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FARMERS' PREFERENCE FOR PLANTAIN ATTRIBUTES IN NIGERIA: A BEST-WORST SCALING APPROACH

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ABSTRACT

Plantain is an important staple crop which plays key role in enhancing food security and livelihoods. However, the productivity of existing varieties is being threatened by biotic and abiotic factors hence, the need for breeding improved and resilient varieties. Understanding trait preferences of producers is a major step in developing a demand-driven breeding programme that will deliver acceptable products. Therefore, the study investigated farmers' preferences for plantain attributes in southern Nigeria using a Best-worst scaling approach. A multistage sampling technique was used to sample 445 plantain farmers in the southern Nigeria where plantain production is predominant and data were obtained with the aid of a semi-structured questionnaire. Results showed that the sampled plantain farmers were mostly male (74.2%), married (83.6%), educated (95.2%) and with mean age (45.18±11.30 years), household size (7±4 members) and years of experience in plantain production (13.35±8.97). The Best-worst scaling results revealed that the four most important attributes to the farmers were "early maturity", "heavy bunch", "big fingers" and "many (full) fingers on bunch" in that order, while "dwarf plant height", "firm pulp" and "thick peel" were the least important in that order of sequence. Considering the relative importance and ranking of the attributes, the first four top ranked attributes were "big fingers", "early maturity", "heavy bunch" and "pest and disease resistance", while the first four lowest ranked attributes were "thick peel", "firm pulp", "dark green peel at maturity" and "dwarf plant height". These results have important implications for improving plantain hybrids for better adoption and impact in Nigeria. The study therefore recommends that farmers' preference be taken into consideration while breeding for new varieties. Improved plantain varieties which have all the best preferred or most important attributes may boost farmers' productivity and food production in Nigeria.

Keywords: Best-worst scaling, plantain attributes, attribute preference, southern Nigeria

INTRODUCTION

Nigeria is among the major producers of plantain in Africa (Lescot, 2020) and ranks fifth in the world producing 3,077,159 tonnes in 2020 (FAO, 2022). Plantain production ranks third among starchy staples in the country after cassava and yam (Akinyemi et al., 2010). It is mainly produced in the Southern states of Nigeria, which include Akwa-Ibom, Cross River, Imo, Enugu, Rivers, Edo, Delta, Lagos, Ogun, Osun and Oyo states (Ayanwale et al., 2016). The production cycle is about 12-15 months with the harvest season covering the month of October to February. Plantain is mainly cultivated by smallholders for their starchy fruits which serve

as a source of calories. It can be processed for consumption across different stages of ripeness. It serves as a useful crop for small-scale farmers and co-exists easily with established farming systems (Edeoghon and Okoedo-Okojie, 2011). It has the potential to contribute to strengthening national food security and decreasing rural poverty (Adejoro et al, 2010). It is a seasonal product, though the demand is all year round. Plantain consumption has risen tremendously in Nigeria in recent years because of rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations (Akinyemi et al., 2017). With the potential for industrial processing

and increased interest in production by large and small scale farmers in the country, it is believed that Nigeria will continue to be one of the world's largest producers of plantain (Akinyemi, 2010).

In view of the significant contributions of plantain to the economic development of both rural and urban households in Nigeria, it is imperative to improve the productivity and quality of plantain and its products and also reduce the gap between supply and demand. According to the Demand-Led Breeding (2020), climate change, rising population and the need for farming systems to be sustainable for future generations require both innovation and change. Hence, the need to provide in-depth and useful information that could inform breeding programs as well as insights to support farmers in making evidence-based decisions in relation to the structure of the plantain market and thus, improve its performance in Nigeria. Therefore, understanding trait preferences of producers is the first step in developing a demand-driven breeding programme in order to enable breeders to improve hybrids for better adoption and impact (Newilah et al., 2020; Udomkun et al., 2021). Although there are several studies (Adejoro et al, 2010; Agwu et al., 2012; Akinyemi et al., 2010 & 2017; Ayanwale et al., 2016; Edeoghon and Okoedo-Okojie, 2011, etc.) on economics of plantain production and marketing, however there is a dearth of information on farmers' preferences for plantain attributes in Nigeria. This study therefore aimed at providing useful information on farmers' preferences for plantain attributes. Specifically, the study examined the socio-demographic characteristics of plantain producers, their common production practices as well as preferences for plantain attributes using the Best-worst scaling approach.

