Ethiopia (Potter, 1992). It is a climbing annual herbaceous crop, 1.5-3.0 m in height depending on the staking material. It also exhibits a perennial habit of regenerating from root stocks at the commencement of the rainy season. Grown as a minor crop, it is propagated by seed (Agbowuro, 2021). It is an underutilized crop with immense nutritional value both from the seeds and edible tubers, but it has however been relegated to an unimportant crop, with the bulk of the genetic resources left in the hands of older generations of farmers. This has led to a dearth of information on the crop (Cullis and Kunert, 2017; Ojuederie *et al.*, 2016, 2017).

For the sustainability of this agronomically important crop, the full agri-value chain from pre-production and production to supply chain and consumption needs to be well established. Iwuchukwu *et al.* (2017) already highlighted the importance and benefits of evaluating the value chain practices of AYB farmers. However, the supply

chain for this crop between production and end-users is not fully understood. The supply chain is a comprehensive network that encompasses all steps involved in producing and delivering goods and services to the consumer or end-user. In this wise, it is concerned with steps taken to deliver food from the farmer to the consumer. Stakeholders within the supply chain play a critical role in the value chain process making sure that the flow of product between the farmer and the end-user is unhindered. The measure of supply chain success is how well activities coordinate across the supply chain. The understanding of the supply chain concerning AYB will go a long way to promote its sustainable production and increase its awareness and diverse utilization while enhancing food security.

Iwuchukwu *et al.* (2017) indicated that the low utility of this agronomical crop might be attributed to the lack of awareness of the potential of the crop and the challenges in getting this crop from the farmer to the consumer or end-user. Hence, most of the AYB produced ends up being used by the smallholder farmer and his family. Dealing with the challenges within the supply chain between farmers and end-users can be likened to killing two birds with a stone, as this will take care of the awareness issue while also bridging the gap between the farmers and the end-users.

Hence, a deliberate act to understand these challenges within the supply lines for AYB, a legume with so much potential to mitigate and alleviate food insecurity in a country like Nigeria, is a step in the right direction. This study, therefore, assesses stakeholders including farmers, wholesalers and retailers within the AYB supply chain to ascertain key challenges within its supply line.

## Materials and Methods

### *Ethical approval*

Ethical approval was obtained from the Human Research Ethics Committee, College of Medicine, University of Lagos, Nigeria with a reference ID: CMUL/HREC/1108/19. Participants' anonymity and confidentiality were maintained. Participants had the option to decline the survey if they wished to. The purpose of the study was first explained to participants who were required to consent before enrolment. Signed consent was obtained from all participants included in the study before the commencement of the survey. Confidentiality was assured by not including the names of the participants, while the participants who declined to be part of the study were excluded.

### *Sampling and questionnaire administration*

The study was conducted in Wurukum market, Makurdi LGA, Benue State, North Central Nigeria based on local recommendations. The target participants were the AYB sellers. A total of one hundred participants comprising the supply chain stakeholders, majorly of whom were wholesalers and retailers, were recruited for the study. Only participants linked to the AYB supply chain activities were sampled.

The questionnaire used in the study consisted of both closed-ended and Likert-scaled questions. The structured interview was adopted in this study to allow the researcher to explain each terminology used to the participants. The questionnaire was divided into three (3) sections: Section A dealt with the respondents' sociodemographics, Section B the respondents' marketing history, and Section C the respondents' challenges with marketing their products. Before the deployment of the questionnaire, a pilot survey with 20 respondents was done to ascertain the suitability and ease of questionnaire deployment. A reliability coefficient of 0.87 Cronbach's alpha value was obtained from the pilot survey.

### *Data collection and analysis*

Each participant was interviewed by the researcher after the contents of the questionnaire had been read and explained to them in their native tongue (for the illiterate participants) or English (for the literate participants) for their understanding. The completed questionnaires were collected and analysed. Data collected were reported as frequencies or as percentages and ranked where necessary.

## Results and Discussion

### *Description of the sampled population*

The study evaluated 100 participant stakeholders in the marketing of AYB (Table 1). The AYB sellers included five (5) farmers, fifteen (15) wholesalers, and eighty (80) retailers who were sampled accordingly. The participants were from Igala, Tiv, Idoma, Igbo and Hausa ethnicities. The farmers were observed to be of Tiv ethnicity. Only five (5) of these participants cultivated and sold AYB in the market. Igala (n = 8), Idoma (n = 5) and Tiv (n = 2) participants were majorly wholesalers while retailers comprised Igala (n = 17),

Tiv (n = 18), Idoma (n = 15), Agatu (n = 15) and Igbo (n = 10).

