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Empirical Analysis of African Aubergine (*Solanum gilo*) – Marketing and Income Disparity among Traders in Owerri, Imo State, Nigeria

Abstract. African Aubergine is an indigenous tropical crop cultivated in Nigeria. Agricultural marketing creates incentives that accelerate the promotion of further production and consumption of harvested produce. Therefore, this study analysed African Aubergine marketing and income disparity among traders in Owerri, Imo State, Nigeria. Primary data collected via multistage sampling from ninety-five (95) respondents was analysed using descriptive statistics, marketing margin and efficiency analysis, Ordinary Least Square regression and Gini Coefficient index. The results show that the mean age, years spent in school, household size, trading experience and quantity of bags sold were 37 years, 8 years, 7 people, 9 years and 8 bags per month, respectively. The estimated marketing margin and efficiency index were ₦1,250 and 0.36, respectively. The estimated coefficients of Ordinary Least Square regression (R^2) were 0.773. Thus, the variables (marketing experience, cost price, quantity sold and marketing cost) in the regression model accounted for 77% of the variation in the marketing margin of African Aubergine traders in the study area. The estimated Gini Coefficient was 0.59, indicating a moderate level of income disparity (inequality) in the sales income of the respondents. Several marketing constraints were observed in the study area. Therefore, this study recommends improved credit access and market information dissemination, commodity cost subsidisation, storage technology adoption, market infrastructure development and interventions, commodity price control and policy modification that regulates market activities.

Key words: agribusiness, commodity markets, Gini index, marketing margin and efficiency, market structure

JEL Classification: D4; L22; Q02; Q13

Introduction

African Aubergine (Solanum gilo) is one of the most important vegetable crops (FAOSTAT, 2022). This crop is not only consumed almost daily, but also serves as a source of income for many rural households (Iheke, 2010a). While this vegetable crop is traded internationally on a limited scale, only a very small share of the total production in Nigeria is exported. The crop has intriguing nutritional characteristics and potentially useful agronomic traits. Additionally, there is notable diversity in the varieties cultivated in Nigeria (Onuwa et al., 2017). African Aubergine is among the oldest vegetables and is an indigenous tropical crop cultivated in Nigeria (Onuwa et al., 2017). FAOSTAT (2022) also reported that African Aubergine, as a vegetable, has been affirmed and recommended for tackling the malnutrition problem in Africa. African Aubergine can be consumed raw as snacks by both adults and children. African Aubergine is surpassing its status as a staple

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fruit to become a more commercial commodity that is now a major source of income for producing households and traders (NBS, 2022).

Agricultural markets can be defined as a set of conditions and activities that facilitate trade transactions whether or not the parties physically meet (Onuwa et al., 2023, Agba, 2006). 'Market' denotes the interaction of the forces of demand and supply, irrespective of the physical location of buyers and sellers. It involves not only the physical movement of goods and services to points where the produce is wanted, but also putting them into the desired form and amount and having them ready at the needed time (Iheke, 2010b). Marketing is a function that assesses consumer needs and then satisfies them by creating an effective demand for and providing the commodities and services required by consumers (Ariyo et al., 2013).

Market channels (structure) refer to characteristics of the market believed to influence the nature of competition and the process of price formation. Understanding market channels provides relevant information regarding the operational mechanism of markets and forms the basis of reducing marketing inefficiencies along the market chain. Marketing channels are avenues through which agricultural products move from producers to consumers. It is the chain of intermediaries through which the products pass from producers to the final consumers (Ayelech, 2011 and Sarode, 2009). The length of the channel varies from commodity to commodity depending on the quantity to be moved, the form of consumer demand and the degree of regional specialisation in production. Other marketing studies have identified a number of channels in the marketing chain. Onuwa et al. (2022) and Mussema (2006) posited multiple marketing channels in their respective studies on agro-commodity marketing. Without markets, agricultural production remains stagnant. Markets dictate how much producers will increase and/or produce their output (Onuwa et al., 2022).

