



(RESEARCH ARTICLE)



Validating the place of Underutilized Indigenous Vegetable (UIV) Marketers: A case of Agrarian Communities, Southwestern Nigeria

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Abstract

Over the years, staple crops have faced several challenges, and a step away from over-reliance on them is very important to achieve food security in Nigeria. Indeed, underutilized vegetables are usually indigenous ancient crops that are still used reasonably in local, national, and even international communities. Hence, this study validates the spatial pattern and network of underutilized indigenous vegetable (UIV) marketers in Ondo State, southwestern, Nigeria with emphasis on fluted pumpkin (*Telfaria occidentalis*), African eggplant (*Solanum macrocarpon*) and Amaranth (*Amaranthus virides*). A multi-stage sampling technique was used to select a total of 120 UIV marketers from 5 villages. Primary data were collected and gathered using structured questionnaires and responses from the interview were coded and analyzed with STATA and UCINET. The study further examines the factors influencing the performance of the UIV marketers and determines the predictors driving association membership using multiple linear regression and binary logistic regression, respectively. The analysis results revealed that the majority (90.83%) of the UIVs marketers are female with a large proportion of the marketers within the age range of 51-60 years. The primary occupation of most of the respondents is trading (51.67%). From the regression results, belonging to a vegetable association is not statistically significant and thus it can be concluded that being a member of a vegetable association does not affect the income of the marketers. This is in sync with the information gathered from the focus group interviews that the association only serve as a medium to get firsthand information on price, product quality, and vegetables demanded. However, from social network analysis, it can also be concluded that the major actors involved in UIV marketing are interrelated and that they transfer information between themselves with the association being the common ground for such exchange. The study recommends that the government should consciously push for the wide acceptance of vegetable cultivation and provide good network roads in rural areas.

Keywords: Underutilized Indigenous Vegetables; Network Analysis; Binary Logistic Regression; Multiple Linear Regression; Nigeria; UCINET

1. Introduction

The term vegetable can be used to distinguish the tender edible shoots, leaves, fruits, and roots of plants that are eaten whole or part, raw or cooked as a supplement to starchy foods (Williams et al., 1999). According to 2013 statistics, China is the leading producer of vegetables (51.3%), followed by India (10.6%). The other three leading producers are the United States (3.01%), Turkey (2.49%), and Iran (2.08%) with Nigeria ranked at number twelve producing 11.92 million metric tons. Vegetables and vegetable products form a large percentage of food in most African countries. In most West African countries, about 50% to 90% of the vegetables consumed are produced within the country especially in the rural areas or close to the city (Cofie et al, 2003). It is high in nutritional value as it contains vitamins A, C, D, E, and K and has high fiber content. It was reported by (Onyango, 2007; Shiundu and Oniang'o, 2007) in their studies that African indigenous vegetables (AIVs) are endowed with higher levels of nutrients than their exotic counterparts; hence the need to concentrate more on their production. Vegetable, being the largest and fastest-growing sector of horticulture

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in Nigeria has a great deal of potential in production and export. However, over the last decade, African leafy vegetables (ALVs) have been traded increasingly in both formal and informal markets. Before 2000, ALVs were mainly found on the streets and in a few open-air local markets but since then, they have been found in supermarkets where values are added (Irungu et al., 2007). It has been found in a study carried out by IITA (1999) that African indigenous vegetables are becoming increasingly consumed due to their ability to fit into an all-year-round planting scheme. Previous studies have established the fact that most small-scale producers consume most of their produce while the remnants are then sold at local markets or to district markets depending on the information available to them.

Marketing system is a complex interrelated parts that have a defined common goal which in agriculture is to maximize the use of resources to enhance productivity and the components are independent of one another. However, a change in one of them influences the others and the whole system. Market and marketing systems are growing in importance as key factors influencing the success or failure of efforts to improve food production. The marketing of agricultural produce is very important and should be given special attention due to the perishability of the products involved. Despite the intensive cultivation of cash crops in Nigeria, farmers are no longer interested in high prices for cash crops; rather they are interested in crops whose returns are constant and not seasonal of which vegetables are a perfect example. Indeed, the agricultural and food marketing system has been viewed as consisting of four (4) main sub-systems: production, distribution, consumption, and regulation. According to Micheal (2013), a network is a structure that links actors; individuals, or organizations and identifies how actors are connected; from simple relationships to family ties. However, for marketers of agricultural produce, such positions as members or executives of a particular network are a valuable source of information, knowledge, and opportunities to promote their offers.

There is an increasing need for a stable and continuous source of income for rural farmers. Cultivation of cash crops is usually seasonal and not reliable. Some vegetables are growing wild in rural areas and their potential has not been fully harnessed. Most women in rural areas simply harvest these vegetables and eat them hence the term 'underutilized' in their nomenclature. However, it is difficult to precisely define which attributes make the vegetable underutilized, but they are often associated with linkage with the cultural heritage of their place of origin, weak or no formal seed supply system, and receiving little attention from research.