This study observed more females (95%) within the supply value chain as opposed to a balance of males and females reported by Iwuchukwu *et al.* (2017) in their study. This might be a result of females being more active in the marketing of agricultural produce as observed in a country like Nigeria. Age is considered an important variable in agriculture because it influences farmers' productivity, attitude, skill, aspiration and adoption of technologies. The average age among participants is 45, 42 and 48 years for sampled farmers, wholesalers and retailers, respectively. Similar to the reports of Iwuchukwu *et al.* (2017), respondents in this study were in their active years.

It was observed in the study that most (40%) of the stakeholders completed their secondary school education. While 25% of the retailers completed their primary education, about 18% and 10% did not complete their primary and secondary school education, respectively. About 5% did not have any form of Western education.

The monthly income reported by these stakeholders ranged between ₦10,000 and ₦90,000 with a modal range between ₦10,000 and ₦30,000. The farmers have been marketing AYB for an average of 21 years, the majority of the wholesalers have been in the AYB business for an average of 15 years while the retailers have been selling AYB for an average of 17 years. Similar to the report of Iwuchukwu *et al.* (2017), most income from participants report a range between ₦10,000 and ₦30,000 monthly income, with an average marketing experience of 17 years of business history.

### *Purchasing power of African yam bean by respondents*

The study showed more marketing transactions done on AYB grains than on tubers. Among the respondents, 83% purchased only grains while 12% indicated that they purchased both grains and tubers. No respondent (0%) purchased only tubers. This might be due to AYB being more of a grain legume than a tuber. Several studies (Ikhajagbe and Mensah, 2012; Abdulkareem *et al.*, 2014) have reported most accessions of AYB-producing grains while some produce tubers alongside grains. Respondents purchased between 1 and 6 bags of beans as compared to ½ bags of tuber mostly bought by sellers, with a bag weighing 45-50 kg for both beans and tuber according to respondents. The majority (45%) of these purchases were made directly from the farmers and wholesalers, respectively. Only 10% was attributed to purchases made from retailers and none from any institute in the study (Table 2).

While AYB grains are mainly cultivated in Nigeria, its tubers are mostly grown in countries like Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Ghana, Togo, Malawi, Zimbabwe and parts of East Africa (Uttech, 2007; Iwuchukwu *et al.*, 2017). Akinyosoye *et al.* (2017) have reported the production of tubers in some AYB in a year and no tuber production in the following year, implying that tuber production by these accessions might be environmentally influenced. Such environmental factors may be climatic and /or soil factors.

**Table 1.** Demographics of sampled participants about their ethnicity, gender, level of education, monthly income, and business history

Ethnicity	Farmer	Wholesaler	Retailer	Total
Igala	0 (0%)	8 (8%)	17 (17%)	25 (25%)
Tiv	5 (5%)	2 (2%)	18 (18%)	25 (25%)
Idoma	0 (0%)	5 (5%)	15 (15%)	20 (20%)
Agatu	0 (0%)	0 (0%)	15 (15%)	15 (15%)
Igbo	0 (0%)	0 (0%)	10 (10%)	10 (10%)
Hausa	0 (0%)	0 (0%)	5 (5%)	5 (5%)
Total	5 (5%)	15 (15%)	80 (80%)	100 (100%)
Gender				
Female	4 (4%)	14 (14%)	77 (75%)	95 (95%)
Male	1 (0%)	1 (0%)	3 (5%)	5 (5%)
Total	5 (5%)	15 (15%)	80 (80%)	100 (100%)
Age <sup>a</sup>	45	42	48	47
Level of Education				
Completed primary education	0 (0%)	0 (0%)	25 (25%)	25 (25%)
Complete secondary education	5 (5%)	13 (13%)	22 (22%)	40 (40%)
Did not complete primary education	0 (0%)	2 (0%)	18 (20%)	20 (20%)
Did not complete secondary education	0 (0%)	0 (0%)	10 (5%)	10 (5%)
None	0 (0%)	0 (0%)	5 (5%)	5 (5%)
Total	5 (5%)	15 (15%)	80 (80%)	100 (100%)
Monthly income (N)				
10,000 - 30,000	0 (0%)	7 (7%)	67 (65%)	74 (72%)
30,000 - 50,000	3 (3%)	6 (6%)	7 (7%)	16 (16%)
50,000 - 70,000	2 (2%)	2 (3%)	5 (5%)	9 (9%)
70,000 - 90,000	0 (0%)	0 (0%)	1 (3%)	1 (3%)
Total	5 (5%)	15 (15%)	80 (80%)	100 (100%)
Business history <sup>a</sup>	21	15	17	17

