URBANISATION AND HOUSEHOLD FOOD SECURITY IN SOUTH WEST NIGERIA

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A Thesis in the Department of Agricultural Economicssubmitted to the Faculty of Agriculture in partialfulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF IBADAN

JUNE, 2019

DEDICATION

This work is dedicated to Almighty God and my saviour, Jesus Christ the wisdom of God, whose imparted wisdom and grace saw me through the course of this study.

ABSTRACT

Rising urbanisation influences the structure of household food consumption pattern. Preliminary findings show that urban food insecurity persists despite improvement in agri-food system, changing demographics, income growth and economic opportunities attributed to urbanisation. Empirical evidence of urbanisation effect on household food consumption and food security is limited. Hence, effect of urbanisation on household food security in South West Nigeria was investigated.

A four-stage sampling procedure was employed. Oyo and Ekiti States were randomly selected from South West zone of Nigeria. Ibadan and Ado Ekiti were purposively selected from each state, being the most urbanised locations. Nine Enumeration Areas (EAs) were randomly selected from each location. A total of 482 households were randomly selected from the EAs proportionate to size. Data were collected on socioeconomic characteristics (age, sex, educational status, household size, occupational status, monthly income, employment status, membership of social groups), urban characteristics (housing, health facilities), quantities and expenditure of food groups consumed (cereals, Root and Tuber-RT, legumes, meat, Fat and Oil-FO, Fruit and Vegetables-FV and Other Foods-OF). Urbanicity Index (UI) was classified into Low Urban, (LU: 0-34.9%), Medium Urban, (MU: 35.0-64.9%) and High Urban, (HU: 65.0-100.0%) using principal component analysis. Dietary Diversity Index (DDI) was grouped into low (0-4), medium (5-9) and high (10-12) using FAO classification. Data were analysed using descriptive statistics, quadratic almost ideal demand system, berry index and multinomial logit regression model at $\alpha_{0.05}$.

Age of household heads was 47.35±9.85 years with household size of 5.23±1.56 persons and monthly income of ₦51,124.31±17,808.95. The LU, MU and HU households were 34.9%, 40.6% and 24.5%, respectively. Across UI categories, RT had the highest budget share in LU (34.0%), MU (26.1%) and HU (28.2%). Expenditure elasticity values for LU, MU and HU increased by 1.16, 1.41 and 2.42 for meat and 0.45, 1.11 and 1.18 for OF, respectively. Demand increased for cereals by membership of social groups (β=0.0021), occupational status (β=0.0012), income (β=0.0012); RT by household size (β=0.0006); legume by income (β=0.0013); meat by UI (β=0.0014); FV by household size (β=0.0008), UI (β=0.0014); and OF by income (β=0.0018); but decreased for cereals by household size (β=-0.0006) and for RT by

income (β=-0.0012) and UI (β=-0.0011). Highest percentage in low, medium and high DDI were found in LU (16.3%), HU (57.9%) and MU (44.9%), respectively. Food Security (FS) line was two-third mean per capita food expenditure (₦1,758.67k/week) and mean DDI was 7.23±0.06. Expenditure and DDI of food secure households were 25.6% and 10.6%, respectively. Being in male headed households (β=0.83), membership of social groups (β=1.39), occupational status (β=0.88) and UI (β=1.88) increased FS by expenditure while being in male headed households (β=1.28), employment status (β=1.65), educational status (β=0.86), income (β=1.69) and UI (β=1.74) increased FS by DDI. Combining expenditure and DDI, FS increased by being in male headed households (β=0.70), educational status (β=0.71), income (β=1.55) and membership of social groups (β=1.01) but decreased by household size (β=-0.36).

Increasing urbanisation improved household food security through wider access to food and consumption of diverse diet across categories in South West Nigeria.

Keywords: Urbanicity, Dietary diversity, Urban household, Food expenditure, Food Security status.

Word Count: 499

ACKNOWLEDGEMENT

I give all the glory, honour and adoration to the Ancient of days, Jesus Christ, my redeemer, Holy Spirit my companion for the grace I received all through this programme. All praises be to God for the wisdom, knowledge and understanding granted to me for the successful completion of this study.

This academic journey would not have been a success without the firm, steadfast support of my supervisor, Professor Victor Olusegun Okoruwa. I am extremely grateful for his guidance, constructive comments, invaluable contribution and unflinching commitment in bringing out the best from this thesis. May God bless him and his family in Jesus name.My appreciation goes to my supervisory committee, Professor Bolarin T. Omonona and Doctor Kabir K. Salman for their helpful contributions towards the success of this work.

I appreciate the head of department of Agricultural Economics, Professor Suleiman A. Yusuf and equally grateful to the members of academic staff of the department of Agricultural Economics; Prof. M.A.Y. Rahji, Prof. Timothy T. Awoyemi, Prof. Omobowale A. Oni, Prof. Adetola I. Adeoti, Dr.Kemisola O. Adenegan, Dr.Oluwakemi A. Obayelu, Dr. Adeola O. Olajide,Dr. Abimbola O. Adepoju, Dr Olubunmi.O. Alawode,Dr.Fatai O. Sowunmi, Dr.Oghenerueme Obi-Egbedi and Dr Chuks O. Idiaye, for their contribution to the achievement of this academic feat. I also appreciate the non-academic staff members of the department; Mrs. Onifade,Mr.Ogbolu, Mr. Moses and Mrs.Olawande for their cooperation and assistance.

I appreciate my faithful friends, Mrs Aderonke M.Omotola, Dr (Mrs)OyeronkeA. Adejumo, and Dr (Mrs)TemitayoA. Adeyemo for their support and commitment to this work. I equally thank Dr Hashim O. Akin-Olagunju, Mr SegunObasoro, and Mr Gbenga Dada for their contribution during the analysis stage of this work. A big thank you to Pastor and Mrs F.A Ogungboye, Mr and Mrs S.O Asaolu, Olumide, Fisayo and SeunBejide (my siblings) for their support and prayers, they are most cherished. Sincere thanks to Mr and Mrs Aiyebogun, Pastor and Mrs Akinwande, Daddy and Mummy Emmanuel, Pastor and Pastor (Mrs) Omogbemi, for their encouragement. My special appreciation to Deaconess C.O. Ikudayisi for her motherly role, moral support and prayers all through the programme, her days shall be filled with joy in Jesus name. Pastor (Dr) and Mrs Olufemi, Dr and Dr (Mrs) Ibhafidon,

Engr.and Mrs Akinola and Mr and Mrs Agbaje are well appreciated for their support. Also to my parents, Chief (Surv.) and Mrs A.S Bejide both of blessed memory, who put my feet on the path of sound education. May they rest in the bosom of the Lord.

My unreserved and sincere appreciation goes to my beloved husband, Arc. Ayodele Emmanuel Ikudayisi for his love, financial support, care and commitment all through the course of study. He gave all to bring out the best in me, God will continually bless and elevate him in all endeavours. And to my lovely and wonderful children, Toluwani and Eniola, I appreciate their patience and support. They are destined for greatness in Jesus name. Finally, I say thank you to all those whose names were not mentioned but their contributions are most cherished.

CERTIFICATION

I certify that this research work was carried out by Adesola Adebola IKUDAYISI in the Department of Agricultural Economics, University of Ibadan.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Globally, food systems are changing as a result of increasing urban population which is closely associated with urbanisation, rising income and market liberalization (Seto andRamankutty, 2016). These changes within the food systems cover production, processing and packaging, distribution and consumption. The changes influence food processing and access to food products, which subsequently results in varying dietary patterns. Urbanisation, according to Satterthwaite, McGranahan andTacoli (2010) refers to increasing share of a country's population living in urban areas. The process through which urbanisation evolved was accompanied by other relevant socioeconomic transformations which often result in greater geographic mobility (United Nations, 2014).

The world is undergoing the largest wave of urban growth in history with the level of urbanisation increasing especially in developing countries (Cockx, Colen and De Weerdta, 2017). About half of world's population resided in urban areas in 2008; and it is projected that, by 2030, the percentage of people living in urban areas will rise to about 5 billion (UN, 2014). This increase will be concentrated in Africa and Asia; China, India, and Nigeria are expected to add about 900 million urban residents by 2050 to world population (International Food Policy Research Institute, 2017). The scale and pace of urbanisation in Nigeria are also increasing, with a total population of about 190.9 million in 2017 (UN, 2017), about 49.6% of urban population (Figure 1) and 4.82% annual rate of Urbanisation (World Development Indicator, 2016). This rise in urban population is linked to varying economic opportunities as well as changes in the level of developmental activities (Ikwuyatum, 2016).

As a result of population growth, economic growth, Urbanisation and changes in urban lifestyles, particularly in developing countries, demand for food is increasing with preference for food tastes, safety and quality (Matuschke and Kohler, 2014; Zhou andStaatz, 2016).

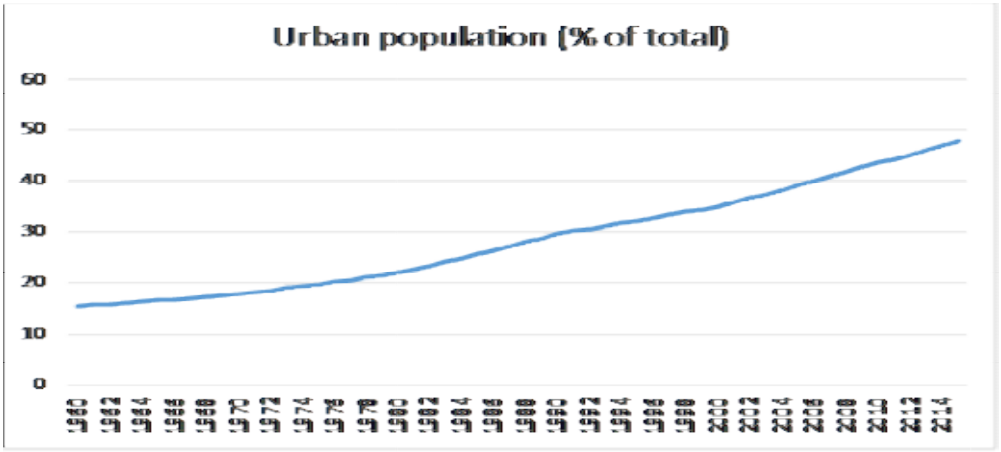

Figure 1: Urban Population in Nigeria 1960-2014

Source: WDI (2016)

The quest for greater socioeconomic opportunities, better education,and access to basic public facilities for improved well-being is responsible for the rapid increase in rural-urban migration. This changing food demand pattern can often be linked to higher incomes, improved job opportunities and growing participation of women in the workforce. Also, this tends towards changes in the traditional diets, as diets become more varied because of the increased availability and variety of food products that urban markets offer. Urbanisation influences consumption behaviour through increase in the availability, accessibility and utilization of food items via improved marketing system and modern retailing (Hawkes, 2006).

In Nigeria, rising urbanisation and income have been responsible for the upsurge in food demanded, especially in urban areas (Kuku-Shittu, Mathiassen, Wadhwa, Myles andAjibola, 2013).Consequently, the structure of food demand is tending towards more livestock products, oils and sugar and mainly processed and easy-to-prepare foods (Cockx, et al. 2017). This trend is accentuated by the increasing heterogeneity of lifestyle, facilitated by social and economic attributes of urban areas (Codjoe, Okutu, and Abu, 2016). Although there is an increasing trend in population growth and food production index (Figure 2) in Nigeria, food demand is rising faster owing to rapid urban growth resulting in growing pressure on food system. Despite the agricultural sector contribution of about 24.4% to Nigeria' s gross domestic product (GDP), with about 5.1% of export earnings (National Bureau of Statistics (NBS), 2016), increased food

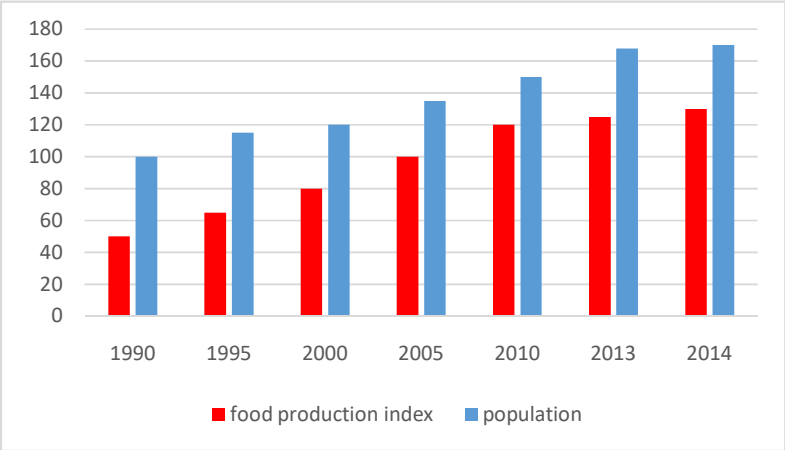

Figure 2: Population and Food Production Index (2004-2006=100) in Nigeria (1990- 2014)
Source: WDI (2016)

demand is met through food importation since about 80% of the smallholder farmers'engaged in subsistent food production (Mgbenkaand Mbah, 2016). With the rise in this food demand, having sufficient resources to afford safe food is most important, as this reflect the level of food access, a crucial aspect of household food security in urban areas (Kuku-Shittu et al., 2013; Ruel, Garrett, Yosef and Olivier, 2017).

Consuming diverse diets has been linked to rising urbanisation, which is linked to the heterogeneity of the urban lifestyle with changes in food consumption pattern in terms of quantity and composition (Cockx et al., 2017). Diversification of diet as an essential component of the food utilization aspect of food security is a major thrust beyond grains as income grows into high-value commodity (Reardon, Tschirley, Minten, Haggblade, Timmerand Liverpool-Tasie, 2013). It encompasses the allocation of food, the nutritional aspect of food consumed in terms of sources of caloric energy and micronutrients and the extent to which the nutrients can be absorbed and metabolised, which is meant to reduce the risk of malnutrition. Most importantly, the shift away from predominantly agrarian activities, which often results in occupational changes, indicates that food consumption choices are facilitated by increased reliance on commercial food supplies. In addition, the rising participation of women in the workforce tends to reduce the amount of time spent on food preparation necessitating increased choice and taste for more conveniently consumed and diverse diets (Codjoe et al., 2016; Cockx et al., 2017).

According to Vhurumuku (2014), food security can be regarded as a situation in which people have sufficient and economic access to safe and nutritious food for active and healthier lifestyle. Food access and utilization components, as determined by level of household food demand and dietary diversity, respectively, are most relevant to urban household food security. This is because urban residents are net food buyers often without direct engagement with production (Matschkeand Kohler, 2014). These factors are critical in shaping household food and nutrition security. How this would be managed is also important for agricultural growth and household welfare (Szabo, 2016). Thus, the pathway between extent of food access and food utilization and the interaction is most important in examining household food security level (Ogundari, 2017). Therefore, understanding the relative importance of food demand and diverse diet as well as food security status within urban households in southwest Nigeria is essential owing to the increasing pace of urbanisation and the challenges of attaining urban food security. This will further help to understand what drives urban household food demand and dietary diversity and develop policy options that would ensure agriculture growth and improved food security outcome.