The Nigerian Canadian vegetable (NICANVEG) program took a bold step to evaluate the production efficiency of underutilized indigenous vegetables (UIVs), their resource use efficiency, and their profitability. The NICANVEG program was carried out in some South-western states (Ondo, Oyo, Osun, and Ekiti) of Nigeria from 2011 to 2014. The study started with over twenty (20) vegetables but was narrowed down to four (4) and it includes Ugu (*Telfaria occidentalis*), Tete (*Amaranthus hybridus*), Igbagba (*Solanum macrocarpon*). The NICANVEG program was linked to another national program (fertilizer micro-dosing) that is still ongoing. Apart from the work conducted in Nigeria by IITA in 1999, Ndagbu et al; 2020; Namani et al; 2009, not a lot of empirical work has validated the place of Underutilized Indigenous Vegetable (UIV) Marketers in rural southwestern Nigeria. Furthermore, much has not been done around network analysis of the various UIV marketing actors. Poor marketing strategy is one of the factors mitigating against the production of UIVs in Nigeria. It is also unclear whether the UIV marketers have sufficient knowledge about the flow of information as well as how such information affects marketing decisions. Thus, the study validates the current network of underutilized Indigenous vegetable marketers in Ondo State, Central Western Nigeria, analyzes the socioeconomic characteristics of UIV marketers, examines the various actors involved in UIV marketing, analyzes the pattern of social networks among the marketers as well as their interdependence, and determines the factors influencing their profitability.

2. Review of Related Literature

In Nigeria, UIV are vegetables whose values have not been properly exploited due to some factors (Salami 2011). Amujoyegbe *et al.*, (2015) described vegetables as shrubs, leaves, or any other part of plants that make up a major portion of the human diet in many parts of the world and play a significant role in human nutrition, especially as sources of Vitamins A, B, C, and E; minerals, dietary fiber, and phytochemicals. Salami (2011) revealed that these vegetables can greatly reduce the problem of malnutrition by providing adequate protein, minerals, and vitamins to the body. According to Ojeniyi (2002), vegetable production forms about 25% of the major food crops cultivated in Nigeria and is a source of livelihood for a considerable section of the population, mostly women. Amujoyegbe *et al.*, (2015) also stated that "Women are the custodians of the indigenous knowledge on the use, management, processing, preparation, and sale of indigenous vegetables. These vegetables have suffered significant scientific under-exploitation and abandonment due to several social and economic factors, thus, they are threatened with extinction, but they have the potential to enhance farmers' economic condition if integrated into the existing traditional farming system and help in the conservation of these vegetables". Ibukun et al., (2024) emphasized the potential increase that will be observed in vegetable production due to the acceptance and incorporation of precision agriculture. Chweya and Eyzaguirre, (1999)

have affirmed in their study that indigenous vegetables have been identified with poor rural lifestyles and low status and affirmed that cultural changes and urbanizations have led to further neglect of the UIVs. The NICANVEG project in Nigeria has identified some different underutilized indigenous vegetables in Nigeria as shown in Table 1 below.

Table 1 Some Underutilized Indigenous Vegetables (UIVs) in Nigeria

English name	Yoruba name	Botanical name
Fluted pumpkin	Ugwu	<i>Telfaria occidentalis</i>
African eggplant	Igbagba	<i>Solanum macrocarpon</i>
African spinach	Tete	<i>Amaranthus hybridus</i>
Amaranth	Tete atetedaye	<i>Amaranthus virides</i>
Snake tomato	Tomati Elejo	<i>Trichosanthes cucumerina</i>
Bitter leaf	Ewuro	<i>Vernonia amygdalina</i>
Field pumpkin	Elegede	<i>Curcubita pepo</i>
Fire weed	Ebolo	<i>Crassocephalum crepidoides</i>
Glossy Night Shade	Odu	<i>Solanum nigrum</i>
Bologi	Worowo	<i>Solanecio biafrae</i>
Huckleberry	Ogunmo	<i>Solanum scarbum</i>

Source: NICANVEG 2013 www.Nicanveg.org

UIVs have also been identified as scientifically neglected tropical vegetables which are of high nutritional and medicinal value. Although UIVs are greatly appreciated for their taste and nutritional quality, they are usually the first item to drop from the household diet when the family's purchasing power improves. Adebooye *et al.*, (2005) reported that following the introduction of exotic species of vegetables, the cultivation and consumption of the indigenous ones decreased substantially, and various reasons have accounted for that. For example, deforestation, and heavy reliance on research that focused on exotic vegetables rather than traditional ones.

It is important to note that marketing is an important factor that determines the patronage of any vegetable. Ndaghu *et al.*, (2011) found out that interest in vegetable production and marketing has increased rapidly in the last two decades because of a greater appreciation of the importance of vegetables supported by rising awareness of a balanced diet and increasing knowledge of the fact that the introduction of vegetables is crucial to attaining a balanced diet. Interestingly, the production and marketing of UIVs also serve as an important source of livelihood for people with low levels of education without white-collar jobs. Ndaghu *et al.*, (2011) further affirmed that the marketing of vegetables has increased rapidly over the years in Nigeria. In Nigeria, the farmers cultivate vegetables throughout the season which necessitates a commensurate increase in buyers and marketers all over the country. The marketing of UIVs should involve monitoring and understanding markets and consumer preferences, networking with potential buyers, and building sustainable relationships with existing buyers.