METHODOLOGY

Study area: The study was conducted mainly in the Southern Nigeria, which contains fertile forest and laterite soils conducive to plantain growth (Ayanwale et al., 2018). The region comprises three agro-ecological zones namely; the South-east, South-west and South-south. Its climate is characterized by strong latitudinal zones, becoming progressively drier as one moves north from the coast (Ozor et al., 2012). The zones were chosen because they are the major plantain growing areas in the country (Ayanwale et al., 2016).

Sources and type of data: The study made use of primary data which were obtained through the use of structured and semistructured questionnaire containing both closed and open-ended questions. Interviews were conducted in English, pidgin and local languages depending on the preference of the respondents. Information was elicited from respondents on socio-economic and demographic characteristics such as gender, age, level of education, household size, years of experience; production practices (such as labour, fertilizer usage, cropping system, etc.), plantain attributes and attributes preferences among others.

Sampling procedure and sample size: A multistage sampling technique was employed for the study. In the first stage, four (4) states predominantly known for plantain production namely Cross river, Edo, Enugu and Ondo were purposively selected from southern Nigeria (Ekunwe and Ajayi, 2010; Akinyemi et al., 2010; Ayanwale et al., 2016). Secondly, two (2) Local Government Areas (LGAs) were randomly selected from among the LGAs known for plantain production in each state, making a total of 8 LGAs. Finally, 3 rural communities were selected from each LGA. In total, 4 states, 8 LGAs and 24 rural communities were covered for the study. Twenty (20) plantain farmers were randomly selected from each rural community making a total number of 480 farmers, however only responses from 445 respondents were used for analysis, the remainder were excluded on grounds of incompleteness or a similar flaw. Data were collected between October and December, 2021.

Analytical technique: In order to achieve the stated objectives for the study, data were analyzed using descriptive and inferential statistics and the Best-worst scaling approach. The tools were used to describe the socio-demographic characteristics of plantain producers (producers, marketers, processors and consumers) as well as other factors relating to plantain production, marketing, processing and consumption.

Best-worst scaling approach: Best-worst is an innovative discrete choice experiment based on the inherited comparative judgments when individuals face numerous choices. The approach has its origin from Jordan Louviere in 1987 (Finn and Louviere 1992; Flynn and Marley, 2012) and an extension of Thurstone's (1927) method of paired comparison (Fabbris et al., 2016; Glenk et al., 2014).

Comparisons made by various studies (Campbell and Erdem 2014) between Best-worst scaling and other conventional rating scales that are more cognitively sensitive and susceptible to a range of behaviour anomalies showed strong relationships between the Best-worst measures and real choices. The approach is considered “scale-free” and prevents a scale-use bias (Baumgartner and Steenkamp 2001; Campbell and Erdem 2014). Therefore, based on decision-making theories from cognitive science, Best-worst scaling is an efficient approach to understanding farmers’ preferences which avoids many of the problems associated with other methods.