1.2 **Problem statement**

Changing demographics and heterogeneity of urban lifestyles are resulting in shift in food consumption pattern, with preference for foods with minimal processing time, quality and taste in developing countries (Szabo, 2016; Liverpool-Tasie, Adjognon, and Reardon, 2016). This has led to increased consumption of value-added and easy-to-prepare foods, often processed and well packaged food products, especially in urban areas (Ogundari, 2012). However, most of these foods, often with high salt and sugar content and preservatives to extend shelf life, usually have low nutritional value and are detrimental to health. The challenge of this trend is that, without care for methods and nutritional quality of ingredients, this shift to processed foods,would increase diet-related diseases, such as overweight, obesity, hypertension, cancer and diabetes mellitus, which is now prevalent in most urban cities in Nigeria (EkpenyongandAkpan, 2013;Awosan, Ibrahim, Essien, Yusuf, and Okolo, 2014).

These patterns of urban food consumption could be traced to low value addition in most of the locally produced foods. This segment of the value chain still remains underdeveloped, as mid-stream activities, especially processing and marketing, are plagued by inadequate infrastructure, such as processing and preservation technology, poor feeder roads, and

irregular electricity supplies(Metu, OkeyikaandMaduka, 2016). Also, there are operational difficulties in certification and product registration and poor integrated market network as a result of fragile linkages between smallholder farmers who produce bulk of food for urban consumers (MgbenkaandMbah, 2016). As growth in income and food preferences translate into growing demand for more food, the rate of consumption has outstripped food production because of rising urban population and food deficit is largely met by importation, which has made the country a net food importer. Statistics have shown that, on average, between 2011 and 2015, about ₦1.4 trillion was spent on food imports with wheat, milk, rice, sugar and malt extract, constituting the bulk of Nigeria's food import bill (NBS, 2016).

Food insecurity, a constraint to households' means of accessing sufficient food quantity and adequate food quality, is a critical challenge in developing countries (Ruel et al., 2017). In Nigeria, the likelihood of worsening food insecurity situation among urban households persists, with the continued growth in urban population at 4.82% per annum (UN, 2017) and higher growth estimates of food demand at 6.5% with that of food production rate of 3.7% (Liverpool-Tasie, Kuku and Ajibola, 2011). This deficit has led to rising food importation resulting in high food inflation rate, currently at 11.46% (Central Bank of Nigeria (CBN), 2018). This volatility with respect to food prices often limits the purchasing capacity of urban households which often reduces the level of food accessed by households. Thishas resulted in the consumption of foods with low nutritional value. This is because of the unequal economic access to the available food supplies owing to income inequality (Kuku-Shittu et al., 2013). This situation necessitates relevant policy interventions that aid securing sustainable food security among urban households.

Several policies have been developed by the government to curb importation and improve value chain. Some of these agricultural policy instruments include Agricultural Transformation Agenda (ATA) of 2012, designed to improve farmers' income and food security and to transform the export opportunities of local food market (Ajani andIgbokwe, 2014; ObayeluandObayelu, 2014). Also, more recently is the Agricultural Promotion Policy (APP) of 2015, which was designed to resolve food shortages and improve output quality of food produce (Federal Ministry of Agriculture and Rural Development, 2016). However, much impact has not been felt due to the low-quality response from producers and processors along the food value chain, which has continued to increase consumption of value-added

imported food products. Also, many of the interventions emphasised increased food production with little attention to value addition enhancement programmes.

Furthermore, it remains unclear whether the identified problems, with respect to urban food demand and dietary diversity, can be ascribed solely to urbanisation effect, or other relevant socioeconomic factors within urban households. Based on these identified problems, this study was designed to examine urban household food demand, dietary diversity and food security in the context of urbanisation. In view of this, this study answered the following questions:

(i) What is the extent of urbanisation in the study area?
(ii) What is the food demand pattern of urban households?
(iii) What is the dietary diversity pattern among urban households?
(iv) Dourbanisationand other socioeconomic factors determine the food security status of urban household?

1.3 Objectives of the study

The main objective of this study is to examine the effect of Urbanisation on food security among urban households in Southwest, Nigeria.

The specific objectives were to:

i. profile the extent of urbanisationof households in the study area;
ii estimate the food demand pattern among urban households;
iii. examine the dietary diversity pattern among urban households;
iv. determine if urbanisation and other factors affect food security status of urban households in the study area.

1.4 Justification for the study

Understanding household food security level through the knowledge of various food consumed, especially in urban areas, is essential in determining household welfare. This is also necessary as consumer preferences and their purchasing decisions are changing and often not only influenced by price but also by other non-price attributes (OjoghoandAlufohia, 2013). Therefore, information on food demand and dietary pattern and how they interact in the context of urbanisation to determine the overall food security status of urban households is most important.

Rising urbanisation has led to diversification of the consumption bundle of households towards demand for value-added foods. Information on factors that drive urban household food consumption pattern from this study is central to policy intervention in agri-food sector transformation. Need for value addition for locally produced food, most importantly availability and quality aspect, is essential in meeting urban food consumption. In this regard, investment and provision of favourable business environment in this sector, especially the midstream (processing and packaging) and downstream (retail) segment, would boost income generation among actors and subsequently welfare improvement through employment opportunities. These potential benefits in food systems transformation is expected to strengthen rural-urban food linkages and enhance better access to healthier food and consumption of diverse diets which would improve the urban food security status of household.

Knowledge of how urbanisation influences household food consumption pattern remains limited, as previous studies failed to disaggregate the effect within urban areas. In terms of methodology, studies (Obayelu, Ajani and Oni, 2009; PangaribowoandTsegai, 2011; Ashagidigbi, Yusuf andOkoruwa, 2012; Bett et al., 2012; Udoh et al., 2013; Mottaleb et al., 2017) on household food consumption have focused mostly on the administrative comparison of rural and urban areas. Information from the classification of the rural-urban dichotomy that presents a constant food consumption pattern, though useful, might not capture locational differences, especially within urban areas.

In recent times, studies (Ofem, 2012; Gupta, 2013; Ikwuyatum, 2016) have shown that alternative methods have been developed in defining processes and patterns of urbanisation. With respect to this, different techniques have been applied, such as scales and score index with different weighting approaches for measuring the effect of urbanisation (McDade and Adair, 2001;Dahlyand Adair, 2007; Allender et al., 2008; AntaiandMoradi, 2010; Jones-Smith and Popkin, 2010). This multi-factor scale approach, although improves on the dichotomy, still remains a one-dimensional way of measuring urbanisation. This equal weighting synonymous to urbanicity scales could lead to biased estimates and inconsistent results (Jone-Smith andPopkin, 2010; Thompson et al., 2014). This further suggests the importance of analysing the urban components independently with the use of more

econometric statistical procedures(Champion and Hugo, 2004). Therefore, this study adopted urbanicity index to quantitatively assess the effect of urbanisation on food consumption patterns among urban households with relevant policy directions. This approach is necessary, as it would help in better delineating food consumption patterns rather than generalization of urban areas. This study filled the gap in the literature and improves on the existing food consumption studies; it also explored the heterogeneity of the extent of urbanisation on urban household food security.

Furthermore, studies (Obayelu, 2010; Iorlamen, Abu, andLawal, 2014; Akinboade, Mokwena, and Adeyefa, 2016) have examined food security status among urban households most often with single component, which might not fully capture the multidimensional concept of food security. As urban food insecurity increases, there is need to employ indicators 2that better reflect aspects of food security most relevant to urban households. Thus, this study harmonized food security measures, namely food access and utilization proxy by per capita food expenditure and mean dietary diversity index, to classify urban households into food security status (Ogundari, 2017). Combining food security indicators would give a comprehensive and holistic overview of food security outcomes. This approach presents varying levels of household food security status, which is important in setting specific and appropriate urban food and nutrition policieswith the challenges of attaining food security.

1.5 **Plan of the study**

The study is organized into five chapters. Chapter one has already been discussed. Chapter two reviews theoretical concepts and relevant literature. Chapter three presents, in detail, the methods of data collection and methods of analysis employed to achieve the set of study objectives. Chapter four discuss the results in line with empirical works. Chapter five presents the summary of major findings, conclusion and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the theoretical framework underpinning this work, review of major methodological issues, empirical review of relevant literature on food demand, dietary diversity, food security as well as the conceptual framework.

2.1 Theoretical framework

This section discusses consumer theory with the Lancaster model, demand theory, urbanisation theory as well as diversification models.

2.1.1 The Consumer Theory

Consumer theory entails the procedure through which consumers make consumption decisions. The theory of consumer behaviour can be explained as how consumers choose goods being influenced by prices, income and other non-financial attributes (Varian, 2010). This choice is based on preferences which reflect changing consumer tastes and quality as their income levels change (Deaton, 1997; Ogundari, 2012). These preferences exhibited by the consumer, as reflected in their choice of goods and services, are based on some axioms. For example, if X and Y represent a pair of goods and if the consumer decides to choose X instead of Y, or prefers Y to X, or is indifferent to the two goods, what obtains is referred to as axiom of completeness.

Preferences are termed transitive when a consumer chooses X rather than Y and Y rather than Z; then the consumer automatically prefers X to Z. But if indifferent to the two goods, X and Y, and indifferent to Y and Z, then the consumer is certainly indifferent to X and Z, then the consumer will choose the most preferred alternative (Mas-Collel, Whinstonand Green, 1995). Indifference curve explains this consumer behaviour in terms of preferences for different combinations of two goods (Jhingan, 1997).

Preferences that satisfy the completeness and transitivity axioms are expressed by utility function (Green, 2008).Utility function represents a set of mathematical function that quantifies each feasible preference relation for any commodity X and Y. For example, if $x_1$denotes the amount of goods consumed and x_2 denotes the amount of goods consumed. The utility function can be written as:

$$U = u(x_1, x_2) \quad (1)$$

$$s.t.\ P.X \leq Y \quad (2),$$

where U (.) is the utility function, that quantifies each set of goods consumed $x_s$subject to a budget constraint. However, the choice of consumption bundle with the highest utility subject to budget constraint indicates that the consumer solves an optimization problem which include: choice, utility function and constraints (Deaton, 1997). With respect to influence of urbanisation on food demand and dietary diversity as a result of changing demographics and income growth, an optimization problem can be rewritten as: the choice of food basket by consumers (with preference for taste, convenience as a result of urban lifestyle) in order to maximize utility (some nutrition benefits, that is, to increase the micronutrient intake through diversified diet and increased food access) is subject to some constraint (income, price, perceived attributes). Mathematically, it is expressed as:

Maximize $U(q)$

$$Y = \sum_{i=1}^{n} p_i q_i \quad (3),$$

$$q_i = f\left(Y, p_{1,}..., p_n\right) \quad (4)$$

where U is the utility,

q is the quantities of goods subject to the budget constraint,

Y is the income and

p_i and q_i represent the price and quantity

2.1.2 **Demand Theory**

Demand, according to Jhingan (1997), is the quantity of goods a consumer is able and willing to buy at various prices at a given period of time. The theory of demand shows an inverse relationship between the quantity of good demanded and its own price. Implicitly expressed as:

$$Q = f(p) \quad (5)$$

Also, the food demand equation for a product q, for consumer*i* is expressed as:

$$q_i = f(p, pr, y, d) \quad (6),$$

where *p*denotes price of food,

pr = prices of related goods,

y = income, and

d= other non-price attributes of a product

The non-price determinants which influence food consumed may include rapid urbanisation, changing demographics, income growth, increased women in workforce, level of education, sedentary lifestyle changes and perceived attributes, among others. Rozin et al. (1986) argue that economic factors, such as price, product availability and income, influence only actual consumption of food. This choice will not always reflect real preferences. Goldberg (1999), aver thatchoices of food consumed will be guided more by food safety, nutritional values and composition of such food products. Therefore, a consumer's demand for a commodity depends on his preferences for quality, income and prices.

However, the theory of consumer demand does not explicitly take into consideration quality differences in the demand for food (Drescher et al, 2009). According to Fischer (2006), there are other non-financial factors responsible for household food choice which explains consumer's preference for food product choice. A relevant extension of the demand theory is the Lancaster model, which explains quality differences in demand.

2.1.3 **TheLancaster Model**

The traditional demand model does not explain a broader overview of how product attributes influences demand for products. The Lancaster (1971) model incorporates product attributes into the demand functions as follows: Let z_{ij} representmeasure of attribute *i* within good *j,* such that demand for good *q* expressed as a function of this attribute,*z* and price *pi* is given as:

$$\text{Maximize:} \quad U = U(z_1, ..., z_n) \quad (7)$$

$$\text{Subject to:} \quad P_n X_n \leq Y$$

With $Z = BX,$
$Z, X \geq 0$ (8)

$U(BX) = u(X)$ (9)

where U= utility

P = price of goods

X = quantity of goods

Y= income

Z = product attributes,

B = matrix of consumption technology,

u(X) = new utility function in terms of X.

In equation (7), consumer maximises utility (U) subject to budget constraint Y, which is, however, a function of the product attributes (Z). B represents the transformation relationship that exists between the goods X and attributes Z. It explains the relationship between the products purchased and the attributes obtained from them, If B= $[b_{cn}]$, then b_{cn} is the transformation coefficient which represents the level of cth attribute Z_c attained from the consumption of one unit of nth product, X_n. Therefore, Z = BX, where P (price of product) and Y (budget constraint of consumer) determine the efficiency frontier. The new utility function in terms of X, depends on the structure of matrix B. Moreover, combining consumer utility of preferences for attributes and efficiency frontier could result in consumers making their product choice decisions (Pendleton and Shonkwiler, 2001).

With regard to demand elasticity effects, price elasticity is the proportional change in the quantity of good demanded relative to a change in price of the good, which is referred to as own price elasticity. The relationship between the quantity demanded of a product and the prices of other products is referred to as cross price effect. For substitute products, the relationship between the price of one and the demand for the other is expected to be positive, while complementary goods have negative sign. For independent products, the relationship is expected to be zero, indicating that the price of one does not affect the demand for the other (Jhingan, 1997). Conversely, income effects alongside differences in the range of goodsconsumed by households can be explained by the Engel Law. The law states that increase in income reduces the share of expenditures for food (and, by extension, other)

products (Engel, 1977). The curve further describes consumer's expenditures pattern as it relates to their total resources holding prices fixed (Lewbel, 2006). The form/shape of Engel curves further explains demand system modelling which also tends to provide more realistic results. The empirical expression of Engel Law in the quantity form is given as:

$$q_i = f_i(y, z) \tag{10},$$

where $q_i$is the quantity of good consumed,
y represents expenditures on goods, and
z denotes other characteristics of the consumer, such as demographic and socioeconomic characteristics, and preference attributes.