The significance of network analysis in the marketing of UIVs has been addressed in the literature and understanding the pattern of relationships that exist among actors is germane (Ndagbhu *et al.*; 2011; Branning, 2007; Cynthia and Pamela 2004). Cynthia and Pamela (2004) affirm that establishing a sustainable relationship between supplier and customer and coordinating cross-functional pathways of communication are fundamental issues in validating the place of UIV marketers globally. Indeed, it has been concluded that several actions taken, and choices made within the marketing system are determined by networks of relationships and not by the individual. Several theories of networking have been adopted for several marketing issues and the diffusion and adoption of new products and services (Midgley *et al.*; 1992).

Wellman (1983) identified that the major focus of network analysis is to understand how the various networks affect the behavior of every individual within the network. It is very important for any enterprise looking forward to achieving the goal of profit maximization to be fully informed of all the happenings in the market concerning its product via the information made available through the various connections. Phipps and Yoram, (1994) affirmed that social networks in marketing can be classified according to several attributes, including the level of formalism, whether the network is

centered on a marketing-related task, and the behavior and nature of the relationship among the members of the network. The degree to which the transaction is recurring as well as the extent to which the buyers and sellers are organized has also been documented in literature. To explore hidden relationships among actors in network analysis, the social network was also introduced. This can be traced back to the early sociologists like Georg Simmel and Emile Durkheim who wrote about the importance of studying patterns of relationships that connect social actors. Studies have identified the scarcity of evaluation of social networks and relationships at the organizational level. Indeed, to our knowledge, this is the first study that adopts graphic social network and spatial techniques to explain the interplay that exists between the UIV marketers, and the actors involved in traditional rural areas of central-western Nigeria.