Marketing systems in most developing countries often have operational inefficiencies that limit market performance (Lutfa et al., 2019 and Obasi, 2008). Market performance assesses the effectiveness of the marketing process and the successful achievement of its goals (Eronmwon et al., 2014). In market analysis, determining the marketing margin is crucial. The marketing margin for a specific commodity is the difference between the price the consumer pays for the final product and the amount the producer receives (Toure and Wang, 2013). It plays a vital role in analysing market performance and efficiency (Achike and Anzaku, 2010). Marketing efficiency significantly impacts market performance. The significance of agricultural marketing cannot be overstated. However, low marketing margins have been reported in agro-commodity marketing (Iheke, 2010b). Marketers often have to sell their products at very low prices to prevent waste or losses, consequently reducing marketing margins and efficiency. Agricultural marketing is viewed as an incentive for promoting more production and consumption of agricultural products (Slamet et al., 2017; Horna and Gruere, 2006). It involves various activities that, if well-implemented, can support livelihoods (Eronmwon et al., 2014). Agro-commodities produced by farmers must be gathered, stored, transported, processed and delivered in the required form, time and place as desired by consumers (Onunka et al., 2011 and Anuebunwa, 2007). Approximately 60% of the Nigerian population is involved in agro-commodity marketing, with the majority being small-scale traders (Anuebunwa, 2007), earning low incomes and facing challenges such as poor marketing facilities, inadequate

storage and preservation techniques, flawed road networks, limited health facilities, unfavourable government policies and a lack of technological expertise (Iheke, 2010a). Additionally, agricultural marketing encompasses the process from the production of agricultural commodities or services to their consumption or use (Iheke, 2010a, Anuebunwa, 2007). The marketing of African Aubergine entails various functions and activities necessary for the commodity to move from the production unit to the consumer. Underdeveloped marketing systems lead to postharvest losses (Slamet et al., 2017 and Adesope et al., 2009). Agricultural commodity marketers are often seen as agents of agricultural development and risk-takers. Many commodity markets are monopolised by a few, enabling them to make excessive profits at the expense of producers and consumers (FAO, 2021). However, there is a lack of empirical information on African Aubergine marketing, particularly regarding its structure, margins and income disparities in the face of marketing barriers. Therefore, this study seeks to analyse African Aubergine marketing and income disparity among traders in Owerri, Imo State, Nigeria. It will attempt to provide answers to the following research questions:

    i.   What is the socioeconomic profile of the respondents?
    ii.   What is the market performance of African Aubergine traders?
    iii. What are the determinants of marketing margin?
    iv. What is the income disparity among African Aubergine traders?
    v.   What are the constraints of African Aubergine marketing?

Research methodology

Study area

The study was conducted in Owerri, the capital of Imo State, Nigeria. The area is situated in the heart of the rainforest in the southeastern region and covers approximately 40 square miles (100 km2) (NBS, 2021). It includes Owerri municipal council, Owerri West and Owerri North (Wikipedia, 2022). The population density ranges from 230 to 1400 people per square kilometer. Imo State's population is mainly rural (Wikipedia, 2022). The climate in Imo State is typically humid, with bimodal rainfall distribution peaking in July and September, with a break in August. Annual rainfall ranges from 1,990mm to 2,200mm. The mean annual temperature exceeds 20°C. Imo State experiences an average annual relative humidity of 75%, which is highest during the rainy season, reaching about 90%. The main agricultural zones in Imo State are Owerri, Orlu and Okigwe (NBS, 2022).

Method of data collection

Primary data were collected through the use of structured questionnaires designed in line with the objectives of the study.

Sampling techniques

A multi-stage sampling technique was employed for this study. The first stage involved the purposive selection of Owerri, including Owerri municipal, Owerri West LGA and Owerri North LGA out of the 27 LGAs in the state, due to the predominance of trading activities in the area. The second stage involved the purposive selection of six (6) major

commodity markets in the study area, namely Owerri main market, relief market, new market, Nkwo-Ukwu Ihiagwa market, Ezi-Obodo market and Obinze market, based on the concentration of vegetable marketing activities and their market size (Onuwa et al., 2022). In the third stage, 95 African Aubergine traders from the commodity markets were randomly selected as respondents for this study.