The budget share form can also be expressed as:

$$g_i = f_i[\log(y), z] \tag{11},$$

where $g_i$is the fraction of y that is spent buying good i

Furthermore, income elasticity, which is the proportionate change in q_i from a unit change in y, income, is written as:

$$\omega_i = \frac{\partial \log_i(y, z)}{\partial \log(y)} \tag{12}$$

Income elasticities define the nature of goods. Therefore, a good whose value is below zero is called an inferior good, while it is referred to as necessity and luxury goods if the values are between zero and one, and above one, respectively (Lewbel, 2006; Pangaribowo and Tsegai, 2011).

2.1.4 **Theory of Urbanisation**

Several theories describe how the trend of urbanisation evolves. The most important ones are theory of self-generated or endogenous urbanisation, modernization theory, dependency/world system perspective and the global city perspective (Peng, Chen and Cheng,2012). The theory of self-generated or endogenous urbanisation involves the era in which people engaged in non-agricultural activities and the attainment of higher social development which resulted in accumulation of communities through rural urban migration shift (Lampard, 1965). This theory recognises industrialization as the most significant factor responsible for this population shift to urban centres. The condition of urbanisation that accounts for the endogenous condition are met if the focus is on cities, as this facilitates the transition from pre-industrial to industrial cities.

Modernization theory postulates that economic development brings significant changes from material survival values to post-materialist quality of life concerns. This structure of the economy transits from the agrarian sector towards the industrialised one, which brings significant changes in social values. Also it suggests that technological advancement shapes urbanisation more importantly that social norms (Peng et al., 2012;Stockemer and Sundstrom, 2014). In addition, changes in urban lifestyle can be attributed to the interlinkages between population dynamics, economic competitiveness, infrastructure and the built environment (Orum and Chen, 2003).

Furthermore, the dependency/world-system perspective theory involves the dynamic role of economic activities, mostly in developing nations, as they grow and expand in the capitalism system (Frank, 1969). To this school of thought, urbanisation occurs as cities respond to global economic changes coupled with social institution, technology and population dynamics which acts as internal factors that led to the expansion of urban centres (Timberlake, 1987). The theory viewsurbanisationas relating to the extent of occurrence of capitalism which later leads to geographic differences between cities.

The resultant effect from the modernization and dependency/world system perspective theories led to the fourth theory known as the Global City perspective in the mid-1980s (Friedman, 1986). The theory is based on the fact that cities emerge from the infusion of other relatively smaller areas. This theory explains the interrelationship between

industrialization, urbanisation and globalization, which forms the agglomerations of the urban order. It marks a theoretical extension of other theories, as it shows the importance of network of cities for understanding broader urbanisation trends and tendencies (Sassen, 2001).

2.1.4.1 **Concept of urbanisation**

In this study, it is important to properly conceptualizeurbanisation, as regions of the world differ in urban population with varying growth rates (Szabo, 2016). Urbanisation can be defined as an increase in the share of people living in urban settlements, while urban growth refers to the increase in the absolute size of the urban population (Ekpenyong and Akpan, 2013). Urban expansion refers to the spatial extension of built-up areas often brought about by urban growth, while its dynamics often depend on the type of physical growth and the population concentrations in those areas.

The phrase urban system characterises the way in which these urban populations within a national terrain are distributed.However, defining the concept of an 'urban' area could be practically indistinct, as no single definition is appropriate as a result of different criteria, such as population size, density, administrative status and employment composition. Urban settlements are often defined as agglomeration of large people in a relatively densely populated area. The factors that contribute to the growth of most urban centres are often linked to population growth by natural increase, rural-urban migration and reclassification in most of the developing countries (Oyeleye, 2013). Also, integration of socioeconomic changes, industrial development and governmental activities contribute to urbanisation trends (Cohen, White, Montgomery, McGee and Yeung, 2004).

According to Mabogunje (1991), urbanisation has three basic concepts, which include the structural (change in economic structure), behavioural (change in behaviour of individuals) and demographic (population concentration). The principles guiding the definitions of urbanisation are multifaceted. Accumulation of people in a particular location over time can be referred to as population urbanisation, which also represents the fundamental aspect of urbanisation (Gu and Wu, 2008). Land urbanisation refers to efficient use of land which results in urban area expansion, while urbanisation in economic sense, often regarded as the power of the urbanisation, involves dynamic changes in the economic structure (Wang, Wang

and Qin,2014). Changes in lifestyle, behavioural habits and values define the aspect of social urbanisation. However, based on these various forms, urbanisation is said to be broad in concept, involving population, spatial and environmental expansion as well as economic arrangement and social values (Wen and Ren, 2017).

Furthermore, world population is increasing, now about 7.6 billon people while its urban share is about 54% and projected to rise to about 66% by 2050 (UN, 2017). This implies an addition of about 2.5 billion people to the global urban population, and about 90% of this estimated growth will happen in Asia and Africa (UN, 2014). In Africa, the urban population has been growing rapidly, with increase from about 32% in 1990 to 39% in 2010, and with the expectation that, by the 2030, this rate will be about 50% (UN, 2017). Likewise, sub Saharan Africa is experiencing a similar trend, such that, by 2020, the proportion of its urban population is estimated to be about 55% (Cockx et al., 2017).

As noted by Long (1998), a nation is urbanized if at least 50% of its population lives in urban area. This assertion is true in the case of Nigeria whose percentage of the people in the urban area increased from about 19% in 1960 to 23% in 1981/82 and rose from 36% in 1991 to 44.4% in 2011 and 49.6% in 2016 (UN, 2017). Over time, the country has experienced tremendous population growth often due to natural increase as evident from rapid increase in total population from 37,860,000, in 1950; 54,959,426, in 1963; 88,992,220, in 1991 and 140, 431,790, in 2006 and 159,708,000, in 2010 to 185,956,000, in 2016 (UN, 2017).

According to World Urbanisation Prospects by UN (2014), Nigeria alongside two other countries in Asia, namely India and China will account for about 37% of the urban growth estimated in 2014-2050. This is occurring at a faster rate in Nigeria, as the total population is about 190.9 million in 2017, with about 49.6% of this total population living in urban areas, while its rate of urbanisation per annum is at 4.82% (UN, 2017). These facts and figures shows that the process of urbanisation is irreversible (Mabogunje, 2005).

Countries are liable to face challenges in meeting the needs of growing urban populations in terms of food, housing, infrastructural development and basic services which are important in sustainable development goals (SDGs). Thus, there is the need to harness the various opportunities urbanisation brings, especially in the agricultural sector, which include

revitalising the food value chain to enhance effective food access of the teeming urban population. The multiplier effect can bring improvement in income generation for actors along the food chain and diverse employment opportunities, promote health values of the populace and increase the foreign base of the nation through export.

2.1.4.2 **Linkages between urbanisation and food security**

Urbanisation involves change in demographics, norms, culture, and lifestyle as well as expansion of built environments (Zhou and Staatz, 2016). As the global population and rate of urbanisation are rising, there is simultaneous increase in demand for food, most especially in urban areas. Therefore, the agricultural sector is confronted with the issue of sustainable food system in improving the food security status of people. Food security is a state of complete food access in physical, social and economic terms with nutritional values needed for healthy living (Matuscke and Kohler, 2014). The relationships between urbanisation and food security dimensions are discussed below.

(i) **Urbanisation and food availability**

Food availability denotes the supply of food through production or imports. Rising urban population influences all sectors of the food system, as more food has to be made available. However, food supply through agricultural production is constrained in terms of location, as urbanisation processes often compete with productive lands owing to urban expansion (Matuscke and Kohler, 2009; Vhurumuku, 2014). In addition, variability in food production, especially climate change, increasingly affects agricultural production and animal husbandry. These vagaries of weather and other risks limit the extent of farm cultivation because the subsistence agriculture being practised, especially in developing countries, affect the level of food availability (Matuscke and Kohler, 2014). Without effective strategies for farm intensification, food demand will be affected and subsequently there will be an upsurge in food prices. This constraint could create a gap between actual production and what is available for final consumer.

(ii) **Urbanisation and food access**

Physical and financial forms of access are two important features of food access. Availability and quality of infrastructure in terms of food storage facilities and commercial food chain often facilitate physical access to food and proper functioning of food markets. In addition,

from the economic access perspective, purchasing power and food prices are also an important factor (Matuschke, 2009). Extent of access further depends on the level of household resources, urban lifestyles, prices and other macroeconomic policies which influence household food security status (Ruel et al., 2017). Structural transformation as a result of rapid urbanisation also determines the extent of food access, as most urban residents, to some extent, purchase most food items from various food retail outlets, which range from traditional open markets to modern actors (Gómez and Ricketts, 2013). This chain of food distribution improves food access in urban centres and presents wider varieties of food which would subsequently enhance food security.

(iii) **Urbanisation and food utilisation**

Utilization of food encompasses the process of allocation of food groups and how food consumed is absorbed by the body for healthy lifestyle (FAO, 2008). This component is a situation in which caloric energy and micronutrient intake from the food consumed influences the nutritional status of individuals. In this regard, dietary diversity, which is referred to as the number of both macro and micro nutrient foods consumed over a period of time, is an important pointer towards dietary quality, which is a measure of food utilization.

Also of importance in food utilization are other indicators such as improved water sources and sanitation facilities that reflect environmental factors. With rising urban population, food value chains no longer respond to only price signals but also wider varieties of foods with preference for food safety and quality (Hazell and Haggblade, 2007). Urban growth affects household utilisation level through vulnerability to volatile food prices which reduce expenditure on nutritious foods (Matuscke and Kohler, 2014). Added to these is the increasing diet-related diseases which is as a result of changes in the dietary pattern towards consumption of processed food items with increased sugar content, artificial sweeteners and hydrogenated fats (Malik et al.,2013).

(iv) **Urbanisation and food stability**

Food stability involves the temporal dimension of food security. It represents the time-based aspect of food security, which can be chronic and transitory in nature (Magrini and Vigani, 2014). As urbanisation evolves over time, the food stability component helps to reveal the trend if growth over time synchronises with the level of food security. In addition, stability

which could be cyclical and temporary, involves a regular pattern to food insecurity and short-term exogenous shock, respectively. As variation continues over time, this component of food stability is better revealed by vulnerability measures.

2.1.5 **Concept of diversification**

Diversification refers to a means in which an organization expands its business horizon to accommodate new products to further satisfy consumer needs (Berry 1975;Andrews 1980). As a growth strategy, it is often viewed from both product and market perspectives through which firms achieve growth and at the same time reduction in investment risk (Hoskisson and Hitt, 1990).

There are two types of diversification which include; the concentric and conglomerate. Concentric diversification refers to a situation where a company diversifies through product or market diversification. It is an increase in market share by a launch of new product that earns more profit. Conversely, product diversification, a subset of concentric diversification entails expanding above its normal products. Market diversification means opening more marketing strategies to cater for broader clientele/customers (Palepu, 1985). Conglomerate diversification is through opening a subsidiary that offers products other than the current market. It entails addition of new products or services to appeal current customers. The main aim of diversification is to lower the financial risk, increase competitiveness and expansion of opportunities, which help to protect against total loss, be it shocks in the market or portfolio (Jung, 2003).

2.1.5.1 **Dietary diversity**

Corporate diversification in relation to dietary diversity is the consumption of varying food groups to increase lines of activity (macronutrients and micronutrients) in the body. This means spreading of food items consumed across a number of food groups to increase the nutrients needed for healthier living (Drescher et al., 2009). Thus, diet diversity is a concept of balanced nutrition resulting from consumption of varying food baskets. Reardon et al.(2013) define diversification of diet as a major thrust beyond grains into high-value commodity as income rises. These changes in diet include an increase in the level and shareof

food basket that contains caloric energy and micronutrients which are meant to reduce risk of malnutrition, while maintaining a balanced diet.

The importance of consuming a wider variety of food can be seen in two perspectives. Firstly, in terms of food supply, it could be a channel through which farmers realise increased earnings as they supply food produce to urban centres which could result in income growth for rural development. On the demand side, it means wider availability and access to food for urban dwellers, which raises food security level. The opportunity this trend brings can be seen through consumers buying locally processed foods from modern food outlets, such as shopping malls and supermarkets. This shows how value addition results in improvement of the agrifood sector (Reardon et al., 2013). Also, this increases efficiency and lowers food prices as a result of technological improvements in processing, which strengthens small-scale enterprises to develop to become a backbone to supply chains.

Furthermore, the time frame over which diet diversity is measured is important, as consumer preferences exhibit different pattern (Moonet al.,2002). In measuring dietary diversity, there is no universal reference period to be used; rather the objective at hand influences the choice. Reference period ranges from one to three days, seven days, fifteen days and up to one (1) month for some food commodities (Food and Agriculture Organization (FAO), 2011).

Considering the need of purchase infrequency, shelf life and perishability of some foods, Akerele and Odeniyi, (2015) used a six-week period, while, in the work of Stewart and Harris (2005), a period of one year was used. Regardless of time frame, Engle-Stone (2010) observe that usual food intake with reference period of one week or less would yield the same conclusion as that of a fourteen-day period because a longer period often leads to loss of memory recall.

2.2 **Methodological review**

This section presents review of the methods employed in this study. The review covers multivariate techniques, demand models, regression models, discrete choice models and measures of urbanisation and diversification.

2.2.1 **Review of multivariate techniques**

Multivariate techniques have been widely used in exploratory analysis, which is useful in subsequent methodological analysis (Hair et al., 2006). Several statistical multivariate methods used for describing and analysing multivariate datasets abound. The important ones are cluster analysis, factor analysis and principal component analysis

Cluster analysis is used when datasets are grouped using factors that are similar among variables with the aim of reducing the dimensionality of data (Holland, 2006). It allocates a set of individuals to a set of mutually exclusive groups such that individuals within a group are similar to one another while individuals in different groups are dissimilar. Methods of clustering techniques include: single linkage (nearest neighbour), complete linkage (furthest neighbour); average linkage (between-group) and ward's method (Ward, 1963). Most of these methods use Euclidean distance, which is the geometric distance in the multidimensional space, expressed as:

$$z_{ij} = \frac{\sqrt{\sum_{k=1}^{p} \left(x_{ik} - x_{jk} \right)^2}}{N} \qquad (13)$$

where z_{ij} = the geometric distance between two similar variables, x_{ik} and $x_{jk}$and can be generated by taking their scores on a variable, k, while calculating the difference.
N = the total number of variables.