3. Methodology

3.1. Study area

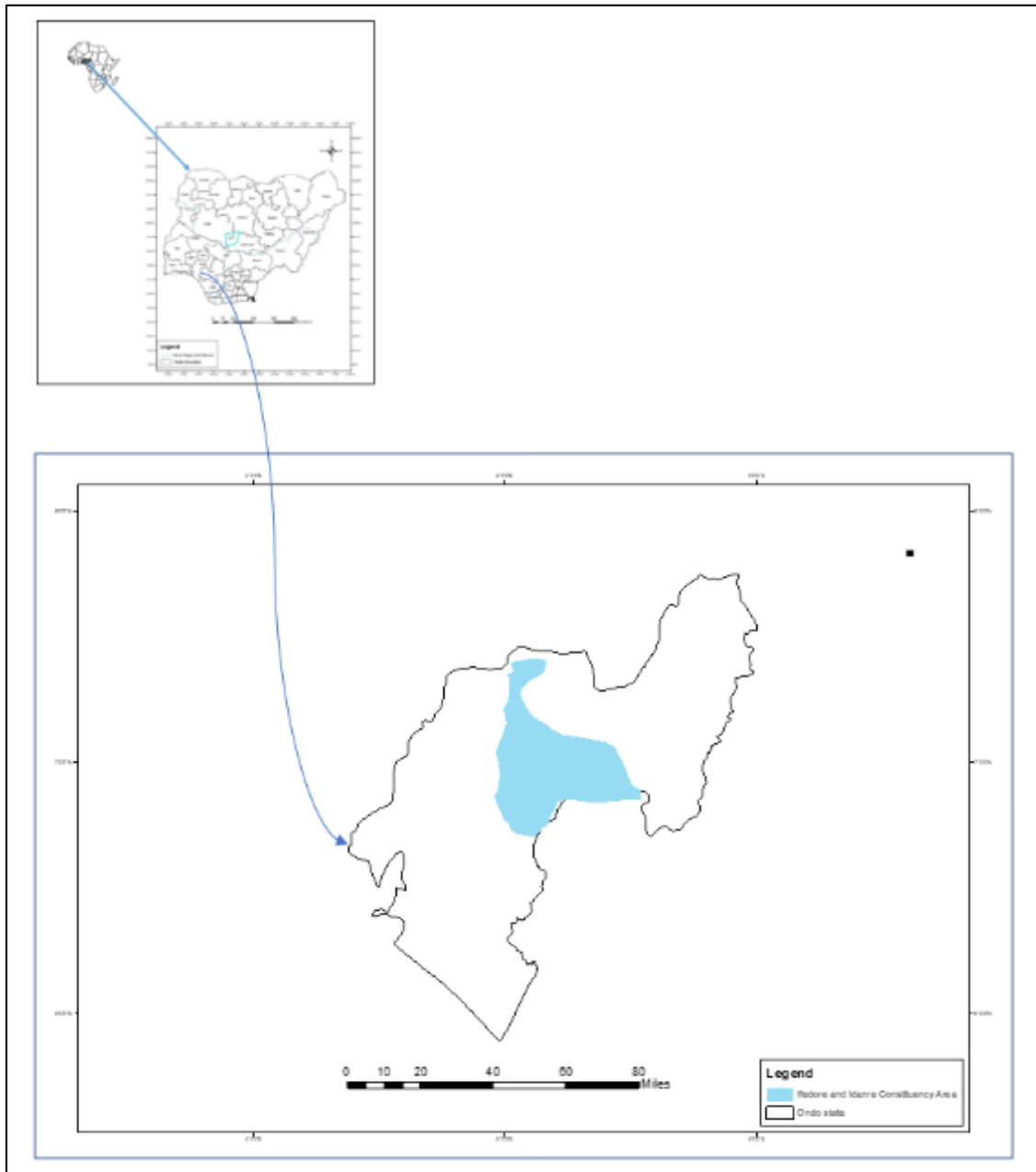


Figure 1 The Map of Africa and Nigeria indicating the Study Area

The study was conducted in Ondo State, central-western Nigeria. The state was created on February 3rd, 1976, by the government of Nigeria. The state was bounded in the North by Ekiti and Kogi States, in the East by Edo State, in the West

by Osun and Ogun states, and in the South by the Atlantic Ocean. Ondo State is located entirely within the tropics with Akure as its capital city. The state lies between latitudes 7°10 N and longitudes 5°05 E. (Figure 1). The 2006 housing and population census shows that Ondo state has a total area of about 15,500 Km² (or 6,000 sq mi) with a population of 3,441,024 people with 1,761,263 males, 1,679,761 females, and a density of 220/km² (NPC, 2006). The climate of the study area falls under a tropical climate consisting of two broad seasons: the rainy season (April-October) and the dry season (November – March).

The temperature throughout the year ranges between 21°C to 29°C with a mean monthly range of 2°C and humidity is relatively high. The annual rainfall varies from 2,000mm in the southern areas to 1,150mm in the northern areas. The State enjoys luxuriant vegetation with a high forest zone (rain forest) in the south and a sub-savannah forest in the northern fringe. An important aspect of the vegetation of the state is the prevalence of tree crops like cocoa, kola, coffee, rubber, oil palm, and citrus with cocoa being the most prevalent. The study area is also characterized by numerous rivers like Owena, Ala, Oluwa, Oni, Awara, Ogbese, and Ose. Generally, the land rises from the coastal part of Ilaje, Ese-Odo, and Okitipupa areas to highlands and steeps down at the Northern parts of the state with the proliferation of many small river channels as the most outstanding characteristics of the drainage system. The vegetation of the state ranges from mangrove swamps to the southern coastal riverine areas through the rainforest of the mid-lands to the derived savannah in the northern part of the state (Oluwafemi et al 2013; Oluwafemi et al 2017). The state is composed of lowlands and rugged hills with gigantic outcrops in several places with some prominent hills found in the Idanre and Akoko area of the state rising above 250 meters. The major economic activity in the local governments selected is farming with a lot of cash crops and food crops being cultivated (Oluwafemi et al; 2017).

3.2. Study population

We selected Idanre and Akoko LGAs of Ondo State as investigation sites (please see Figure 1 for the map of Ondo State indicating the location of the area of interest). The LGAs selected for the study share geographic characteristics in terms of climatic conditions and socioeconomic activities. We further selected five (5) villages (Alade, Odode, Ita-Olorun, Iwaro-Oka, and Arigidi-Akoko) across the two LGAs.

3.3. Sampling and Study Design

In this study, a multistage sampling technique was used to select the study population. In the first stage, purposive sampling was used to choose the two local governments: Idanre and Akoko. In Akoko, two areas were chosen: Iwaro-oka and Arigidi akoko. These areas were also purposively chosen because they are among the baselines for the NICANVEG project in Ondo state, hence the abundance of UIV marketers. Stage two involved the use of a random sampling method to select five villages; Alade, Odode, Ita-olorun, Iwaro-oka, and Arigidi Akoko in the two LGAs and structured questionnaires were administered to the villages based on the numbers of available UIV marketers. The third stage involves using a random sampling technique to select 120 UIV marketers.

A total of 120 structured questionnaires were administered to the selected UIV marketers across the five villages. The questionnaire sought information about the sociodemographic characteristics of the respondents and networking patterns between the UIV marketers and the actors. Forty (40) questionnaires were administered in Arigidi-Akoko, Alade village (20), Odode village (15), Ita-Olorun (10) and Iwaro-Oka (35). We further conducted 5 Focus Group Discussions (FGDs) across the five villages to elicit information on the socioeconomic characteristics of the UIV markets and various actors involved in UIV marketing.

3.4. Data analysis

The responses from the focus group discussions were transcribed and different themes were coded. The responses from the structured questionnaire were also analyzed using STATA software and results were explained using descriptive and inferential statistics. The network analysis of the key actors in UIV marketing was performed to identify and establish the relationships that exist between the actors, and information flow using UCINET software. Multiple linear regression analysis was also conducted to model the relationship between income (dependent variable) and marketing experiences, cost, distance to the market, education, gender, household size, primary occupation, and affiliation to vegetable association.

$$y_i = \beta_0 + x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \dots + x_i\beta_i + \varepsilon_i \quad (1)$$

Where y_i is the dependent variable (income), $x_1, x_2, x_3, \dots, x_i$ are the predictors, β_0 is the intercept, β_1, \dots, β_i are the partial regression coefficients and ε_i is the error term.