To elicit preferences for various attributes of plantain, farmers were asked to choose plantain attributes that could be most and least preferred. In consultations with the literature and experts (e.g., farmers, breeders and agronomists) with hands-on experience and practical knowledge about relevance of plantain attributes, attributes such as: bunch size, finger size, pulp size, colour and texture, peel colour and texture, taste, rate of maturity, tolerance to lodging, resistance to pest and diseases, and suckering ability were identified as the important attributes. Each of these attributes varied across plausible levels encompassing the range of options that farmers would possibly consider in the development of improved plantain varieties. The Best-worst utilizes an orthogonal design method based on a balanced incomplete block design to develop a design containing 13 choice sets with 4 attributes in each set. (see Table 1 for an example of the 13 Best-worst scaling design). Farmers were then asked to complete the 13 choice sets, simultaneously choosing the most important (Best) and least important (Worst) attributes respectively from the 4 attributes in each set. All attributes in the design had equal and independent occurrence so that farmers can judge all possible pairs of items within the displayed Best-Worst set and choose the pair that reflects their maximum difference in preference. The number of time attributes was chosen as Best and worst were respectively added across respondents to get the total number of Best -Worst for each attribute.

RESULTS AND DISCUSSION

Socio-economic characteristics of producers: Results displayed in Table 2 reveals that plantain farmers interviewed are mostly male (74.2%),

married (83.6%), educated (95.2%) and with mean age of 45.18±11.30 years and household size of 7±4 members. The results suggest that plantain farming is still very much dominated by the male gender, a larger proportion of the sampled farmers are in their active and productive age and can easily comprehend new ideas and innovations.

Furthermore, the mean years of experience in plantain production as shown in Table 2 is 13.35±8.97, while 77.3% and 96.7% of the sampled farmers neither had access to credit facilities nor belong to any plantain-related association.

Information on plantain production in the study area

Mean land area dedicated to plantain production is 6.07ha (Table 3). As observed from Table 3, most farmers (41.4%) intercrop plantain with other crops most especially cocoa, while 31.1% plant it solely. Majority (95.5%) does not apply fertilizer on their plantain farm because they feel it is not necessary (87.4%). Plantain suckers are mainly sourced from own farms, while less than 20.0% source suckers from other farmers in the community (Table 3). In most of the states, a sucker is sold for less than N60 except for Edo where it is less than N50.

Attribute preference:

Most preferred attributes: The results presented in figure 1 to 3 shows the plantain attributes mostly preferred by producers in the study area. In general, farmers’ preference were mostly based on bunch morphology such as “big fingers”, “heavy bunch”, “big pulp”, “full fingers on bunch”, “dark green peel at maturity” and “early maturity” followed by the sensory attribute “good taste (Figure 1). The results agree with the findings of Amah et al (2020). However, the order of preference differs from state to state and between genders. For example, Cross River and Edo farmers gave high preference to “big fingers”, “heavy bunch” and “full fingers on bunch”, while Ondo farmers mostly prefer attributes based on fruit morphology such as “big pulp”, “dark green peel at maturity” and “big fingers” (Figure 2). Furthermore, considering gender differences, female farmers prefer attributes such as “big pulp” more than “heavy bunch”, while the reverse is the case for their male counterparts (Figure 3).

Most and least important plantain attributes (Best-worst scenario)

The best-worst scaling results are reported in Table 4. The rankings of the plantain attributes based on the best-worst scaling Standard Score are shown in ranking. The four most important plantain attributes were “early maturity”, “heavy bunch”, “big fingers” and “many (full) fingers on bunch” in that order, while “dwarf plant height”, “firm pulp” and “thick peel” were the least important in that order of sequence. Although, Standard Score demonstrated a ranking of the most to the least important attributes, there is a lack of knowledge with the regards to the relative importance information that is, how important the ranked attributes were relative to each other. To investigate the correlativity, a new index was adopted which was calculated by finding the square root of the best/worst score (B/W). This value was scaled so that the most important with the highest index was assigned an interval of 100 (Yagi et al., 1997). The resulting coefficients in “relative importance” measure the choice probability compared to the most important attribute (Cohen, 2009).