Accuracy of Euclidean distances is determined by smaller distance between more similar cases and otherwise for variables with large size or dispersion differences. A diagram that shows the pattern drawn from connection of cases is referred to as dendrogram. A disadvantage of cluster analysis is the issue of different results due to different criteria for merging clusters (including cases). It also ignores information about the elevation of scores and gives no information about the distance between two variable profiles.

Another multivariate tool is factor analysis (FA). It defines the covariance relationships among correlated variables based on some unobservable factors (Mulaik, 2010). Theseunderlying factors possibly exert causal influence among the variables but their impact is hidden and cannot be measured directly. The model is given as:

$$
\begin{aligned}
r_1 &= \alpha_{11}P_1 + \alpha_{12}P_2 + ... + \alpha_{1m}P_m + e_1 \\
r_2 &= \alpha_{21}P_1 + \alpha_{22}P_2 + ... + \alpha_{2m}P_m + e_2 \\
&... \\
r_k &= \alpha_{n1}P_1 + \alpha_{n2}P_2 + ... + \alpha_{nm}P_m + e_3
\end{aligned} \tag{14}
$$

where r_i (i=1, …, k) denotes standardized variables with mean of zero and variance equal one;α_{11}, α_{12}, ..., α_{n1} are factor loadings of these variables; P_1, P_2, …,P_m are standardizeduncorrelated common factors; and ei is the error terms which are independently distributed. Factor analysis shares similar characteristics with principal component analysis in terms of data reduction. However, it differs in revealing underlying causal structure (Dunteman, 1989). The above reviewed methods however are limited to the causal relationship between the multivariate data set but cannot reduce data to indices; thus, they are not fully suitable for index generation.

Principal component analysis (PCA) is a data-reduction tool that generates index through mathematical procedure. In this sense, correlated variables are transformed to uncorrelated ones while retaining principal components with maximum variance (Suryanarayana and Mistry, 2016). An advantages of PCA is mostly in its reduction of multicolinearity level among variables as a result of several single and disaggregated variables measured separately. Furthermore, it reveals hidden structures that often underlie complex datasets while quantifying each variable dimension in order to describe the variability of dataset (OECD, 2008). Principal Component Analysis is most preferred in the construction of index, as it improves statistical efficiency (Abdi and Williams, 2010). Its disadvantage lies in subjective interpretation of what constitutes the amount of variance accounted for by the matrix (Kellow, 2006). This analysis works best when variables are correlated while standardization is required for variables with differing units. The PCA is structured by a set of equation where variables are related to a set of latent factors, as expressed below:

$$
\begin{aligned}
a_{1x} &= b_{11} \times A_{1x} + b_{12} \times A_{2x} + ... + b_{1N} \times A_{Nx} \\
a_{Nx} &= b_{N1} \times A_{1x} + b_{N2} \times A_{2x} + ... + b_{NN} \times A_{Nx}
\end{aligned} \tag{15}
$$

where, a_s is set of N variables; a_{1x} to a_{Nx} represent the weights of N by each household x. each of these variables are normalized by its mean and standard deviation, where the generated

components and their weights are denoted with A_s and b_s respectively. The Kaiser varimax rotation approach is widely used for selection of the number of principal components. This procedure recommends retaining components that have an eigenvalue higher or equal to one, while other components are not to be taken into consideration. The components with maximum variance are selected through scaling of the weights such that their sum of squares equals the total variance which results in uncorrected set of estimates (Filmer and Pritchett, 2001). This is given by:

$$A_{1j} = b_{11}a_{1x} + b_{12}a_{2x} +...+ b_{1N}a_{Nx} \qquad x = 1, ..., X$$
$$A_{Nj} = b_{N1}a_{1x} + b_{N2}a_{2x} +...+ b_{NN}a_{Nx} \qquad (16)$$

The principal component that retains the largest variance is used to generate the index, which is expressed as:

$$A_{1j} = b_{11} \times (a^*_{1x} - a^*_1)/(g^*_1) +...+ b_{1N} \times (a^*_{Nx} - a^*_N)/ (g^*_N) \qquad (17)$$

The index generated can be categorised into groups of interest using composite scores which further improves statistical effectiveness.

With respect to validity and reliability of index generated, some tests of robustness are necessary. The relevant ones are the Factor Analysis Explained Variance (FAEV), Bartlett's test of sphericity, Cronbach alpha and Kaiser-Meyer-Olkin (KMO). The FAEV indicates that the relationship among variables jointly explains the constructed index, while Kaiser-Meyer-Olkin explains level of adequacy among variables with values above 0.60 adjudged acceptable. In the case of Bartlett's test of sphericity, PCA estimates are valid when the observed correlation in a dataset deviates significantly from its identity matrix.Cronbach alpha predicts the reliability of the variables; any value above 0.5 is acceptable (Mehaina, El-Bastawissi and Ayad, 2016).

From multivariate analytical tools reviewed, PCA was used for urbanicity index construction. It was preferred to other multivariate methods because it optimally gives weight to variables and extract components that best give useful information about the latent (urbanisation) indicator. It reduces multicolinearity among correlated urbanisation variables, which

improvestatistical efficiency. The index developed would be used to disaggregate household into urbanisation categories to reveal the extent of urbanisation in the study area.

2.2.2 **Review of demand models**

Different demand models have been employed in explaining expenditure patterns. The mostly applied ones are Linear Expenditure System (LES) (Stone, 1954), Rotterdam model (Barten, 1964), Indirect Translog System (ITS) (Christensen et al.,1975), Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980) and Quadratic Almost Ideal Demand System (QUAIDS) developed by Banks, Blundell and Lewbel, 1997). These models are classified based on rank, which represents the amount of space occupied by Engel curves within a demand system (Lewbel, 2006). Rank one demand system is the most restrictive demand system that generates constant elasticities without expenditure effect. Demand models that are not too restrictive, which permit curves that do not necessarily pass through the origin, are referred to as rank two, while rank three models permit non-linear Engel responses which are least restrictive.

2.2.2.1 **Linear Expenditure System (LES)**

It is a linear functional form of the demand system developed by Stone (1954). It assumes that the average propensity for any consumer expenditure vary with the income level (Davies, 2003). This is as a result of minimum subsistence requirement imposed on each good consumed. It is expressed as:

$$P_i Q_i = p_i \eta_i + \beta_i \left(X - \sum_j p_j \eta_j \right) \qquad \text{(i, j = 1, . . . , n)}$$

$$0<\beta_i<1,\ q_i>\eta_i, \qquad (18)$$

where X is the total expenditure;

$p_i \eta_i$= minimum income to attain a minimal subsistence level, and

$X - \sum_j p_j \eta_j$ = the necessary supernumerary expenditure between the goods in the fixed proportions β_i.

An advantage of LES is that it satisfies all theoretical constraints in the demand model without loss of linearity. However, the model is limited, as it assumes the addictive form of utility function with constant marginal budget share at all income levels. It also allows little Engel flexibility; it is therefore inconsistent with utility maximising behaviour (Sivaramane, 2009).

2.2.2.2 **Rotterdam demand model**

This model uses utility-maximisation theory to give restrictions on the demand functions and takes certain transformations of the slopes of the demand functions to be constant (Barten, 1964). Although the effect of the utility function is not clearly specified, it remains within demand equations. The model is expressed as:

$$\overline{w}_i Dq_{it} = \theta_i DQ_t + \sum_{j=1}^{n} \prod_{ij} Dp_{jt} \qquad (19),$$

where: $\overline{w}_i Dq_{it}$ = changes in the weighted budget-share on quantity consumed of good *I,*

DQ_t, = change in income

P = change in each of the prices of good consumed,

θ_i = represents the marginal share of good *i*, and

$\prod_{ij}$ = is the Slutsky coefficient which indicates substitution effect

An advantage of the model is the ability to detect the presence of homogeneity and its symmetric nature during estimation. Constant marginal share which occurs as a result of the inverse relationship between budget share and income elasticity is the major disadvantage of the model (Paraguas and Kamil, 2006).

2.2.2.3 **Transcendental Logarithmic (TL) demand system**

This model uses indirect utility function in terms of expenditure-normalized prices with the application of Roy's identity to obtain quadratic and logarithmic condition (Christensen et al., 1975). It is expressed as:

$$wi = \frac{\alpha_i + \sum_j \gamma_{ij} \log \frac{p_j}{x}}{\sum_j \alpha_j + \sum_j \sum_i \gamma_{ij} \log \frac{p_j}{x}} \quad (20),$$

where w_i = the budget share, p_j = price of the commodity, x = number of commodity and γ and α are parameters estimates. Its advantage is its flexible functional form that is non-addictive in the demand system. The disadvantage of the model lies in determining how accurate the approximation to the log differential would be as well as the required structural parameters needed in a maximum likelihood estimation. It has also been criticized for its assumed misclassification the nature of goods (Deaton and Muellbauer, 1980).

2.2.2.4 **Almost Ideal Demand System (AIDS)**

This model allows linear behavioural responses in income-consumption relationship with the flexible functional form which does not impose apriori restriction (Deaton and Muellbauer, 1980). The model does not assume separability between consumption goods (Van Oordt, 2016). The model is given as:

$$wi = \alpha i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(x / P^*\right) \quad (21),$$

where w_i= expenditure share,

p_j= price

x = number of commodities consumed, and

P^*= Stone's price index.

The advantage of AIDS is that it satisfies the restrictions of demand theory (homogeneity and symmetry). However, it has difficulty in capturing non-linear Engel effects; its budget share predictions may lie above unity and it does not take into account consumer heterogeneity in demand estimation (Okrent and Alston, 2011). Low Engel curve flexibility synonymous to earlier reviewed demand models could not accommodate higher demand functions which could lead to bias estimates (Pangaribowo and Tsegai, 2011). As a result of this shortcoming, a higher flexible functional forms called Quadratic Almost Ideal Demand System model (QUAIDS) was developed by Banks et al. (1997).

2.2.2.5 **Quadratic Almost Ideal Demand System (QUAIDS)**

This model improves mainly on the flexibility characteristics of AIDS with the inclusion of the quadratic expenditure term which resulted in increased Engel flexibility of the demand system (Okrent and Alston, 2011). This model also accounts for behavioural responses and consumer heterogeneity. Implicitly, QUAIDSis expressed as:

$$\ln V = \left\{ \left[\frac{\ln m - \ln a(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1} \quad (22),$$

where the term [In m - *In a(p)]/b(p)* is regarded as the indirect utility function of the price independent generalised logarithm, *m* = total food expenditure, and parameter a(p), *b(p)* and λ*(p)* which represent functions of prices *p,* maintains their homogeneity property of the indirect utility function, if *a(p)* is homogenous of degree one in prices, and *b(p)* and λ*(p)* homogenous of degree zero in prices (Maganga et al., 2014). However, the function ln *a(p)* can be further expressed in translog form as:

$$\ln a(p) = \alpha_o + \sum_j \alpha_j \ln p_j + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \quad (23),$$

while b(p), Cobb-Douglas price aggregator function is given as:

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i} \quad (24)$$

andthe price aggregator function $\lambda(p)$, is given by:

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i \ln p_i, \sum_i \lambda i = 0 \quad (25),$$

where *i* =denotes the quantity of food groups entering the demand model.

Expressing QUAIDS in budget share form can be generated through the application of either the Roy's identity or Shephard's Lemma to the indirect utility function, which is given as:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{m}{a(p)} \right] + \frac{\lambda_i}{b(p)} \left\{ \ln \left[\frac{m}{a(p)} \right] \right\}^2 \quad (26).$$

It is important to have better understanding of changing consumer preferences and heterogeneity across households. The linear demographic translating method developed by Pollak and Wales (1981) allows inclusion of such socioeconomic and demographic variables in the estimation process. This gives the empirical specification of the QUAIDS budget share expressed as:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 + \sum_{i=1}^{L} \delta_{is} Z_s + \varepsilon_i \qquad (27),$$

where w_i= expenditure share for each product *i*,

p_j= the price of product *j*,

m = total food expenditures,

Parameters to be estimated are αi, β, γ.

α_i = this represents the average value of budget share without price and income effects.

β = parameter that determines the expenditure elasticity

γ_{ij} = effects of cross price elasticity

λ_i = is the parameter that determines effects of quadratic term, and

δ_{is} = vector of explanatory variables

Z_{is}= socioeconomic and demographic variables.

Based on consumer theory, theoretical restriction of adding up, homogeneity and symmetry are imposed by setting:

$$\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_i \lambda_i = 0, \sum_i \gamma_{ij} = 0 \qquad (28)$$

The adding up condition implies that all expenditures must be one, expressed as

$$\sum_i \alpha_i = 1,$$

With respect to the condition of demand being homogeneous of degree zero in prices, it is expected that the quantity of good demanded by a consumer must remain the same when

prices and total expenditures vary at a constant proportion (Sulgham, 2006). This property is given as,

$$\text{Homogeneity: } \sum_j \gamma_{ij} = 0 \tag{29}$$

Also, the negativity condition implies downward sloping compensated demand functions as a result of symmetric cross price estimates. It is expressed as:

$$\text{Symmetry: } \quad \gamma_{ij} = \gamma_{ji,} i \neq j \tag{30}$$

Furthermore, when the budget share form of this model is differentiated with respect to *ln m* and *ln* p_j, expenditure and priceelasticities of a demand system are obtained, respectively as expressed below:

$$\mu_i = \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\} \tag{31}$$

$$\mu_{ij} \equiv \frac{\partial \omega}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_j + \sum_k \gamma_{jk} \ln P_k\right) - \frac{\lambda_i \beta_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 \tag{32}$$

P_k=is a price index calculated as the arithmetic mean of prices for all *k* food groups

Explicitly, the expenditure elasticity determines the nature of goods (normal or luxuries) at all expenditure levels are then obtained by:

$$\ell_i = 1 + \frac{\mu_i}{w_i} \tag{33}$$

The uncompensated or Marshallian price elasticity indicates relative changes in the quantity demanded as prices change given by:

$$\ell_{ij}^u = \frac{\mu_{ij}}{w_i} - \phi_{ij} \tag{34}$$

where ϕ_{ij} is the Kronecker delta equaling one when $i=j$, and zero otherwise.

Using the Slutsky equation, the Hicksian price elasticity shows change in quantity demanded relative to other prices. It also measures only the price and welfare effect through compensation variation which is useful for better policy measure (Sulgham, 2006). It is expressed as:

$$\ell_{ij}^{c} = \ell_{ij}^{u} + w_j \ell_i \tag{35}$$

The main advantage of QUAIDS is the high flexibility which allows non-linear relationship between expenditure and quantity demand. As a result, this study used QUAIDS to estimate household food demand among urban households, which would provide better information on how urban households respond to food demand.