Binary logistic regression analysis was also employed to model the factors that influence the affiliations to vegetable associations among the UIV marketers (dependent variable) and gender, marital status, experience of UIVs, UIVs marketer, distance to the market, household size and average monthly profits (independent variables).

$$\text{logit}(p) = \log(p/(1-p)) = \beta_0 + x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + \dots + x_i\beta_i + \varepsilon_i \quad (2)$$

$\text{Log}(p/1-p)$ is the logit of the probability or the predicted log odds of a UIV marketer belonging to an association instead of obtaining market information from external sources, $x_1, x_2, x_3, \dots, x_i$ are the predictor variables, β_0 is the intercept, β_1, \dots, β_i are the partial regression coefficients and ε_i is the error term.

4. Results

4.1. Participant's characteristics

The results showed that 45% of the respondents were between the ages of 51 and 60 years while only 1.67 % of the UIV markets fell between the ages of 21-30 years. The mean age of the UIV marketers is 53.5 years with a standard deviation of 8.37 years while the minimum age is 22 years, and the maximum age is 76 years (Table 2). This study agrees with Makhura (2001) who concluded that older individuals engage in UIV marketing and therefore have more experience and stronger networks in UIV marketing in Africa. The result further reveals that the majority of the UIV marketers (90.83%) are female and only 9.17% are male. Onyango (2007) had earlier affirmed that vegetable marketing activity is principally carried out by women, and this is not far-fetched from the fact that African women are considered to have developed marketing skills over a long period. The role of education cannot be overlooked in any UIV studies, this study reveals that 65.8% of the UIV marketers have secondary school education and none of them had tertiary education. The overall result reveals that 87.50 % of the UIV marketers had formal education while 12.50% had no formal education. Gloy et al; (2000) earlier affirmed in their study that education tends to increase marketing skills. The study further reveals that the proportion of UIV marketers with rich experience in UIV marketing activity relies heavily on the period of years spent as marketers. Indeed, the 6-10 years UIV marketing period had the highest percentage of experience.

4.2. UIV marketing

Farmers do not expect that their vegetables will be picked up or get to markets without conscious marketing effort by the various actors involved in UIVs marketing. The study reveals clearly that the three UIVs mostly patronized in the study area are: Fluted pumpkin (Ugwu) (*Telfaria occidentalis*), African eggplant (Igbagba) (*Solanum macrocarpon*), and Amaranth (Tete Abalaye) (*Amaranthus virides*). The study reveals that the most preferred UIV is fluted pumpkin (Ugwu) (*Telfaria occidentalis*) with (88.33%). Also, the study further categorized the actors involved in UIV marketing into Retailers (46.67%), Wholesalers (45%), and Undefined actors (8.33%).

Table 2 Socioeconomic Variables of UIV Marketers

Criteria	Frequency	Percentage
Age (in years)		
21-30	2	1.67
31-40	5	4.17
41-50	38	31.67
51-60	54	45.00
61-70	18	15.00
71-80	3	2.50
Gender		
Male	11	9.17
Female	109	90.83
Education Level		
Primary	25	20.83

Secondary	79	65.83
Tertiary	01	0.83
Adult Education	00	0.00
No formal education	15	12.50
UIV most Preferred		
Ugwu	106	88.33
Igbagba	04	3.33
Tete-abalaye	10	8.33
UIV actors		
Undefined	10	8.33
Retailers	56	46.67
Wholesalers	54	45.00

4.2.1. Wholesale Actors

The wholesalers are usually known to take title to and own the products they handle. They usually engage in trade to make profit. They are known for purchasing vegetables in bulk with better financial and information capacity. They buy UIVs mainly at the farm gate, mostly in remote areas, and at the roadside in larger volumes than any other marketing actors do. Sometimes, wholesalers negotiate with the farmers on the price they are willing to sell their vegetables and once the price is agreed upon, they take upon themselves the harvest cost and transport to town or markets. Each wholesaler mainly uses lorries, cars, and sometimes motorcycles to transport the vegetables to the market. Generally, wholesalers are relatively fully engaged in wholesale buying by wandering to other areas outside the district in the other months of the year looking for the commodity to sell. Wholesalers resell UIVs to retailers and sometimes sell some quantities to street hawkers.

4.3. Retailer Actors

They are known for their limited capacity for purchasing and handling products as well as their low financial and information capacity. Retailers buy UIVs from wholesalers or farmers but in small quantities. Mostly, they are the ultimate actors in the market chain that purchase and deliver vegetables to the final consumers. They are very numerous compared to wholesalers. Their main function is to sell to final consumers in pieces and on a retail basis after receiving larger volumes from wholesalers or farmers. When retailers buy from wholesalers, it can usually be obtained on a credit basis which would be paid at the end of one or two market days. The retailers, especially in Idanre LGA majorly sell in their stalls which are constructed with wood and corrugated iron sheets to protect them from rainfall and sunlight. However, vegetables treated this way are subjected to contaminants like flies. The major buyers from retailers were final consumers and sometimes, restaurants.