Analytical techniques

Data collected was analysed using the following techniques: descriptive statistics (mean, frequency counts and percentages) were used to analyse objectives i and v; market performance (objective ii) was analysed using marketing margin and efficiency; ordinary Least Square (OLS) regression was used to analyse the determinants of marketing margin (objective iii); the income disparity among African Aubergine traders (objective iv) was analysed using the Gini Coefficient index.

Market performance

An efficient marketing system minimises the cost of the marketing process and ensures greater returns to producers, while at the same time providing final consumers with quality products at reasonable prices. In measuring market performance, marketing margin and marketing efficiency analysis were adopted.

Marketing margin

The marketing performance of African Aubergine was assessed by computing marketing margins. A marketing margin, also known as profit, signifies the variation in prices across various levels within the marketing system. It quantifies the percentage of the final selling price retained by a specific group of traders within the marketing chain (Toure and Wang, 2013). Alternatively, this term can also denote the price contrast between what producers receive and what consumers pay for the same quantity and quality of a product. It may additionally describe the price differentials between two stages in the marketing chain. Marketing margin (Profit) is an important measure in trade transactions, as it gives the trader a measure of how much profit he makes on merchandise sales. The size of the marketing margin indicates the amount of value (profit) added in the marketing system (Lutfa et al., 2019). Marketing margin comprises different components, including costs of marketing services, total and net returns (profit). The analysis of marketing costs estimates how much expenses were incurred for each marketing activity (Ayelech, 2011 and Sreenivasa et al., 2007). It would also compare marketing costs incurred in the path of distribution. The analysis of marketing margin was computed by comparing the difference between the average selling price (i.e., price at which the African Aubergine traders sold their goods) and cost price (i.e., price at which the African Aubergine traders purchased their goods). The computation employed the following formula presented in Eq. (1):

$$MM = P2 - P1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where:
MM = marketing margin [₦ (Nigerian Naira) /kg];
P1 = price at market level 1 (cost price) (₦/kg);
P2 = price at market level 2 (selling price) (₦/kg).

Marketing efficiency

Marketing efficiency is a ratio of marketing margin to marketing costs. Marketing efficiency is the maximisation of the ratio of output to input (Gebremedhin and Jaleta, 2012). Marketing efficiency is the most frequently used measure of market performance. Improved marketing efficiency is a common objective of farmers, wholesalers, retailers and commodity traders (Yohanes, 2015). The following marketing efficiency notation was adopted in this study and presented in Eq. (2):

$$\text{M.E.} = \text{Marketing margin (profit)} \div \text{Cost of marketing} \dots\dots\dots\dots\dots\dots \text{(2)}$$

Decision rule:
If M.E. = 1, marketing is efficient;
If M.E. < 1, marketing is inefficient;
If M.E. > 1, high marketing efficiency.

Ordinary Least Square (OLS) Regression

The Ordinary Least Square (OLS) regression was used to determine factors that influence the marketing margin of African Aubergine traders. The OLS regression model provided the best fit and was chosen as the leading equation based on the number of significant variables, the magnitude of the coefficients and statistical and econometric criteria (Gebremedhin and Jaleta, 2012; Wissmann et al., 2007). The OLS regression was used to establish the effects of specified variables on the marketing margin (Wissmann et al., 2007). The Durbin-Watson statistic (d) was employed to detect the presence of autocorrelation at lag 1 in the residuals (prediction errors) in the regression analysis. Additionally, homoscedasticity of the residuals' variance (i.e., the homogeneity of variance) was checked using the Levene test. In its explicit form, the regression model is presented in Eq. (3) as:

$$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \dots\dots\dots\dots\dots\dots.. \text{(3)}$$

Where:
Y = marketing margin [₦ (Naira) /100kg bag];
β_0 = intercept;
$\beta_1 - \beta_5$ = Coefficient of parameters to be investigated;
X_1 = gender (male =1, female =0);
X_2 = marketing experience (years);
X_3 = cost price (₦);
X_4 = quantity sold (number of bags);
X_5 = Marketing cost (₦);
ε_i = Error term.