“Relative importance and Ranking” in Table 4 redefined the ranking using the standardized scale. “Big fingers” emerged as the most important attribute to farmers after taking the interval scale of 100. All other standardized scales were computed relative to this value. For example, “thick peel” estimated to at 19.21% was 0.1921 times as important as “big fingers”. Similarly, the relative importance of “tolerance to lodging” and “high suckering ability” were 52% and 51%, respectively indicating that “big fingers” is about twice more important as “tolerance to lodging” and “high suckering ability”. Overall, the first four top ranked attributes were “big fingers”, “early maturity”, “heavy bunch” and “pest and disease resistance”, while the first four lowest ranked attributes were “thick peel”, “firm pulp”, “dark green peel at maturity” and “dwarf plant height”. The standard scores of the average (best minus worst) counts per attribute in the best-worst analysis indicate the extent to which attribute importance deviate over the total sample (Loose and Lockshin 2013).

CONCLUSION AND RECOMMENDATION

The study employed a best-worst scaling to ascertain farmers’ preference for plantain attributes in southern Nigeria. The results have revealed farmers’ strong preferences for “big fingers”, “early

maturity”, “heavy bunch” and “pest and disease resistance”, and farmers’ weak preferences for “thick peel”, “firm pulp”, “dark green peel at maturity” and “dwarf plant height”. The results have important implications for improving plantain hybrids for better adoption and impact in Nigeria. The study therefore recommends that farmers’ preferences be taken into consideration while breeding for new varieties. Improved plantain varieties which have all the best preferred or most important attributes may boost farmers’ productivity and food production in Nigeria.

Limitations of the study: Data collection was constrained by insecurity in some communities in the study area.

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Table 1. Example of best worst (B-W) choice situation

The most important item (select one attribute indicating “√”)	Which attributes are the most and least important to you? Early maturity Plant height Peel thickness Suckering ability	The least important item (select one attribute indicating “√”)
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Source: Authors’ survey, 2021

Table 2: Socio-demographic characteristics of plantain producers

Variable	Pooled sample (n=445)	Cross River (n=118)	Edo (n=112)	Enugu (n=99)	Ondo (n=116)
Gender					
Female	25.8	18.6	18.8	54.5	15.5
Male	74.2	81.4	81.2	45.5	84.5
Age					
20 – 30	10.3	18.6	7.2	7.1	7.8
31 – 40	26.3	36.4	19.6	20.2	27.6
41 – 50	35.1	29.7	37.5	39.4	34.5
51 – 60	19.8	13.6	25.9	23.2	17.2
61 and above	8.5	1.7	9.8	10.1	12.9
Mean	45.18	40.91	46.64	47.17	46.40
SD	11.30	9.91	10.86	10.95	12.28
Marital status					
Married	83.6	83.1	81.3	85.9	84.5
Single	10.6	12.7	13.4	8.1	7.8
Divorced/Separated	0.9	0.9	0.9		1.7
Widow/Widower	4.9	3.4	4.5	6.1	6.0
Education					
None	4.0	3.4	2.7	8.1	2.6
Primary	24.0	11.0	23.2	38.4	26.7
Secondary	53.7	52.5	53.6	44.4	62.1
Tertiary	18.2	33.1	20.5	9.1	8.6
Household size					
1-5	36.9	32.2	37.5	40.4	37.9
6-10	53.9	56.8	56.2	51.5	50.9
11-15	7.6	11.0	5.4	6.1	7.8
≥16	1.6		0.9	2.0	3.4
Mean	6.70	6.42	7.5	6.67	6.23
SD	3.56	3.41	4.15	3.77	2.73
Access to credit facilities					
No	77.3	83.1	72.3	77.8	75.9
Yes	22.7	16.9	27.7	22.2	24.1
Membership in plantain-related association					
No	96.6	99.2	95.5	93.9	97.4
Yes	3.4	0.9	4.5	6.1	2.6

Years of experience in plantain production					
1-10	54.2	50.8	57.1	54.6	54.3
11-20	29.6	31.4	28.6	33.3	25.9
21-30	11.5	11.0	9.8	11.1	13.8
31-40	3.8	5.9	3.6	1.0	4.3
41-50	0.9	0.9	0.9		1.7
Mean	13.35	12.53	12.52	14.76	13.78
SD	8.97	9.10	8.57	10.50	7.67