2.2.3 **Review of regression models**

Regression techniques are statistical tools used for analysing relationships between variables (Gujarati, 1995). These include ordinary least square (OLS), maximum likelihood estimation, methods of moment, and quantile regression. The major ones are ordinary least square and quantile regression.

2.2.3.1 **Ordinary least square**

Ordinary least square (OLS) has been extensively used because of its ease of estimation compared to other methods. It shows the linear relationship between an outcome variable Y and explanatory variable X. It is expressed as:

$$Y = \beta_1 + \beta_2 X_i + \varepsilon_i \tag{36}$$

The coefficient β_1 represents the intercept which predicts the outcome value of *Y*, without any effect from *X,* while β_2 is regarded as the slope, that is a change in *Y* for unit change in *X* and ε_i is the error term (Suryanarayana and Mistry, 2016). The major advantage of OLS estimation is the linear association among variables with a single slope based on mean estimation E(*Y*|*X*). However, it is limited, as it assumes that associations between independent

and dependent variables are the same at all levels and does not consider differential effects at other points, which can lead to imprecise or at least incomplete findings (Kandpal and McNamara, 2009).

2.2.3.2**Quantile regression model**

This model extends the characteristics of linear regression model as it captures differing effects among variables along quantile *q* distribution (Koenker and Bassett, 1978). As a non-parametric model, there is no problem of sample bias in selection because it uses the entire sample information. It gives an overview of estimates across varying quantile functions by minimizing asymmetrically the weighted absolute errors (Petscher and Logan, 2014). The implicit quantile function of y is expressed as:

$$q(Y_i) = \beta_q X_i + \ell_{qi} \tag{37}$$

where *q* is a specified quantile of the distribution (*Yi)*,

β_q is the coefficient that shows the marginal effects of factors *i*on quantile*q*

Xi is the socioeconomic determinants, and

ℓ_{qi} is a random disturbance, $\mathrm{E}[\varepsilon\theta_i / X_i] = 0$

The advantage of this model is that it offers better estimates, as it minimizes the effect of outliers compared to least square regression (Koenker and Bassett, 1978). It can provide several rates of slopes along dependent variable, which helps to reveal the underlying relationship between variables not taken into consideration by mean estimation.

To ascertain that quantile coefficients are statistically significant with different weights across quantiles, Wald tests for equality is essential. The simultaneous quantile regression generates estimates for QR simultaneously across quantile and allows differences between QR coefficients to be tested (Yang et al., 2012). The Wald's test is expressed as:

$$\omega^* = \frac{\hat{\beta}_j^p - \hat{\beta}_j^q}{\mathrm{var}\left(\hat{\beta}_j^p - \hat{\beta}_j^q\right)} \tag{38}$$

where β_j^p and β_j^q are coefficients of *jth* explanatory variables at quantiles *p* and *q*.

Quantile regression was used to isolate various factors affecting household diet diversification at different quantiles of diversity distribution. It was preferred as it considers the impact of a covariate on the entire distribution, not restricting to conditional mean, which is relevant to small changes peculiar to food diversity.

2.2.4 **Review of qualitative response regression**

The discrete choice model examines causal relation between variables whose response variables are qualitative (categorical/discrete) as opposed to continuous response variable in the linear regression model (Gujarati, 1995). The response variable is not quantitative or an interval scale; thus, the standard additive normal error is not tenable for these models (McFadden, 1984). The models are based on the assumption of distribution of the conditional probabilities of various outcomes. Qualitative response regression includes linear probability, logit, tobit and probit models.

The linear probability model (LPM) shares similar characteristics with linear regression, only that the dependent variable is binary (Gujarati, 1995). In this case, the probability of success changes linearly with respect to x_i, which is expressed as:

$$\pi(x) = \alpha + \beta x \qquad (39)$$

where β refers to the likelihood per unit change in x. The model is simple enough to possibly predict values of a dependent variable when it is less than zero or greater than one over a restricted range of x values. Its disadvantage is that the likelihood of occurrence increases linearly with x,which means that the marginal effect of x remains constant. This leads to the development of other models that allow non-linear relationship, such that, as X increases, probability P_i=E(Y_i=1/X) increases (Agresti, 2007).

The probit model assumes a normative cumulative distribution and that the occurrence of a variable is dependent on a latent variable, I_i, such that the level of the value of I_i determines the extent of probability of occurrence of the event. The probability that I*, an unobserved variable, is above or below I_i given the normality assumption, is rendered as:

$$
\begin{aligned}
A_i &= A(Y = 1/X) = A(I_i^* \le I_I) \\
&= A(Z_i \le \beta_1 + \beta_2 X_i) \\
&= f(\beta_1 + \beta_2 X_i)
\end{aligned}
\qquad (40),
$$

where the normal cumulative distribution function is given as:

$$
F = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta_1 + \beta_2 X_i} e^{-Z^2} / 2dz \qquad (41)
$$

The probability of the event occurring thus ranges between -∞ and I_i. The extent of latent variable depends on the unobservable variable y_i and on series of independent variables X.

Furthermore, the logistic regression estimates non-linear relationships between the dependent and independent variables (Gujarati, 1995). The logistic distribution is based on cumulative logistic distribution (CDF). It is expressed as:

$$
P_i = \mathrm{E}(Y_i = 1/X_i) = \frac{1}{1 + \ell^{-(\alpha + \beta x)}} \qquad (42)
$$

where $p_i$is the probability of interested outcome with values between 0 and 1, which have non-linear relationship with the explanatory variable, X*i*. The rate of steepness of the curve is determined by the magnitude of β. An advantage of logit regression is that it has slightly fatter tails than probit regression because the conditional probability approaches 0 or 1 at a slower rate (Gujarati, 1995).

Extension of logistic regression could be in binary form, where the dependent variable is dichotomous or polychotomous, as the case of multinomial logic. Multinomial logit (MNL) regression reveals the probability of categorical membership of a dependent variable based on the influence of other multiple independent variables. The model is expressed as:

$$
(y) = \ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 x_1 + \ldots + \beta_k x_k \qquad (43)
$$

$$= \frac{\ell^{\alpha+\beta_1 x_1+\ldots+\beta_k x_k}}{1+\ell^{\alpha+\beta_1 x_1+\ldots+\beta_k x_k}} = \frac{1}{\ell^{-(\alpha+\beta_1 x_1+\ldots+\beta_k x_k)}}$$

There is no normality, linearity, or homoscedasticity assumption in this model and it fits all categories simultaneously within the same model which helps to extract more information from a dataset. It also prevents loss of information due to collapsing of categories in other models. Assumption of independence among the dependent variables can be tested by the Hausman-McFadden procedure to ensure that selection of membership in one category is unrelated with others (Starkweather and Moske, 2011). The multinomial logit model was well suited in explaining the factors that influence food security status among urban households. It was preferred because the dependent variables were mutually exclusive and were naturally unordered.

2.2.5 **Review of measures of urbanisation**

The urbanisation measures are most crucial in understanding levels of urbanisation. Its level has been widely recognized as a key characteristic when studying urban and socio-economic plans (Mehaina et al., 2016). The measures of classifying settlements into urban or rural include: rural-urban dichotomy, urbanicity index and agglomeration index.

2.2.5.1 **Rural-Urban dichotomy**

This measure is one of the oldest ways of reporting population statistics of world urbanisation level by the United Nations (Champion and Hugo, 2004). Although, the approach is simple and easy for computingthe level of urbanisation based on population, it is inadequate especially in predicting changes in urban processes as well as heterogeneity within urban areas (Vlahov and Galea, 2002). This is as a result of variation in definition of "urban" or "rural" settings across countries. Also, measuring urbanisation by only one factor will not explore its multifaceted concept.

2.2.5.2 **Urbanicity Index**

Urbanicity refers to the state of urbanism which measures urbanisation as a process (Dahly and Adair, 2007). Urbanicity index, developed by Allen in 1976, measures the extent to which a place at any point in time exhibits characteristics of an urban environment (McDade

and Adair, 2001; Vlahov and Galea, 2002). This approach improves on the dichotomy measure because it allows for comparison of similar indicators at a point in time across urbanizing environments. The index is a continuous variable.

The criteria for classification, therefore, varies depending on set objectives (Mehaina et al., 2016). According to the United Nations report on methodology (UN, 2014), the criteria used in defining urban areas include urban functional characteristics, administrative designations, economic characteristics and population size/density. Among these methods, urban functional characteristics further helps to reveal patterns and changes in urban areas (Dahly and Adair, 2007). This index treats urbanisation as a process of accumulation of urban elements, rather than as emerging of a city in an administrative sense (Miao and Wu, 2015).

2.2.5.3 **Agglomeration index**

This is a measure of population concentration which is determined based on some factors, such as density, number of people and travel time within an area. The index does not measure urbanisation based on urban characteristics and other governmental practices as well as availability of services or activities. Alternatively, the index focuses on how accumulation of cities and their geographic terrains evolve, which determines the level of urbanisation (Uchida and Nelson, 2008). This index is most suitable for measuring the extent of spatial analysis. Based on reviewed measures, urbanicity index is used to profile the extent of urbanisation because of its ability to provide variation in urban changes over time and allows for more refined urban effects. It also facilitates more empirical analysis of the relationships between urbanicity and other control variables in this study. This captures the attributes that affect residents and is more flexible in capturing changes in a community and their effects on food consumption outcomes.

2.2.6 **Review of measures of diversification**

In measuring diversity, number, distribution and healthiness of food are most crucial in defining extent of diversification (Drescher et al., 2009). These measure are broadly categorised into count and distribution measures.

2.2.6.1 **Count measure**

Count measure refers to the number of food items/groups consumed within a given reference period (Kant et al., 1991). The method is relatively easy and cheap to conduct. This method

has been widely applied in nutrition studies as a stand-alone measures of diet diversity (Hatloy et al.,1998; Ajani, 2010).

This is calculated as:

$$D = n \tag{44}$$

where D= diversity value; and

n = number of food items

Its advantage is that it considers the number dimension of diversity. However, it fails to account for distribution of food basket and neglects relative share of food items (Drescher et al., 2009).

Another variant of count measure of diversity is household dietary diversity score (HDDS). It is a qualitative measure of food consumption that reveals the economic access of a household to a variety of food which correlates with socioeconomic status and food security (Vakili,Abedi, Sharifi and Hosseini, 2013). It is regarded as economic vulnerability measure of household diet quality (Ogundari, 2012). It is calculated as:

$$\text{HDDS}= \sum_{i=1}^{n} s_i \tag{45}$$

where s_i is the share of food in the total bundle.

Higher HDDS suggests an increase in intake of micronutrient which subsequently results in better dietary quality (Swindale and Bilinsky, 2006; FAO, 2011).

2.2.6.2 **Distributional measures**

From an economic perspective, an index of diversification could be defined as a function of product number, distribution, and heterogeneity (Gollop and Monahan, 1991). These are defined as inverse of concentration measures. Distributional measures quantify variety by calculating the relative occurrence of items related to their entirety (total basket); thus they quantify the partitioning of any complete sum of attributes (consumption bundle) on several statistical units (food items/groups). Distributional measures are maximised when items are

evenly distributed. The weighted aggregate measures mostly applied include: Herfindahl Index; Berry Index, Entropy Index and Rumelt's classification system.

(i) **Herfindahl Index**

It measures extent of concentration within a given number of items whose value declines with increasing number of items (Lee and Brown, 1989). It is calculated as

$$HI = \sum_{i=1}^{n} s_i^{\,2} \tag{46}$$

where s_i is the share of each individual item to the total bundle. The share can either be calculated based on quantities, expenditure or calories of food consumed. The values of the index have their range from 1/n to 1 and attain value of one if shares are totally concentrated on single item.

(ii) **Berry Index**

Berry index is a method used for measuring the extent of diversification. It measures diversity by incorporating number as well as distribution dimension for different items considered (Berry, 1975). It measures diversification proportionally and attains the maximum when consumption shares are equally distributed among varieties (Thiele and Weiss, 2003). This method has been widely employed to examine diversity of diets because of ease of estimation (Stewart and Harris, 2005). It is expressed as:

$$BI = 1 - \sum_{i=1}^{n} s_i^{\,2} \tag{47}$$

where s_i is the budget share for the *ith* commodity on total bundle. The share can either be calculated based on quantities, expenditure or calories of food consumed. The index is bounded between value of 0 and *1-1/n*, where 0 indicates that only one product is consumed, and *1-1/n* indicates that each product in the basket is consumed at an equal share (Kumbarov and Zemke, 2014). Logit transformation might be necessary as a result of assumption of normality in the index (0<B*Ii*<1). The Transformed Berry Index (TBI) is expressed as:

$$TBI_i = \ln\left[\frac{BI_i}{1 - BI_i}\right] \quad (48)$$

(iii) **Entropy Index**

Entropy Index is similar to Berry Index. It measures diversity by weighing the consumption shares of each food with the reciprocal of its logarithmical share (Jacquemin and Berry, 1979). It can be expressed as:

$$EI = \sum_{i=1}^{n} s_i \ln\frac{1}{s_i} \quad (49)$$

The index takes the value of zero whenever the selection is totally concentrated on any single item, while log (n) represents absolute equal distribution. The advantage of the method is it's not being restricted to an upper constraint, while the disadvantage is that it is time-consuming (Sambharya, 2000).

(iv) **Rumelt classification system**

This is a categorical measure of diversification strategy that involves subjective assessment (Rumelt, 1974). It categorizes items into various forms based on the magnitude of relatedness. It takes into cognisance other factors which are assumed to be difficult to quantify but are important in influencing the level of relatedness. However, the criteria for categorization is rather subjective and biased, while its reliability is uncertain (Sambharya, 2000). In line with the reviewed measure of diversification, this study used Berry Index to estimate extent of dietary diversity of food consumed among urban households, as it captures both number and their relative distribution.

2.2.7 Review of measures of food security

Different measures of food security/insecurity have been employed to determine food security position (Pangaribowo et al., 2013). The relevant food security measures include Foster-Greer and Thorbecke (FGT), per capita food expenditure, Rasch method and cost of calories (COC), dietary diversity, food insecurity access scale, dietary energy availability per capita and food consumption score.

2.2.7.1 **Foster-Greer and Thorbecke (FGT) Measures**

This measure is a traditional measure of food security in many cross-sectional studies. Based on household level data on food expenditure, the FGT measure is computationally simple and straightforward.

The FGT measures mirrors the determinants of poverty using household expenditure (Foster et al., 1984). The standard FGT poverty decomposition for food security classification modified from the poverty measure is as follows:

$$P_i = \frac{1}{N}\sum_{i=1}^{n}\left[\frac{Z - Y_i}{Z}\right] \tag{50}$$

where P_i is the food insecurity gap shortfall index; Z represents the food security line calculated as the 2/3 mean per capita food expenditure; *n* is the number of households below the cut-off line;*N* denotes the total number of households considered; and Y_i is the per capita food expenditure of each household. Households whose food expenditure falls below the generated food security line are termed as food insecure. The FGT measure can be used to determine the level of access of households to food; however, it may not necessarily measure food consumed but food purchased during the period of measurement.