Gini coefficient

The Gini Coefficient technique is a measure of statistical dispersion intended to represent the income dispersion of the respondents in the ith class. It is the most commonly used measure of income inequality (Onuwa et al., 2017). The Gini Coefficient ranges between 0 and 1, where 0 implies equality in income distribution and 1 implies inequality (Yohanes, 2015). The closer the Gini Coefficient is to zero, the greater the degree of

equality in income distribution among the respondents. Similarly, the closer the value is to unity (1), the greater the degree of inequality. In other words, the Gini Coefficient, therefore, measures the degree of income (G) as presented below in Eq. (4) as:

$$G \;=\; 1 - \sum XiYi \;...\; (4)$$

Where:

Xi = percentage of traders in the i_{th} class;

Yi = percentage of trader's gross income in the i_{th} class;

$XiYi$ = product of the decimal values of X and Y in the i_{th} class.

Results and discussion

Socioeconomic profile

Table 1 shows the socioeconomic profile of African Aubergine traders. The results revealed that the mean age of the respondents was 37 years. This implies that most of the respondents are in their economically active age bracket and thus were able to undertake higher business risks associated with marketing. They are expected to effectively and efficiently utilise the available resources. This result is consistent with Toure and Wang (2013) and Ayoola and Zever (2010) who reported in their respective study a significant relationship between the respondents' age and marketing efficiency. The average number of years spent in school was eight (8) years. This indicates that most of the respondents attained primary education. This is desirable because the level of education not only increases their production, but also their ability to understand new techniques. This factor influences African Aubergine marketing in the study area. Iheke (2010b) opined that the educational attainment of a respondent will increase their versatility and equip them with other skill sets. This feature puts them in a position to understand and adopt available innovations that facilitate an increase in their trading activities. Thus, education mitigates barriers in trade transactions.

Table 1. Descriptive (summary) statistics of respondents' socioeconomic profile

Variables	Sample mean
Age (years)	37.2
Educational level (years)	8.1
Household size (population)	7.4
Trading experience (years)	9.2
Bags sold (number)	6

Source: Onuwa (2022).

The mean household population was seven (7) people, implying that the respondents have reasonable household sizes. Iheke (2010a) noted that the higher the number of people working in the household, the higher the household income, ceteris paribus and, hence, the improved welfare of the household. Also, a mean household size of six (6) persons was reported by Nwaiwu et al. (2012). The mean years of experience of the African Aubergine traders was nine (9) years. This suggests that the traders had adequate years of experience in the business, which might indicate the high practical knowledge required to overcome

marketing challenges associated with the business. The years of experience of the African Aubergine traders would have exposed them to various challenges associated with African Aubergine trading and, therefore, they would have more adaptive strategies to marketing challenges, resulting in better profitability. Therefore, the more experience a marketer has, the higher their understanding of the marketing system, conditions and price trends. Nwaiwu et al. (2012) reported that respondents would rely heavily on their experience for increased productivity rather than on their educational attainment. The mean number of fruit bags sold per month by the traders was six (6) bags. This implies that African Aubergine traders sold minimal quantities of their commodities, indicating that the business was relatively viable in the study area. This suggests that most of the African Aubergine traders were predominantly retailers. This is supported by Lutfa et al. (2019), Onunka et al. (2011) and Ugwumba (2009), who reported in their respective studies on agro-commodity marketing, a large population of retail traders.

Market performance

Table 2 revealed the results of market performance (marketing margin and efficiency). The estimated marketing margin was ₦1,250 per 100kg bag, indicating that African Aubergine marketing is a relatively profitable business venture in the studied area. Additionally, the estimated market efficiency index was 0.36, suggesting that the marketing of African Aubergine in the study area was inefficient. This result aligns with Yohanes (2015), Ayelech (2011) and Iheke (2010b), who reported similar marketing margins and efficiency indexes for agricultural crops.