Source: Survey, 2021; SD=Standard deviation

Table 3: Information on plantain production

Variable	Pooled sample (n=445)	Cross River (n=118)	Edo (n=112)	Enugu (n=99)	Ondo (n=116)
Land dedicated to plantain					
1-10ha	89.0	93.2	79.5	89.9	93.1
11-20ha	4.5	3.4	14.3		
≥21ha	6.5	3.4	6.2	10.1	6.9
Mean	6.07	6.30	12.67	2.49	2.04
SD	13.75	15.70	19.54	3.69	2.74
Cropping system					
Crop rotation	0.2	0.9			
Inter cropping	21.4	27.1	21.4	9.1	25.9
Mixed cropping	41.4	40.7	39.3	47.5	38.8
Sole cropping	37.1	31.4	39.3	43.4	35.3
Fertilizer application					
No	95.5	98.5	96.2	89.3	95.6
Yes	4.5	4.5	3.8	10.7	4.4
Reason for not applying fertilizer					
Not necessary	87.4	89.6	84.8	84.4	90.2
Not readily available	6.2	6.1	5.7	7.8	5.4
Too expensive	5.7	4.3	7.6	6.7	4.4
Others	0.7		1.9	1.1	
Main source of sucker					
From previous production	62.2	57.2	73.4	79.4	44.9
Purchased	18.5	27.4	13.3	4.5	22.1
Both	5.6	11.9	1.6	1.8	2.9
Received as gifts	13.5	3.5	11.7	14.3	29.4
Trade by barter	0.2				0.7
Cost of sucker (in Naira) Mean					
	53.86	55.86	47.23	54.55	58.00
SD	25.94	26.86	23.65	26.59	27.10

Source: Survey, 2021; SD-Standard deviation Table 4: Best-worst scaling analysis results

Attributes	Best		Worst		B - W			Sqrt (B/W)	Relative	Ranking
	Frequency	Importance (%)	Frequency	Importance (%)	Score	Score	Score (%)			
Big fingers	281	9.7%	78	2.7%	203	3	0.070	1.898	100.0%	1
Early maturity	373	12.9%	126	4.4%	247	1	0.085	1.721	90.7%	2
Heavy bunch	397	13.7%	160	5.5%	237	2	0.082	1.575	83.0%	3
Pest & disease resistant	307	10.6%	148	5.1%	159	5	0.055	1.440	75.9%	4
Full fingers on bunch	365	12.6%	184	6.4%	181	4	0.062	1.408	74.2%	5
Tolerance to lodging	230	7.9%	230	7.9%	0	6	0.000	1.000	52.7%	6
High suckering ability	218	7.5%	229	7.9%	-11	7	-0.004	0.976	51.4%	7
Big pulp	187	6.5%	227	7.8%	-40	8	-0.014	0.908	47.8%	8
Sweet/good taste	169	5.8%	293	10.1%	-124	9	-0.043	0.759	40.0%	9
Dwarf height	157	5.4%	313	10.8%	-156	10	-0.054	0.708	37.3%	10
Dark green peel	118	4.1%	297	10.2%	-179	11	-0.062	0.630	33.2%	11
Firm pulp	49	1.7%	253	8.7%	-204	12	-0.070	0.440	23.2%	12
Thick peel	48	1.7%	361	12.5%	-313	13	-0.108	0.365	19.2%	13