2.2.7.2 **Cost of calorie measure**

Cost of calorie is an example of expenditure-based measure of food security. The cost of calorie measure examines the cost of the actual calories consumed by the households in a recall period as compared to the minimum calorie required for households. The cost of calories method determines the threshold food security line based on the minimum calorie requirement for households. Minimum calorie requirement is standardized by size of household coupled with the age-sex ratio within the household (Sultana and Kiani, 2011). Using the cost of calorie method, the cost of the minimum calorie requirement constructed within the sample population, is thus regarded as food security line. Any household short of this is classified as being food insecure. Estimating the cost of calories is given by:

$$\ln h = a + bC \tag{51}$$

'h' is the cost of calorie per adult equivalent, C is the actual calorie consumed by the households, which has been normalized by adult equivalent, while a and b are estimated factors.

After the above estimation is carried out, the food insecurity line is estimated as; $Z = e^{(a+bL)}$
Z is the food insecurity mark, L is the minimum dietary intake of calorie recommended, 'a' and 'b' are parameters estimated from the previous equation. Household at or above this food insecurity line are classified as food secure, while households below the line are classified as food insecure. The cost of calories method gives food security estimates closest to the calories requirement of household. A major limitation in the use of the cost of calories approach is that it does not consider food consumed away from home, which may be a substantial part of food consumed by urban households.

2.2.7.3 **Household Food Insecurity Access Scale (HFIAS)**

Household Food Insecurity Access Scale (HFIAS) is based on the qualitative method of analysis (Ballard et al., 2014). This scale explores the severity of food insecurity-based experiences of households over a recall period (Obayelu, 2010). The experience-based food security measures are subjective measures that look at food security from the perspectives of people to hunger and food insecurity. The experience-based measure goes beyond physical food security measures to understand the fundamentals of food insecurity using the household as a unit. Scaling and measurements are also straightforward and can be adapted to different sociocultural settings. The main disadvantage of this method is that it is purely subjective, leading to biased estimates.

2.2.7.4 **Dietary diversity food security measure**

Dietary Diversity (DD), a measure of the food utilization component of the food security shows the relative consumption of diverse macronutrients and micronutrients (Magrini and Vigani 2014). Considering the demand theory aspect, allocation of resources by household towards consumption of foods with more quality and taste after meeting basic food requirements suggests a maximization of higher utility (Heady and Ecker, 2012). Dietary diversity can be expressed in terms of scores and index. The dietary diversity score (DDS) reflects the dietary quality of food consumed but fails to reflect the way food groups consumed are distributed (Ruel, 2002; Smith and Subandoro, 2007). In order to examine

extent of diverse diet, the dietary diversity index (DDI) is well suited as it shows various levels which households belong to in dietary distribution (Drescher and Goddard, 2011; Das, 2014).

2.2.7.5 **Per capita food expenditure measure**

This measure is most preferred for measuring food access, as food expenditure determines level of access as well as vulnerability of household to food security (Smith and Subandoro, 2007). This measure is equally important as it reveals economic access through food prices which has been identified as a crucial element in food security. However, it does not fully capture the nutritional quantity aspect of food consumption. Therefore, attaining a higher level of food expenditure has been regarded as an essential indicators of food security (Faridi and Wadood, 2010). Similarly, a threshold can be constructed using this measure to further reveal different food security levels (Omonona and Agoi, 2007). Following Ogundari (2017), this study combined two food security measures, namely per capita expenditure and dietary diversity index, to determine household food security status, which provides a holistic and broader concept of food security status, further fulfilling its multidimensional nature.

2.3 **Empirical review**

This section is devoted to review empirical studies related to this study. It covers studies on household food demand, dietary diversity measures, urbanicity measures and food security measures.

2.3.1 **Review of empirical studies on food demand**

Several demand models have been used in estimating household food demand. The relevant ones include ordinary least square, almost ideal demand system and quadratic almost ideal demand system. With respect to ordinary regression model, Chikobola and Edriss (2016) and Babalola and Isitor (2014) estimated urban household food demand pattern in Zambia and Nigeria, respectively using the double logarithmic method. Both studies showed that household income and household composition had a significant effect on food expenditure.

To account for socio-demographic effects on urban food expenditures using AIDS, the linearized demographic translation is usually applied. Studies such as Tsegai and Kormawa (2003), Dudek (2011), Osei-Asare and Eghan (2013) and Ulubasoglu et al. (2017) used the

linearised almost ideal demand system to estimate household food demand structure. With this same method, Udoh et al. (2013) estimated the structure of urban household food demand in Nigeria.

The results showed that household demand for different food groups responded significantly to changes in the household size, marital status, household's head education and their income. Likewise, the study on urban household response to food demand in Nigeria by Ojogho and Alufohai (2010) showed that being in a male-headed household and household size influenced demand across food groups. Also the study established the effects of non-price factors on demand for food items in Nigeria, which include ease of preparation, household characteristics and urban lifestyles.

With the focus on the dynamic form of Almost Ideal Demand System, studies like Liao and Chern (2007) and Zhou et al. (2014) investigated food demand for urban household in China. Their results were similar, indicating that most primary food products were necessities and price-inelastic for most urban households in China. This dynamic model has a tendency to produce lesser elasticities in magnitude compared to the static form, but also allows habitual effects to be factored in with respect to consumption behaviour. Likewise, Mhurchu et al.(2013) assessed price elasticity for food in New Zealand. The results showed differences in demand elasticities across income levels, as low-income households were more demand-elastic; and, thus, more sensitive to price changes. These empirical works reviewed were linear in form, which allows an exact aggregation among consumers, but not flexible enough to estimate nonlinearity of the Engel curve associated with household food demand.

To overcome the linear relationship in demand models, a nonlinear QUAIDS model have been used empirically to examine household food demand responsiveness to price and expenditure changes. Studies that followed this line of model included Pangaribowo and Tsegai (2011),Bett et al. (2012), Ashagidigbi et al. (2012), Rizov et al, (2015), Van Oordt (2016) and Mottaleb et al. (2017). This model was also employed by Bopape and Myers (2007) to evaluate household food demand patterns in South Africa. The results showed difference in the pattern of demand, as staples had the highest expenditure share among rural and low-income groups, especially households with large sizes. Also, high-income households residing in urban areas had higher preference for high-value commodities (such as meat, fish, fruits and vegetables) than rural areas. Similarly, Obayelu et al. (2009) used this

method to examine food demand among households in North Central, Nigeria. The results showed that most food groups were price inelastic, while animal protein consumption had the highest expenditure elasticity. Furthermore, household head's level of education, occupation, access to credit, presence of children below 6 years and household size significantly determined the level of food demanded.

Olorunfemi (2013) took a different approach by combining both the linear and quadratic demand models. The results empirically confirmed the use of QUAIDS to be more reliable to its linear version AIDS, as QUAIDS allowed expenditure elasticities to vary as income improved for all food groups. Consumer behaviour at different income and price levels influenced the extent of food access. Likewise, the work of Liu (2003) corroborates the superiority of QUAIDS in estimating household food demand. Also, QUAIDS results from household food demand in the studies by Ashagidigbi et al. (2012), Rizov et al. (2015) and Pangaribowo and Tsegai (2011) showed that expenditure elasticity varied with income level and price elasticity estimate was consistent with economic expectation, as household was more responsive to food demand.

Most of the studies reviewed above did not disentangle urban effect but employed rural-urban dichotomy to delineate place of residence. In this respect, literatures that factored in effect of urbanisation on household's food demand using QUAIDS include the work of Hoang and Meyers (2015), which estimated food demand system for Vietnam household. The results revealed increased preference for high-value commodities (meat, fish) with declining demand for staples, which indicated demand for diversified diet.

Also, Zheng, Henneberry, Zhao and Gao (2015) assessed how rise in income and urbanisation influenced food demand in China using QUAIDS. The results indicated that, with continued rise in per capita income and urbanisation rate, the budget share of food grains and vegetables decreased, while share of foods with animal and high-value commodities rose, especially among urban residents. Guo (2016) examined the influence of urbanisation on changing food demand pattern in East Asia. From the results, it was evident that the structures of food consumption patterns in urban areas significantly differed, while rapid urbanisation influenced the food intake through reduction in the consumption of cereal grains and increase of animal proteins and fruits.

Likewise, Mittal (2010) estimated price and expenditure elasticity of different food groups in India using QUAIDS. Urbanisation was found to have a positive effect on food expenditure with taste and preferences changing over time. Expenditureshare negatively affected intake of staples and sugar, while fruits and vegetables and oil consumption increased with urbanisation.

None of the reviewed empirical studiesquantified the effect of urbanisation on food demand. Rather they used administrative factors. Although, these studies focused on developing countries, like Nigeria, which are also experiencing rapid urbanisation, their findings would provide basis for comparison about the pattern of urban household food demand. Since this study focuses on urban household food demand, it is necessary to quantify the effect of urbanisationon food demand across households. This study therefore extends previous studies by incorporating urbanicity index for urban food differential.

2.3.2 **Review of empirical studies on dietary diversity**

Dietary diversity has been measured by different methods depending on the subject of interest. The major ones are anthropometric measure, household dietary diversity score, berry index and entropy index. Anthropometric measure and dietary diversity score were employed by Ajani (2010) to assess dietary diversity among women of reproductive age and their children below age five in six Nigerian states. Diet diversification was low based on average food groups consumed over the reference period, while factors, such as location, educational level, income, and household size, influenced extent of diet diversity.

Cordero-Ahiman et al.(2017) assessed urban household dietary diversity status in Mexico. The results from household dietary diversity score showed that the households had diverse diets while discriminant analysis results revealed that factors such as employment, being married and the conditional cash transfer programme best explained dietary diversity. Although, the method is relatively simpler with regard to computation and understanding, the distribution of food groups consumed was not well accounted for, which might give imprecise information on dietary pattern. Based on this shortcoming, Swindale and Bilinsky (2006) argue that the method should not be used as a stand-alone measure of diversity.

Studies that considered the distributional measure of diversity include Thiele and Weiss (2003), Drescher and Goddard (2011),and Liu et al. (2013). Also, Cockx et al. (2017) used Berry index and regression method to examine effect of urbanisation on the food consumption of migrants in Tanzania. The findings showed that nutrition transition was more pronounced among those who relocated to urban areas. The study found that living in an urban environment did not contribute positively to the intake of protein-rich foods nor to diet diversity but largely linked to rising incomes. With respect to studies that combined diversity measures, Alexandri and Kevorchian (2015) applied the count and Berry index measure to investigate factors that influence food consumption diversity on the Romanian household. The result showed that age, educational level and income better increased food diversity while there were income disparities between households from urban and rural areas, as food diversity was higher among urban households.

Likewise, Qineti et al.(2017) employed Berry index to assess food diversity at household level in Kosovo. Also, anthropometric measure was used to access the state of the food and nutrition security at the individual level. The result revealedthat the pattern of the household food consumption remained diversified over the time period observed, but restricted by the low level of income. The anthropometric estimates revealed that prevalence of undernourishment wasmore pronounced among school-age children, while overweight was the main nutritional problem among the adults.

Similarly, Codjoe et al. (2016) employed dietary diversity index and bivariate analysis to examine urban household dietary diversity status in Ghana. It was found that most households had moderate diet diversity but the intake of micronutrients foods was low. Also, Akerele and Odeniyi (2015) applied Berry index and ordinary least square (OLS) to investigate household dietary diversity in Nigeria. There was heterogeneity in food diversity within household, as income positively influenced demand for diverse diets, while spatial differences influenced the extent of diet diversity, as households in urban areas had higher diversity.

The reviewed literature focused on rural-urban dichotomy, this mode of classification might not fully capture the extent of diet diversity, especially in urban settings, thus the need for a better representation. Regression models were mostly employed to isolate factors that

influence dietary diversity. In view of the sensitivity of diet diversity to smaller changes as observed by Rizov et al. (2015), a more robust econometric model is necessary. This is because ordinary least square regression might not reveal the impact of covariates across dietary distribution and information obtained is often limited to the mean distribution which often leads to imprecise and incomplete findings (Kandapal and McNamara, 2009).

Das (2014) and Drescher and Goddard (2011) examined dietary diversity and its determinants using entropy index and quantile regression in India and Canada, respectively. The results from the quantile regression estimates showed distributional effects of covariates on diversity across quantiles. Both studies revealed that income, education and infrastructural facilities had a significant and positive impact on consumption of diverse diets, while a negative association existed between quality-adjusted unit price values and dietary diversity. This study extends the work of Das (2014) and Drescher and Goddard (2011) by incorporating urbanicity index to quantify the effect of urbanisation on urban household dietary diversity, while the quantile regression gives a more comprehensive view of diet diversity for food groups consumed.

2.3.3 **Review of empirical studies on urbanicity index**

Studies have shown that food consumption pattern differ across rural and urban populations (Obayelu et al., 2009; Pangaribowo and Tsegai, 2011; Ashagidigbi et al., 2012; Udoh et al., 2013). However, these studies are based mostly on comparative purposes, which might not adequately distinguish food demand and dietary pattern, particularly in contexts of rapid changes in food consumption (Cockx et al., 2017). In order to quantify influence of urbanisation on food consumption, the use of urban variables singly during estimation often leads to statistical problems such as multicollinearity (Das, 2014). To overcome these problems, a composite index is essential, as it summarizes the various aspects that encompass the concept of urbanisation. With respect to this, different techniques have been applied in the literature, such as scales and score index with different weighting approaches, principal component analysis and area under curve.

Empirical studies that used urbanicity scales to capture heterogeneity in urban settings include McDade and Adair (2001), Dahly and Adair (2007), Allender et al. (2008), and Antai and Moradi (2010). The work of Jones-Smith and Popkin (2010) constructed urbanicity scale

components indicator of urbanisation which includes from infrastructure, economic, population and social services. The results showed heterogeneity of change in the urbanicity component used although this multi-factor scale is a clear improvement over the dichotomy, it is still one-dimensional in weighting.

Likewise, Liu et al. (2003) and Dahly and Adair (2007) subjectively allocated weights to various urban characteristics to construct an urbanicity scale to quantify urban environment. This equal weighting, that is synonymous to urbanicity scales, could lead to bias estimates and inconsistent results (Jone-Smith and Popkin, 2010; Thompson et al., 2014). This suggests the importance of analysing the scale components independently with the use of a more econometric statistical procedure (Champion and Hugo, 2004).