Table 2. Marketing margin and efficiency of African Aubergine traders

Variables	Cost (₦/100kg per bag)
(A) Sales revenue (selling price)	4700
Total sales revenue	4700
(B) Marketing cost:	
i. Unit (cost) price	2,800
ii. Transportation cost	250
iii. Market/union charges	150
iv. Storage cost	100
v. Packaging & handling cost	150
(C) Total marketing cost (cost price)	3,450
(E) Marketing margin (profit) (A-C)	1,250
(F) Marketing efficiency Index (M.E.I) (E/C)	0.36

Source: Onuwa (2022).

Determinants of marketing margin

Table 3 presents the Ordinary Least Square (OLS) regression analysis. The OLS regression was used to establish the effects and determine the factors that affect the marketing margin of African Aubergine traders in the study area. The F-ratio (5.859) is significant at $P < 0.05$ (5%) level, implying that the variables (X_i) in the regression model accurately predict the outcome variable (Y_i). The Durbin-Watson statistic (-3.152) (d>2)], indicates negative autocorrelation, suggesting that the residuals (prediction errors) from the least squares regressions are serially uncorrelated. Also, the Levene test (2.241) was significant at $P < 0.05$ (5%) level, implying that there are no significant differences between

the variances of the samples (i.e., the homogeneity assumption of the variance is met). Thus, the regression model is well-fitted to the dataset. The estimated coefficient of multiple determination (R^2) was 0.773, which implies that 77% of the variation in the marketing margin of African Aubergine traders was accounted for by the independent variables (marketing experience, cost price, quantity sold and marketing cost) in the regression model, the remaining 23% not explained may be due to omitted or unspecified variables and the error term.

Table 3. Factors that influence the marketing margin of African Aubergine traders

Variable	Coefficient	Standard Error	T-Ratio
Constant	2.902**	1.131	2.566
Gender (X_1)	0.764[n.s]	0.689	1.11
Market experience (X_2)	0.653**	0.244	2.676
Cost price (X_4)	-0.343**	0.119	-2.882
Quantity sold (X_5)	0.731**	0.267	2.737
Marketing cost (X_6)	-0.575**	0.212	2.712
R^2	0.773		
F-Ratio	5.859		
D-W (*d*>2)	-3.152		
Levene test	2.241**		

**= Significant at 5% (P<0.05) Level; [n.s] = Not Significant.

Source: Onuwa (2022).

The interpretation of the regression result suggests the following:

Marketing experience: The coefficient of marketing experience (0.653) was positive and statistically significant at a 5% level. Hence, the number of years a respondent spends performing any marketing function directly influences their marketing experience and, thus, improves efficiency in commodity marketing over time. This result is consistent with Onuwa et al. (2023) and Onunka et al. (2011), who also reported in their respective studies on the determinants of marketing margins and profitability of African Aubergine marketing a positive correlation between the respondents' marketing experience and profitability in agro-commodity marketing.

Cost price: The coefficient of the cost price per bag (-0.343) was negative and significant at the 5% level. This implies that as commodity prices increase, quantity demanded decreases. Consequently, a decline in the quantity of commodities sold affects the margins derived therefrom. This result corroborates Onuwa et al. (2017), who also reported in their study on the profitability of African Aubergine marketing a significant relationship between the prices at which the goods were purchased and the marketing margin of the African Aubergine traders.

Quantity sold: The coefficient of quantity sold (0.731) was found to be positive and significant at the 5% level. This suggests that African Aubergine traders will earn a more lucrative income as their sales volume increases. This factor is influenced by the forces of demand and supply, which are determinants of market equilibrium. This result aligns with the findings of Onuwa et al. (2022) and Ugwumba (2009), who similarly observed a significant and positive correlation between the sales volume of agricultural commodities and the marketing margin of the participants in their respective studies on agro-commodity marketing.

Marketing cost: The coefficient of marketing cost (-0.575) was negative but statistically significant at the 5% level. This implies that an increase in marketing costs will affect the quantity of bags sold. Agro-commodity marketing costs are influenced by various market function charges. This variable has an inverse relationship with marketing margins. Thus, the higher the estimate, the lower the margins derivable by African Aubergine traders. Policies aimed at reducing marketing costs are necessary to increase the level of supply and profitability. A similar outcome was reported among traders in agro-commodity markets by Gebremedhin and Jaleta (2012) and Ayoola and Zever (2010).