4.4. Network and Regression Analysis

4.4.1. Patterns of UIVs Marketing Among the Actors

Figure 2 shows the pattern of network among the identified actors in UIVs marketing in the study areas. The actors are considered as the nodes and the arrows show the links and their relationships with other parameters identified and collected on the field. Retailers, wholesalers, and other actors collect information through direct visits to the market, telephone conversations, middlemen, and personal meetings. The essential information these actors receive is product quality, price, and highly demanded vegetables. Also, such information is received every week, bi-weekly, monthly, or every market day. The linkage between the wholesaler and the retailer reaffirms the fact that retailers buy vegetables in smaller quantities from the wholesaler while the major challenges facing the actors are poor marketing information, poor roads to market, and high transport costs (Figure 2)

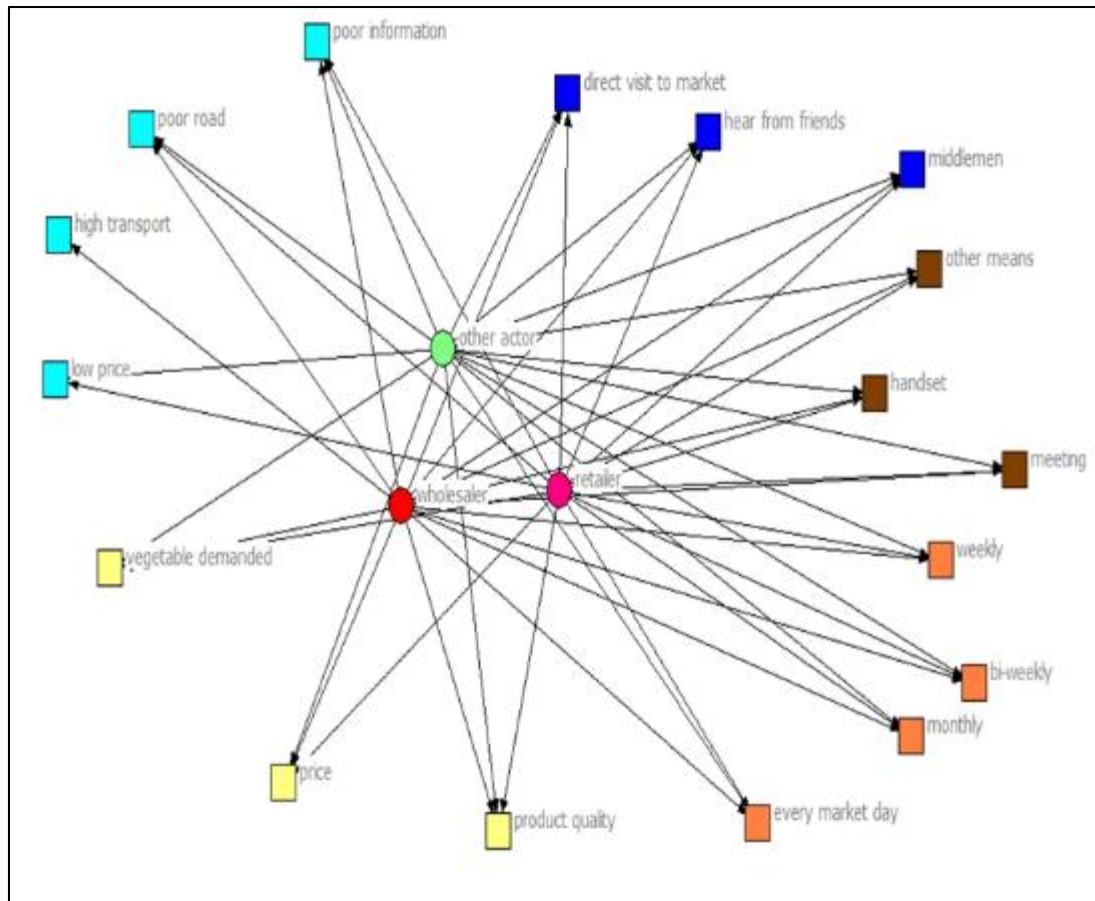


Figure 2 Network diagram of actors involved in UIV marketing

4.4.2. Patterns of UIVs Group Membership and Associated Benefits

Figure 3 shows the network of linkages between the UIV group membership and benefits that accrue to the group members. It is obvious from the network analysis of the vegetable group and membership that the group memberships offer a lot of benefits. Figure 3 shows the administrative positions that the group offers and graphically displays the interdependence that exists among the positions.

Table 3 presents the marginal effect of the determinants of the performance of UIV marketers. It can be inferred from the table that for the significant variables; for example, for every additional year of experience, there will be a 20.29 kobo change in the monthly income of the marketers. Also, for every additional one-naira cost incurred in buying the vegetables, there will be a 46.49 kobo increase in monthly income. Similarly, for every additional one-kilometer distance traveled from the source to the market, there will be a 30.42 kobo increase in income. However, for every additional year spent in school, there will be a 2.22 kobo increase in income. These positive marginal effects are not surprising because these outcomes were buttressed by the focus group interview by their ability to set their prices to maximize profit.