Studies that used multivariate statistical methods to quantify the effect of urbanisation include Van der Poel et al. (2008), Zhou and Awokuse (2014), Liao et al. (2016), Mehaina et al. (2016), Wu et al. (2017), and Li, (2017). Miao and Wu (2015) examined the effect of urbanisation on socioeconomic and health characteristics of households in China. The study adopted the components of Jone-Smith et al. (2010) to construct a composite urbanisation index that treats urbanisation as a spectrum and highlights the characteristics of urban life. The logistic regression revealed that the link between income and health was moderated by urbanisation, and the protective role of education on maintaining health became more prominent in more urbanized areas.

In the same vein, Liao et al. (2016) examined the effect of income and urbanisation on rising food service and outlets in China. Principal components analysis was employed in constructing urbanisation index. It was revealed that urbanisation index delineated different categories of cities and the negative binomial regression estimates further confirmed food environment disparities. Van der Poel et al. (2008) employed factor analysis to determine the structure of urbanisation component in China using community level determinants that reflect urbanicity level on health. The constructed urbanicity index was further used to classify the urban area. The results indicated that urbanicity level increased with the development of infrastructures and services, which positively influenced health status.

In addition, Zhou and Awokuse (2014) examined how rapid urbanisation in China affected nutrition transition and obesity using regression model. The urbanisation index computed by principal component analysis influenced obesity differently by gender while nutrition transition was towards a dietary pattern of more fat and protein intake. In addition, Jie et al. (2013) considered administrative and urban characteristics to assess China's actual urbanisation level. Infrastructure-based method better predicted and accounted for changes in urbanisation over time compared to the population measure.

With the foregoing, simple urban-rural dichotomy might not adequately distinguish the patterns of food demand and diversity experienced in urban areas as rapid urbanisation continues. In view of the limited amount of literature using urbanicity index, this study contributes to literature on quantifying the effect of urbanisation on household food demand and dietary diversity among urban households.

2.3.4 **Review of empirical studies on household food security**

There are lots of food security classification measures but the most relevant ones applied in the literature include cost of calorie, rasch method, two-thirds of mean per capita food expenditure, household dietary diversity score, household food insecurity access scale and anthropometric measures. With respect to Household Food Insecurity Access Scale (HFIAS), Akinboade et al. (2016) investigated the extent of food insecurity situation among urban households in South Africa. The results showed that the degree of food security was moderate, as there was absence of mild food insecurity while increase in income, educational and employment status. Household size also influenced household food security status.

Similarly, Odusina (2014) in addition to HFIAS used Household Dietary Diversity Scale (HDDS) to evaluate food insecurity situation in urban Nigeria. Both measures showed that households had adequate food access and diverse diets, while probit regression results showed that households with older heads, larger household sizes and unemployment had the tendency of being food-insecure. Another measure called Rasch models was applied by Obayelu (2010) to assess status of food security among households in North central Nigeria. There were different categories of household food insecurity, ranging from moderate to severe hunger, with a smaller proportion being food secure.

With respect to expenditure measure, Omonona and Agoi (2007) used food insecurity incidence to examine urban household status in Nigeria. The incidence increased with age of household heads, female-headed households, traders and the unemployed, household size and dependency ratio. However, those with formal occupation, higher educational attainment and improved income were better food-secure. The work of Arene and Anyaeji (2010) was similar to that of Omonona and Agoi (2007); it focused on one domain of food security measure, namely, food expenditure. Also Iorlamen et al. (2014) used a similar measure to construct food security index in Nigeria.The study found that more than half of the households was food- secure while demographics, such as age, household size and income of household heads, influenced the probability of urban households being food-secure.

Sultana and Kiani, (2011) applied cost of calorie intake to determine food security level in Pakistan. Based on classified households by cost of calorie measure, logistic regression result showed that place of residence and number of dependents within household had a significant and negative effect on household's food security status. Moreover, Frimpong (2013) assessed how urban household food security status in Ghana was changing through the influence of rapid urbanisation. From the perspective of using the food security line of minimum daily calorie requirement, the result indicated that staple foods consumption was rather increasing while most urban households are food insecure.

The reviewed studies revealed that various food security indicators have been used specifically to measure different dimensions of food security. However, using a single measure of food security might not give full information since other measures are needed to capture its multidimensional nature. Hence, integration of more indicators is necessary to provide a holistic view of food security outcome, especially in urban areas.

The few studies that follow this line of combining food security indicators include the works of Rose and Charlton (2002), Smith and Subandoro (2007), Gentilini and Webb (2008), and Maxwell et al. (2013). Food poverty and low energy availability ratio was used as a measure of food security in South Africa by Rose and Charlton (2002). This classification permits households to be at several categories, as about half of the households had a low energy availability. The regression analysis revealed that both measures of food insecurity increased with households which had low incomes and large household sizes.

Maxwell et al.(2013) combined coping strategy index (CSI) and household food access insecurity scale (HFIAS) indicator which captures elements of quality (diversity) and quantity (sufficiency). The findings from the network diagram, cross-classification measure and integrated phase classification revealed that the constructed multi-dimensional indicator of food security produced results showing varying food security levels. Ogundari (2017) focused specifically on food access and food utilization components to assess Nigerian household food security levels. The measures produced different categories showing varying food insecurity levels while the multinomial logit regression result indicated that the extent to which households were food insecure was influenced by household size but decreased as the income level of household headsimproved. The study focused on both rural and urban areas, though the combined indicators revealed a broader representation of food security.

This study extended the works of Smith and Subandoro (2007) and Ogundari, (2017) to determine food security status among urban households by incorporating urban effect to capture extent of urbanisation on food security status among urban households. The choice of a combined and comprehensive approach to measure food security status would help to explain simultaneously the broad concept of food security.

2.4 **Conceptual framework**

This section shows the interrelationship between urbanisation and its underlying variables as they link up in influencing urban food demand, dietary pattern and subsequently food security. The rise of urbanisation is transforming food systems, ranging from production, the value addition stages, such as processing and packaging, to distribution,retailing and consumption. Specifically, structural transformation as a result of urbanisation tends towards demographic changes influenced by the growing proportion of people in urban areas and expansion of built environments, which have resulted in developmental activities. This makes urban areas the hub of economic activities, which has led to income growth and infrastructural development, such as technological advancement, better educational facilities, health services, improved access to communication services.

Furthermore, the increasing developmental activities in most urban areas has led to rapid transitions from a typically agrarian economy towards more sedentary occupations, coupled

with increased women participation in the modern workforce. This occupational lifestyle extends working hours, which further alters food demand pattern to more convenient and ready-to-eat foods most times. This expands the availability of foods and accessible modern food retail outlets, resulting in wider choice of ready to eat foods.

This food procurement process reveals how food is accessed by urban households, resulting in greater variety of available food choices and creates new habits and tastes which influence food access and dietary pattern. Therefore, understanding the linkages between urbanisation and food consumption with their resultant effects on food access and utilization, reflects household food security situation. As the urbanisation process continues, there is need to consider integration between urban growth and food security, which is the empirical focus of this study. This interrelationship would have key implications for Nigeria's agricultural and food sector, especially in terms of value-added agricultural products for international trade.

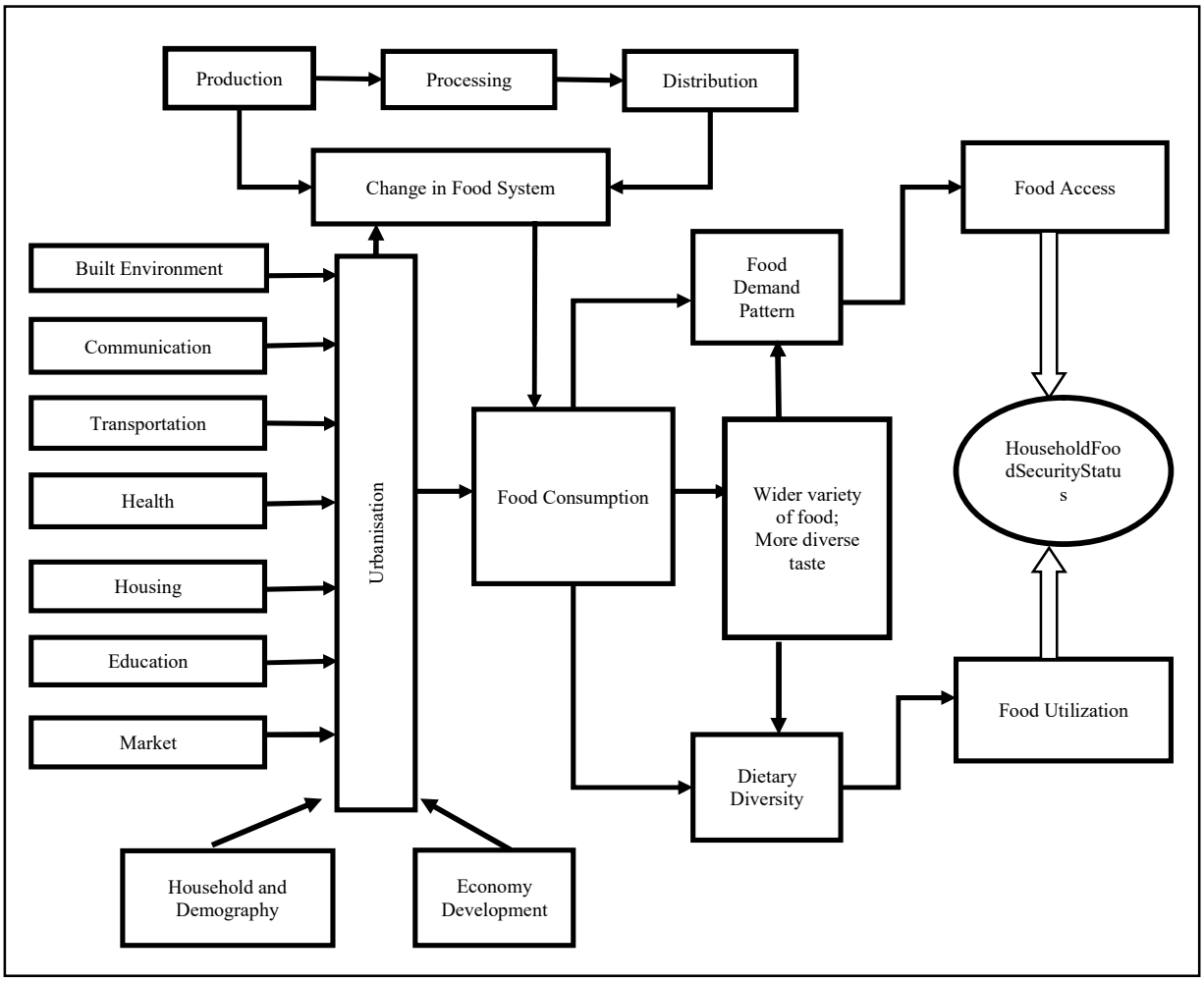

Figure 3: Pathway between Urbanisation and Food Consumption Pattern

Source: Adapted from Seto and Ramankutty (2017)

CHAPTER THREE

METHODOLOGY

This chapter presents the study area, data collection and methods of analysis that were employed to achieve the set objectives of the study.

3.1 Study area

The study was conducted in Southwest Nigeria. It is one of the six geopolitical zones in the country which comprises six states, Ondo, Oyo, Ekiti, Lagos, Ogun, and Osun (Figure 4). With a land area of about 114,271 square kilometres, it has a total population of27,581,992 (National Population Commission (NPC), 2006). This zone has latitude 6° and 4° to the North and South, and longitude 4° and 6°to the West and to the East, respectively. It is bounded in the east by Edo and Delta States, in the north by Kwara and Kogi States, in the west by Republic of Benin, and in the south by the Atlantic Ocean. As a tropical climate zone, it has two seasons, namely dry season (between November and March) and wet season (between April and October). Average annual rainfall is 1480mm, with monthly temperature range of 18°c - 24°c during the rainy season and 30°c - 35°c during the dry season. The vegetation contains fresh water swamp and mangrove forest at the belt with the low land in forest stretches inland to Ogun State and part of Ondo State (Faleyimu et al.,2010).

The southwest zone is mostly a Yoruba-speaking area, although there are different dialects even within the states. The main occupations in this zone are agriculture, trading and white-collar jobs. The major religions are Christianity, Islam and Traditional Religion. The area is noted for its quest for Western education, as most of its urban areas have larger educational facilities and higher literacy rate (NPC, 2006; Ikwuyatum, 2016). In addition, its major urban cities have growing manufacturing sectors, financial institutions, trading corporations, telecommunication companies, and government service centres. These factors characterised the extent of urbanisation and rapid urban growth in the study area. The zone was chosen for this study as a result of the rapid rate of urbanisation (Akolade, 2007; Morenikeji et al., 2017).

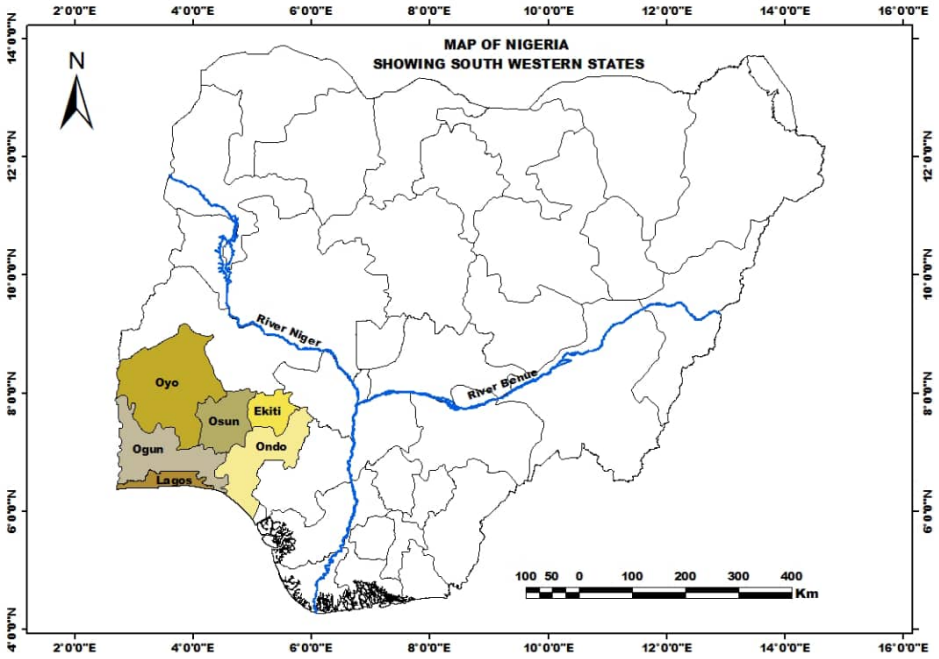

Figure 4: Map of Nigeria showing Southwest Zone

3.2 Sources and types of data

The study involved the use of primary data collected through a cross-sectional survey between the months of September and November 2016. The data were collected through the use of a structured questionnaire administered to respective urban households. Data were collected on household demographics, socioeconomic characteristics, food and non-food expenditure and urbanisation-related variables. Secondary data sourced through journals, statistical bulletins and monographs were also used to obtain information on the relevant literature reviewed.