<sup>a</sup> average in years**Table 2.** Quantity of African yam bean purchases by respondents

## Supply chain challenges of African yam bean

Beans	N (%)	Tubers	N (%)	Sources of purchases	N (%)
No response	5 (5%)	No response	5 (5%)	Directly from farmers	45 (45%)
1-2 bags	89 (89%)	None	83 (83%)	Retailers	10 (10%)
3-4 bags	5 (5%)	½bag	7 (7%)	Wholesalers	45 (45%)
5-6 bags	1 (1%)	1 bag	5 (5%)	Institutes	0 (0%)
Total	100 (100%)	Total	100 (100%)	Total	100 (100%)

**Table 3.** Identified challenges in the supply chain of African yam beans

S/N	Identified challenges by stakeholders	N	%
1	Scarcity of beans	98	98
2	Scarcity of tubers	95	95
3	High demands for grains than available	93	93
4	High quality beans are limited	91	91
5	Damaged beans from diseases	90	90
6	Damaged tubers from diseases	90	90
7	Seeds are not readily available when needed	90	90
8	Unfavourable season of weather conditions	90	90
9	Bad road network to source of purchase	87	87
10	Bad road network to market	85	85
11	Damaged tubers from insects' infestation	85	85
12	Lack of money to buy more at a time	84	84
13	Damaged beans from insects' infestation	80	80
14	Lack of high produce to purchase at a time	78	78
15	High demands for tubers than available	65	65
16	Bad packaging of produce	44	44
17	Labour cost from farm to market is very high	33	33
18	Low pricing of beans in the market	20	20
19	Low pricing of tubers in the market	16	16

N: number of respondents, %: percentage of respondents

### **Challenges within the AYB supply line**

Several factors have fostered a decrease in the agrobiodiversity of potentially important crops in many parts of Nigeria (Hadgu *et al.*, 2009). The study revealed that scarcity of beans was the top (98%) challenge identified by participants limiting both the supply and marketing of AYB (Table 3). This was followed by the scarcity of tubers, demand for beans and tuber than what is available for sale, damaged beans and tuber, unfavourable weather conditions, bad road network from farm to market, and lack of capital to purchase enough farm produce. Iwuchukwu *et al.* (2017) also reported a lack of awareness of the crop's potential, poor

production methods, and poor processing. These are influenced by a lack of basic physical infrastructure, difficulties in accessing credit facilities, weak linkages between agriculture and industry, and poor markets among others which play a significant role in the status of AYB in Nigeria today. An interview with some sampled participants revealed that they had to travel long distances to get AYB grains to sell and at some times, discouragement sets in. Similarly, AYB tubers are also limited in availability as reported by the participants which creates a high demand for the available AYB produced. Klu *et al.* (2001) reported that only limited quantities of AYB are offered for sale in local markets even though the price per unit of measure is

comparable to that of other legumes due to the constraints associated with its production.

Macauley and Ramadjita (2015) also reported production not meeting demands in sub-Saharan Africa due to bad road networks, and poor storage facilities similar to that reported in this study. The participants in the study reported a lack of capital as a factor that limits their purchasing power of the AYB. Similarly, Iwuchukwu *et al.* (2017) also reported a lack of loan facilities to assist the purchase and distribution of AYB in Enugu State. Hence, both authors have suggested government interventions which include, creating better road networks, new markets, and promotion of storage facilities while building the capacity of stakeholders. The report from Iwuchukwu *et al.* (2017) revealed the top information farmers needed was good varieties of AYB. There is an urgent and deliberate need by plant genetics, breeders, and agronomists to genetically improve this indispensable crop to increase productivity and the shelf life of AYB to improve its availability.