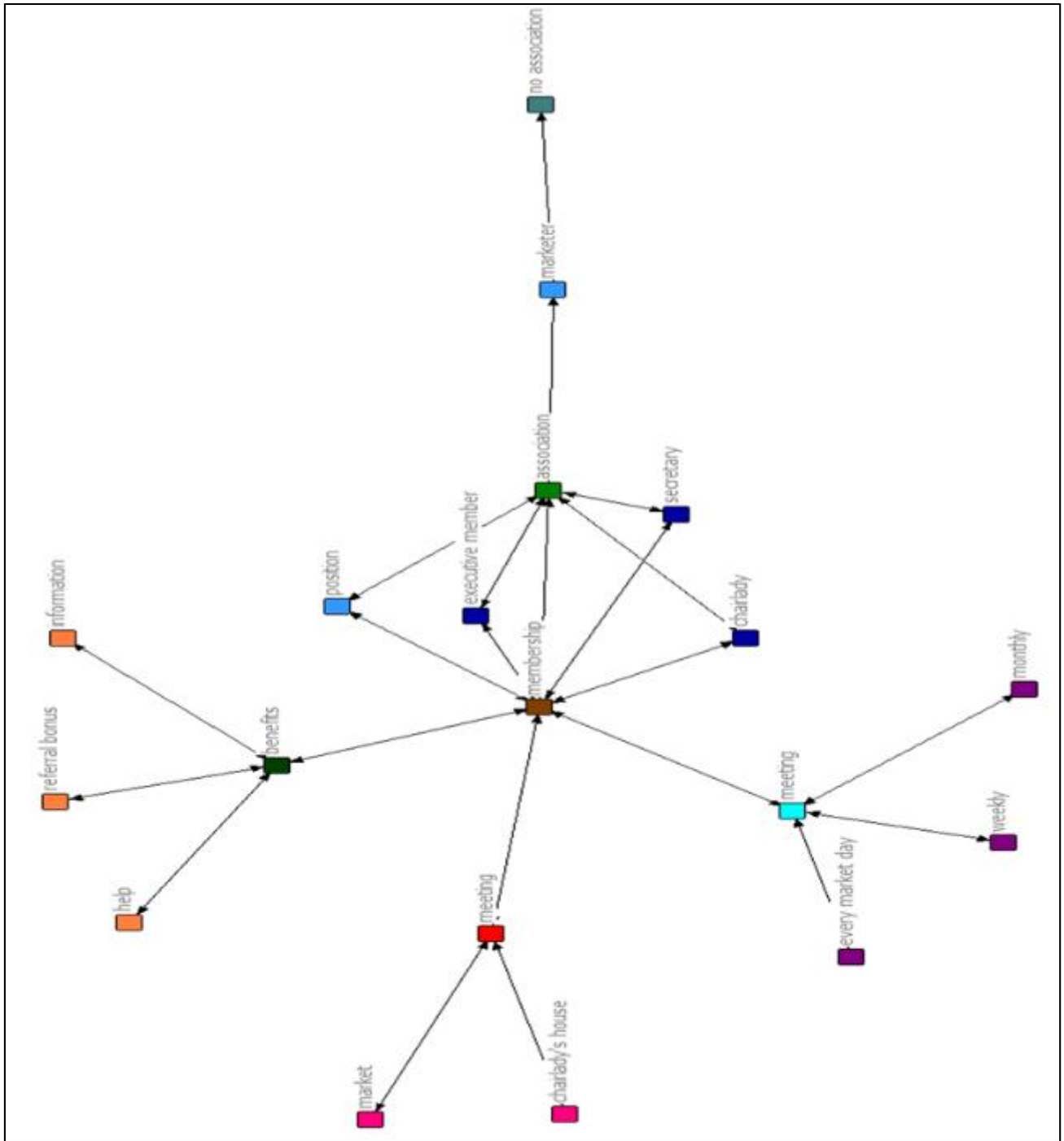


Figure 3 Network analysis of UIV group and membership

Table 3 Marginal value of the determinants of performance of UIVs marketers

Variable	dy/dx	Standard error	z value	P>[z]
Experience	0.2028928	0.06924	2.93	0.003***
Cost incurred	0.4648483	0.08259	5.63	0.000***
Distance to market	0.3041805	0.07221	4.21	0.000***
Years of Education	0.0221833	0.01213	1.83	0.067
Vegetable Association	0.0756486	0.09988	0.76	0.449
Gender	0.1853119	0.20447	0.91	0.365
Household size	0.0989086	0.14204	0.70	0.486
Primary Occupation	-0.0103618	0.08006	-0.13	0.897
y fitted	8.3923605			

*** Significant at 1%, ** significant at 5%, * significant at 10%

4.4.3. Relationship Between the Performance of UIV Marketers and the Examined Explanatory Variables

In this study, we isolated the real explanatory variables that influence the profitability of UIV marketers and further subjected them to multiple linear regression. In the case of the multiple regression analysis, the dependent variable was annual income. The independent variables are years of experience, cost, distance to the market, education, gender, household size, primary occupation, and affiliation to the vegetable membership group. Logit regression analysis was adopted to model the determinants of the UIV membership in the study area. The result of the multiple regression analysis is presented in Table 4. Results show that out of the eight explanatory variables included in the model, three were significant and positive: the experience of the marketers, the cost incurred in buying the vegetables, and the distance from the source to the market. The regression model has an adjusted R² of 0.4471 which indicates that 44.71 percent of the variation in the performance of the UIVs marketers was jointly explained by the independent (explanatory) variables included in the model.