B-Best; W-Worst; Sqrt-Square root; B/W-Best divided by worst, Freq.- Frequency

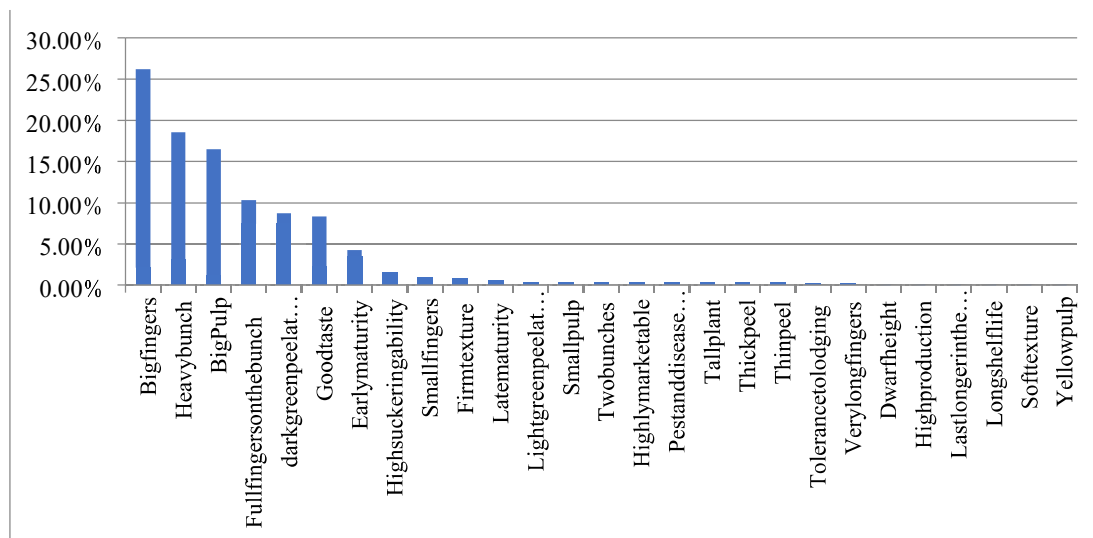


Figure 1: Producers' most preferred attributes (Pooled)

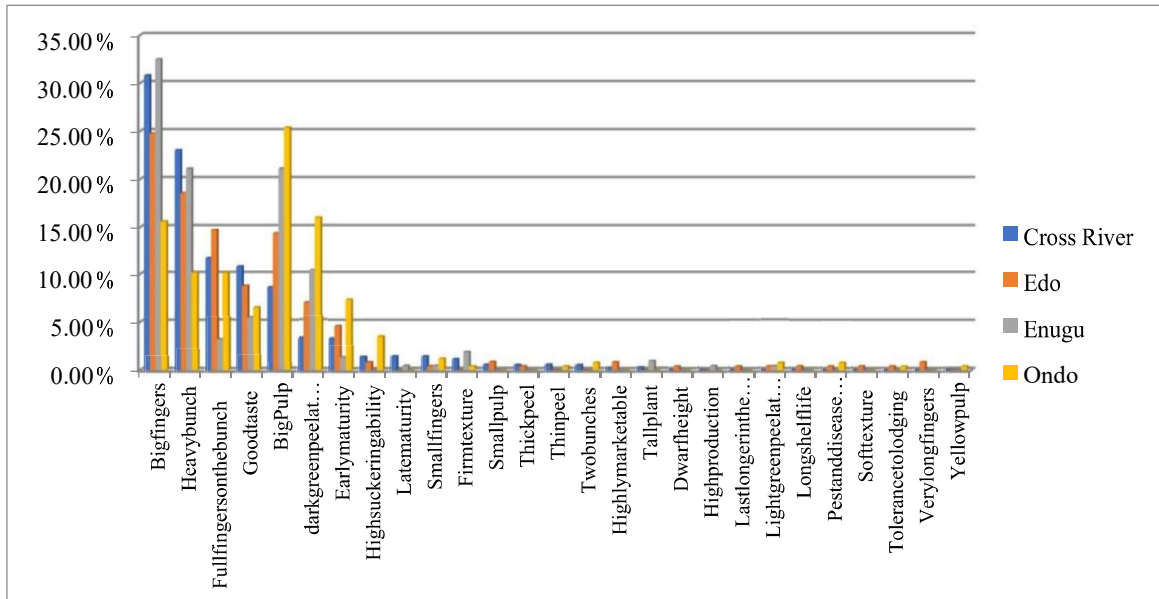


Figure 2: Producers' most preferred attributes (Location)