### Conclusion

AYB is a crop with a lot of potential to tackle food insecurity. However, its optimal use is faced with challenges which range from awareness of potentials, bad road network, unfavourable weather conditions, damage to grains and tubers in storage, and lack of good quality seeds which has affected its optimal application. These challenges if not dealt with will continue to hinder the significant use of the agronomic important crop. Hence, both local and state organizations and arm of government will need to provide basic amenities to mitigate these effects on the AYB supply chain

### Conflict of interest

The authors declare no competing interest

### References

- Agbowuro GO 2021. Introduction to African yam bean (*Sphenostylis stenocarpa* Hochst. Ex.A. Rich. Harms). *Innovare J. Agr. Sci.*,9(6): 9 – 13, DOI: 10.22159/ijags.2021.v9i4.43171
- Akinyosoye ST, Adetumbi JA, Amusa OD, Adeleye A, Anjorin F, Olowolafe MO & Omodele T 2017. Bivariate analysis of genetic variability among some accessions of African yam bean (*Sphenostylis stenocarpa* (Hochst ex A. Rich). *Acta Agr. Slov.*, 109(3): 493 – 507, DOI: 10.14720/aas.2017.109.3.02
- Cullis C & Kunert KJ 2017. Unlocking the potential of orphan legumes. *J. Exp. Bot.*,68(8): 1895 – 1903, DOI: 10.1093/jxb/erw437
- Ikhajiagbe B & Mensah JK 2012. Genetic assessment of three colour variants of African yam beans (*Sphenostylis stenocarpa*) commonly grown in Midwestern region of Nigeria. *Int. J. Mod. Bot.*, 2(2): 13 – 18, DOI: 10.5923/j.ijmb.20120202.01
- Iwuchukwu JC, Nwobodo CE, Ezema CN & Udoye C 2017. Value chain activities and challenges of African yam bean (*Sphenostylis stenocarpa*) farmers in Enugu State, Nigeria. *Sust. Agr. Food Environ. Res.*, 5(4): 42 – 54, DOI: 10.7770/safer-V5N4-art1307
- Klu GYP, Amoatey HM, Bansa D & Kumaga FK 2001. Cultivation and uses of African Yam Bean (*Sphenostylis stenocarpa*). In the Volta region of Ghana. *J. Food Technol. Afr.*, 6: 74 – 77, DOI: 10.4314/jfta.v6i3.19292
- Macauley H & Ramadjita T 2015. Cereal crops: rice, maize, sorghum, wheat. In *Proceedings for Feeding Africa*, Abdou Diouf International Conference Centre, Dakar, Senegal. 21<sup>st</sup>-23<sup>rd</sup> October 2015, pp 1 – 31.
- Ojuederie O, Balogun M & Abberton M 2016. Mechanism for pollination in African yam bean. *Afr. Crop Sci. J.*,24: 405 – 416, DOI: 10.4314/acsj.v24i4.7
- Ojuederie OB & Balogun MO 2017. Genetic variation in nutritional properties of African yam bean *Sphenostylis stenocarpus* (Hochst ex. A. Rich. Harms) accessions. *Nig. J. Agr. Food Environ.*, 13(1): 180 – 187
- Okeola OG & Machuka J 2001. Biological effects of African yam bean lectins on *Clavigralla tomentosicollis* (Hemiptera: Coreidae). *J. Econ. Entomol.*, 94: 724 – 729, DOI: 10.1603/0022-0493-94.3.724
- Potter D 1992. Economic botany of *Sphenostylis* (Leguminosae). *Econ. Bot.*, 46(3): 262 – 275
- Uttech S 2007. Yam Bean: A nearly forgotten crop. *Am. Soc. Agron.*, 15- Sept.-2007
- Hadgu KM, Rossing WAH, Kooistra L, van Bruggen HC (2009) Spatial variation in biodiversity, soil degradation and productivity in agricultural landscapes in the highlands of Tigray, northern Ethiopia. *Food Sec. I*: 83-97, DOI 10.1007/s12571-008-0008-5
- Abdulkareem KA, Animasaun DA, Oyedeji S, Olabanji OM (2015) Morphological characterization and variability study of African yam beans [*Sphenostylis stenocarpa* (Hochst ex a. Rich)]. *Global J. Pure Appl. Sci.* 21: 21 – 27, DOI: 10.4314/gipas.v21i1.4