Table 4 Regression results of the determinants of performance of UIV marketers

Independent variables	Coefficient	Standard Error	t value	P> [t]
Constant	3.541412	0.8009365	4.42	0.000
Years of Experience	0.2028928	0.0692447	2.93	0.004***
Cost incurred	0.4648483	0.0825934	5.63	0.000***
Distance to Market	0.3041805	0.0722113	4.21	0.000***
Years of education	0.0221833	0.0121288	1.83	0.071
Vegetable Association	0.0756486	0.0998842	0.76	0.451
Gender	0.1853119	0.2044728	0.91	0.367
Household size	0.0989086	0.1420386	0.70	0.488
Primary	-0.0103618	0.0800586	-0.13	0.897
R ²	0.4957			
Adjusted R ²	0.4471			
F-value	10.20			

*** Significant at 1%, ** significant at 5%, * significant at 10%

4.4.4. Relationship Between UIV Marketers' Membership Group and the Examined Explanatory Variables

Table 5 presents the estimated coefficients and P-levels from the logit regression model. The Logit model has a chi-square (χ^2) value of 21.01 and pseudo r² equal to 0.4327. In addition, the likelihood function of the model was found to

be -46.734764, and chi-square results show that Likelihood ratio statistics are highly significant ($P < 0.0001$) suggesting the model has a strong explanatory power. This indicated that the data was a good fit for the model. The result shows that most of the explanatory variables are statistically significant at 10% or lower and the results of the estimated equations are discussed in terms of the significance and signs of the parameters. Gender is statistically significant at 5% and has a positive sign which signifies that gender (female) positively impacts vegetable association with females dominating such vegetable association. UIVs marketed as expected are significant at 1% and have a positive sign. This shows that a marketer who deals in vegetable marketing has a higher probability of joining a vegetable association than those who do not sell vegetables. In addition, the distance to the market has a negative sign and is significant at 1% which implies that the farther the distance to the market, the lower the tendency of such marketers to become a member of the vegetable association, particularly those that hold meetings on market days. Average monthly profit is significant at 1% and with a positive sign which means that the higher the profit from UIVs marketing, the higher the willingness of marketers to join vegetable associations to receive information.

Table 5 Regression results of the determinants of vegetable association

Independent variables	Robust coefficient	Standard error	z-value	P>[z]
Female (reference Male)	1.801992	0.9328121	1.93	0.053**
Marital status	-0.0628318	0.2247079	-0.28	0.780
Experience	0.4043011	0.526264	0.77	0.442
UIVs marketed	-0.960169	0.2281056	4.21	0.000***
Distance from market	-2.138882	0.8089707	-2.64	0.008***
Household size	1.150725	0.811805	1.42	0.156
Average monthly profit	2.617457	0.965649	2.71	0.007***
Constant	-23.91727	8.525208	-2.81	0.005
Pseudo R ²	0.4327			
Prob>Chi- square	0.0038			
Log pseudo likelihood	-46.734764			
Wald chi-square	21.01			
Number of obs.	120			

*** significant at 1%, ** significant at 5%, * significant at 10%

In summary, the result of this study revealed that (90.83%) of the UIV marketers are female while only a few (9.17%) of them are male with a large proportion of the marketers within the age range of 51-60 years. The primary occupation of most of the respondents is trading (51.67%) closely followed by farming (44.17) with an average experience of 10.9 years with a standard deviation of 6.367459. Results from the analysis revealed that most of the marketers sell *fluted pumpkin (Telfaria occidentalis)* traditionally called *ugwu* which accounted for 50.00% and it is also the most preferred UIV by buyers. Furthermore, the findings show that the major actors in UIV marketing are wholesalers and retailers. It was found that retailers and wholesalers have more than one place for selling their vegetables. Regression analysis showed that only the experience of marketers, the cost incurred in buying vegetables, and the distance to market significantly influence the profitability of UIV marketers.

5. Conclusions

In this study, we employed network analysis and regression analysis (multiple linear and binary logistic regression) to validate the relationship between UIV marketers and a set of socioeconomic and geographic variables. Our main goal is to evaluate the hidden cumulative influence of socioeconomic, and geographic variables on Underutilized Indigenous Vegetable (UIV) marketers across five selected agrarian communities in southwestern Nigeria. Besides, we also evaluated the social networks among the marketers, their interdependence, and factors influencing the performance of UIV marketers. However, some disparities are visible among the rural communities with more UIV patronage in Arigidi-Akoko. We further recommend that sophisticated advanced spatial techniques should be adopted in future UIV studies to identify spatial patterns and behavior of UIV marketers across geographic space. We conclude that policymakers

should improve road networks as it could improve the patronage and consumption of UIVs while also reducing the overreliance of marketers on association for market information.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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