Income disparity (inequality)

Table 4 revealed that the computed Gini Coefficient for African Aubergine traders in the study area was 0.59. This index indicates an average level of income disparity (inequality) in the sales income of the respondents, which is attributable to marketing inefficiencies and the volume of trade transactions among African Aubergine traders in agro-commodity markets. This corroborates Onuwa et al. (2017), who also reported [in their study on the profitability of African Aubergine marketing] a moderate level of income disparity (inequality) in the sales income of their respondents.

Table 4. Estimation of income disparity among African Aubergine traders

Income class (₦)	Frequency	%(X)	Gross income(₦)	% Gross income (Y)	XY
≤49,999	61	64.2	592,900	48.2	0.31
50,000-99,999	30	31.6	336,300	27.3	0.09
≥100,000	4	4.2	300,500	24.4	0.01
Total	95	100.0	1,229,700		0.41
Gini Coefficient: 0.59					

Source: Onuwa (2022).

Constraints of African Aubergine marketing

Table 5 reveals the critical constraints affecting African Aubergine marketing in the study area. The identified constraints include inadequate capital (89.5%), high marketing costs (82.1%), inadequate price information (64.2%) and poor market infrastructures (57.9%). Other constraints include the perishability of the commodity (45.2%), inadequate storage facilities (44.2%), price volatility (38.9%) and exploitation by middlemen/agents (24.2%). This is consistent with findings from Onuwa et al. (2022), Slamet et al. (2017), Asa et al. (2012) and Sreenivasa et al. (2007), who also highlighted [in their respective studies] similar constraints that significantly impacted agro-commodity marketing.

Table 5. Distribution based on the constraints of African Aubergine marketing

Constraint	Frequency	%
Inadequate capital	85	89.5
High cost of marketing	78	82.1
Inadequate price information	61	64.2
Poor market infrastructures	55	57.9
Perishability of commodity	43	45.2
Inadequate storage facilities	42	44.2
Price volatility	37	38.9
Exploitation by middlemen/ agents	23	24.2

*Multiple responses were allowed.

Source: Onuwa (2022).

Conclusions

This study analysed African Aubergine marketing and income disparity among traders in Owerri, Imo State, Nigeria. The study revealed that socioeconomic factors affected African Aubergine marketing in the study area. Also, African Aubergine marketing is a relatively profitable business venture as indicated by the estimates of the marketing margin. However, low levels of market efficiency persist among the respondents. Also, variables in the regression model, including trading experience, cost price, quantity sold and marketing cost significantly influenced the likelihood of variation in the marketing margin. Additionally, the Gini Coefficient index indicated a moderate level of income disparity (inequality) in the sales income of the respondents. The identified constraints were significant and had a critical impact on African Aubergine marketing. Marketing costs were relatively high, making it crucial to address this issue in the study area. Therefore, policy actions should focus on alleviating these constraints to enhance profitability and lower marketing costs.

Based on the findings of this study, the following recommendations are made:

i. Implementation of policies to improve access to agricultural credit and business capital for African Aubergine traders in agro-commodity markets;

ii. Implementation of policies to subsidise the cost of marketing functions and improve marketing efficiency among African Aubergine traders in agro-commodity markets;

iii. Adoption of modern information communication tools (ICTs) for the effective dissemination of market information among African Aubergine traders in agro-commodity markets;

iv. Providing basic market infrastructures and interventions that support and facilitate the activities of African Aubergine traders in agro-commodity markets by stakeholders and appropriate agencies;

v. Adoption of modern storage facilities that extend the shelf life of the crop (African Aubergine) and thus mitigate post-harvest losses due to the perishable nature of the crop;

vi. Formulation and implementation of policies that mitigate agro-commodity price volatility and exploitation by agents, particularly among African Aubergine traders;

vii. Adoption of policies to improve market performance and reduce income disparities, particularly among African Aubergine traders in agro-commodity markets.

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