3.2.1 Pretesting of survey instrument

Pre-test of survey instrument is a necessary condition that establishes clarity of purpose and identify possible obstacles that could arise in the course of a survey (Hilton, 2015). In this study, pre-test was carried out to assess and affirm the consistency of survey, appropriateness of questions to be asked and their suitability to the respondents. The information considered for the pre-test included household socioeconomic characteristics, asset ownership, social capital, expenditure on food and non-food as well as urbanisation indicators.

Enumerators were trained on the administration of the questionnaire, time frame for each question and proper sampling techniques to be used in selection of households in order to obtain detailed information. Copies of the questionnaire were pre-tested on few respondents drawn from parts of the intended population (Ibadan North) by the trained enumerators in August, 2016. The enumerators administered four copies of the questionnaire in a day. Fifty-two copies of the questionnaires were recovered after the pilot survey. Based on information obtained from the survey, questions were appropriated and restructured in order to achieve the intended objectives.

3.3 **Sampling procedure and sample size**

A four-stage procedure was employed to sample the respondents. In the first stage, southwest states were stratified into high and low urban population area based on population size (NPC, 2006). In this wise, Lagos, Oyo and Ogun States were grouped as high-population density area, while Ondo, Osun and Ekiti States were grouped as low-population density areas. Based on this stratification, two states, Oyo and Ekiti, were selected randomly from the strata to representhigh and low population density areas, respectively.

In the second stage, the most urbanized location within each of the sampled states was purposively selected on the basis of administrative criteria and level of urbanisation, which were Ibadan and Ado Ekiti, from Oyo and Ekiti States, respectively. This study also adapted the view of Adelekan (2012) and Akerele et al. (2016) in the choice of the cities. In the third stage, the selected states had earlier been enumerated by NPC (2006), to representthe primary sampling units used for the 2006 population census in Nigeria. The Enumeration Areas (EAs) were stratified into low-, medium- and high- density residential areas based on population density, in consonance with the works of Coker, Awokola, Olomolaiye and Booth (2008), Enyinnayaeluwa et al.(2012) and Oriye (2013). To have equal representation of each stratum, a random sampling procedure was used to select three EAs from each stratum for the selected urban locations.

The final stage involved the random selection of households from the selected EAs, which represented household heads. From Oyo State, a total of two hundred and ninety-five (295) household heads were interviewed and one hundred and eighty-seven (187) from Ekiti

State,giving a total sampled household of 482 (see Table 1). Out of 482 households, the information from 445 households was found useful for analysis;thirty-seven households were rejected (13 from Oyo State and 24 from Ekiti State) based on incompleteness of information.

3.4 Analytical techniques

The data collected for the study were analysed with descriptive statistics, multivariate principal component analysis, quadratic almost ideal demand analysis (QUAIDS), berry index, quantile regression analysis and multinomial logit regression. The statistical analyses were performed with EXCEL and the STATA 13.0 software packages.

Table 1: Distribution of Households by Sample Size

State	Urban locations	Enumeration Areas	Copies of questionnaire distributed	Copies of questionnaire used for analysis
Oyo	Ibadan	Low-density areas: Bodija Oluyole Estate Jericho	99	93
		Medium-density areas: Bashorun/Ashi Apata Eleyele	98	95
		High-density areas: Orogun Challenge Ijokodo	98	94
			295	**282**
Ekiti	Ado Ekiti	Low-density areas: Federal Housing Estate G.R.A Onigari Ureje/Immigration area	63	52
		Medium-density areas: Similoluwa Omisanjana Basiri	62	54
		High-density areas: Ijigbo Dallimore Odo Ado	62	57
			187	**163**
Total			**482**	**445**

3.4.1 **Descriptive statistics**

Descriptive statistics, which included percentages, mean and standard deviation, were employed to profile the demographic and socioeconomic characteristics of the urban households in the study area.

3.4.2 **Principal component analysis (PCA)**

Principal Component Analysis (PCA) was used to generate an urbanicity index that shows the extent of urbanisation in the study area (Zhou and Awokuse, 2014; Liao et al., 2016). Urbanicity index can be defined as the quantitative effect of living in urban areas at any given point in time (Cyril et al., 2013). It describes the degree to which an area has attributes of an urban setting (Vlahov and Galea, 2002). This index provides a comprehensive representation of urban growth across the study area, following the United Nations (2014) report on methodology for defining urban areas. This further helps to differentiate locational differences in urban household food consumption. This depicts the current standard of living and a measure of effect of urbanisation across food system rather than as emerging from a city in an administrative sense (Miao and Wu, 2015). Merrifield (2014) also posits that the procedure is more effective in revealing the heterogeneity within and across urban places. The selected indicators present salient urban characteristics, which were adapted from reviewed studies (Szabo, 2016).

Following Van de Poel et al. (2008), Jone-Smith and Popkin (2010),and Zhou and Awokuse, (2014), indicators used in constructing the index included the following:

i. communications facilities (access to mail, newspapers, Internet services, cable TV, and mobile phones)
ii. means of transportation and infrastructure (types of road; private, public transport system, for example, taxis, buses, tricycle and motorbike)
iii. educational facilities (availability of primary, secondary, colleges, vocational centres, tertiary institutions)
iv. health services (access to different cadre of health care providers)
v. markets (presence of functioning sales outlets such as retail shops, supermarkets, shopping malls, fast food outlets and bakeries)
vi. housing conditions (presence of sanitary facilities, means of waste disposal)
vii. source of cooking energy (gas, kerosene, fuelwood)

viii. source of power (public electricity, solar energy, inverter, generator)
ix. source of water supply (pipe-borne water, public tap, borehole, well, others)

These indicators were considered important in facilitating urbanisation processes within the urban context (Gomez and Ricketts, 2013; Das, 2014; Zhou and Awokuse, 2014; Zhou and Staatz, 2016). The Principal Component Analysis (PCA) employed in the construction of the urbanicity index can be implicitly expressed as:

$$PCA_i = \sum \frac{f_i (X_{ji} - Xi)}{S_i} \quad (52)$$

where, PCA_i= value of urbanicity index for *ith* household,
f_i = weight for the *ith*variable,
X_{ji} = *jth* household value for the *ith* variable,
X_i = the mean,
S_i= standard deviation of the *ith* variable over all the sampled households.

The main objective of using PCA was to extract the "principal component" needed to compute urbanicity index for each area. The PCA disaggregates data structure such that the variables within a data set are rearranged into components (Petscher and Logan, 2014). These urban components are uncorrelated and contain the linear weighted combination of the initial variables X. This is expressed as:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1p}X_p \quad (53)$$

with X_1, X_2…, X_p representing urban indicators and a_{11}, the weighted value of each indicator X_1. However, the coefficient of the first component shows that the variance of PC_1 is maximized such that it is conditioned that the sum of square of factor loadings equals one expressed as:

$$a^2_{11} + a^2_{12} + a^2_{1p} = 1 \quad (54)$$

This constraint was introduced because PC_1 can be increased simply by multiplying any a_{1p} by a fixed factor (Suryanarayana and Mistry, 2016). Similarly, the second component is completely uncorrelated with the first component, which is also expressed as:

$$PC_2 = a_{21}X_1 + a_{22}X_2 + ... + a_{2p}X_p \quad (55)$$

subject to $a^2_{21} + a^2_{22} + a^2_{2p} = 1$ and cov (PC_1, PC_2) = 0

This component gives additional but lesser information about the underlying factor than the first component.Urbanicity index, therefore, represents the first principal component generated from the extracted factors using the percentage of variance each factor contributes to the weight of total score.

The index constructed for the urban households can be further broken down to categorize households into terciles of low, medium and high urban areas using quantile distribution of the data (OECD, 2008; Mehaina et al., 2016). This procedure reveals the extent of urbanisation across urban households. However, appropriate test of significance is necessary to ascertain statistical significance. The Kruskal-Wallis H test was employed to measure significant differences across all categories. It is expressed as:

$$H = \left[\frac{12}{N(N+1)} * \sum \frac{T^2}{n} \right] - 3*(N+1) \quad (56)$$

where N= total number for all groups

T= rank total across group, and

n= number of observation across group.

The basis for adjudging significance is that, if the calculated value is less (greater) than the critical chi-square value, then variables with identical observation will not be rejected (rejected) at conventional level of 5%.

3.4.2.1**Test of robustness for index construction**

The constructed index by the use of PCA was validated through test of robustness, which include Factor Analysis Explained Variance (FAEV), Bartlett's test of sphericity, Cronbach

alpha and Kaiser-Meyer-Olkin (KMO). These tests provide evidence for internal coherence such that the resulting index is valid and subsequently performed according to empirical expectations. The FAEV indicates that the relationship among urban variables jointly explains the constructed index. Cronbach alpha determines the reliability coefficient of urban variables. It is expressed as:

$$\alpha = \frac{N \times \bar{c}}{\bar{v} + (N-1)\bar{c}} \tag{57}$$

where N= the sum of items

$\bar{c}$ = mean covariance between item-pairs and

$\bar{v}$ = average variance.

Bartlett's test of sphericity describes the extent to which the indicators in a correlation matrix are uncorrelated, while PCA estimates are regarded as valid if correlation diverges significantly from the identity matrix (Tabachnick and Fidell, 1989). This is expressed as:

$$\chi^2 = -\left[n - 1 - \frac{2p+n}{6}\right] * \ln|R| \tag{58}$$

where n = number of observations within dataset

p= number of variables considered and

R= correlation matrix

KMO measures variable's adequacy such that, if distinct components emerge from PCA, the values are efficient (Hutcheson and Sofroniou, 1999). This is expressed as:

$$KMO = \frac{\sum_{i \neq j} r_{ij}^2}{\sum_{i \neq j} r_{ij}^2 + \sum_{i} u_{ij}} \tag{59}$$

wherer_{ij} = correlation matrix

u_{ij} = partial covariance matrix.

Moreover, the Cronbach Coefficient Alpha estimates internal consistency of items and determines the level of reliability among urban variables (Miller, 1995). It is expressed as:

$$\alpha_a = \left(\frac{N}{N-1}\right)\left(1 - \frac{\sum_j \text{var}(x_j)}{\text{var}(x_o)}\right) \qquad a = 1, \ldots, P: \; i, j = 1, \ldots, N \qquad (60)$$

where P indicates the number of cases;

N refers to the number of urban indicators; and

$x_o = \sum_{n=1}^{N} x_j$ represents the sum of all the urban indicators.

With respect to the sum of variability of correlation of indicators, C-alpha equals to zero when no correlation exists. But, indicators are perfectly correlated when C-alpha assumes the value of one. High Cronbach value suggests that the sampled indicators tend to measure the same underlying concept; Nunnaly (1978) suggests a Cronbach value of 0.7 as an acceptable reliability threshold.

3.4.3 **Food demand model**

In estimating household food demand pattern, QUAIDS designed by Banks et al. (1997) was employed. Parameters of the demand system were estimated by STATA's quaids command using iterated feasible generalised nonlinear least- squares estimation via STATA's nonlinear seemingly unrelated regression (Poi, 2012). This method is an improvement on the omission of one of the food groups in order to avoid singular error-covariance matrix during estimation, as QUAIDS command handles that automatically (Poi, 2012), hence the robustness of this model. This STATA software also allows for post-estimation analysis which enables the computation of price and expenditure elasticities and demographic estimates that affect food expenditure. The model is given as follows:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 + \sum_{i=1}^{L} \delta_{is} Z_s + \varepsilon_i \qquad (61)$$

where w_i the share of expenditure for each food group,

P_j = price of each food group,

m = sum of food expenditure

z_s= socioeconomic and demographic variables,

α_i = value of budget share in the absence of price and income effects.

β_i = parameter that determines expenditure elasticity,

γ_{ij} = effect of cross-price elasticity,

λ_i = is the parameter that determines the quadratic term, and

δ_{is} = vector of socioeconomic and demographic variables.

To verify the adequacy of using QUAIDS instead of its linear version (AIDS), Wald test was carried out. This was necessary, because it formally tested the importance of the inclusion of quadratic expenditure term (λ_i) and the explanatory variables, as they jointly explain non-linear food expenditure behaviour. Based on this, if the Chi2 ($\chi 2$) statistics is sufficiently high and the p-value is considerably below the generally accepted significance level of 5%, the null hypothesis of quadratic expenditure term (λ_i), being jointly equal to zero, is rejected. In the estimation process, the theoretical plausibility conditions of demand theory, such as adding up, homogeneity, symmetry and negativity, was assumed (Edgerton et al., 1997).

With respect to food grouping, the weak separability approach was applied. This method groups commodities in accordance with consumer preferences, such that preferences for each group are independent from other groups (Lewbel, 1996; Okrent and Alston, 2011). Furthermore, a number of parametric, semi-parametric and non-parametric approaches can be applied as regards the issue of zero expenditure, which occurs in food consumption studies probably due to infrequent purchase or other factors (Okrent and Alston, 2011). However, the choice of approach further depends on the severity of zero expenditure in the data. A non-parametric measure was applied in this study. This is because the measure is based on large aggregation of food items, a procedure found to be acceptable with the work of Van Oordt (2016).

In this study, food classification was influenced by previous studies on urban food consumption and food classification by National Bureau of Statistics (2012). About eighty-nine (89) food items were grouped into seven (7) food categories, namely root and tuber, cereals, legumes, meat and its products, fruits and vegetables, fat and oil, and other foods groups (sweeteners, beverages, alcoholic and non-alcoholic drinks, snacks, pasta, can foods

and condiments). Aggregation and separation of food into several groups makes estimation easier and reduces the potential bias that could result from reported zero expenditures. Detailed summary of sampled food groups is presented in Appendix 2.

3.4.3.1 **Budget share of household**

The budget share is the percentage of household food expenditure that is assigned to each food group, which is expressed as:

$$W_{GI} = \left(\frac{P_{GI}, Q_{GI}}{X} \right) \qquad \text{G= 1, 2, 3....., N} \qquad (62)$$

where W_{GI} is the share of food group G, in relation to total expenditure in group G;

P_{GI}, Q_{GI} = total expenditure in a specific food group, and

X = sum of total expenditure of all the food groups.

Price for each food group was calculated as follows:

$$P_{a\,b} = \frac{Q_b \times P_b}{meanQ_a} \qquad (63)$$

where Q_b represents the quantity of food *b* in group *a* in kg,

P_b is the price of food *b* in group *a,*

meanQ_a is the average quantity of all food items in group *a* in kg.

Expenditure shares include:

w_i= household's food expenditure shares of ith food group, for i=1,…, 7

w_1=share of cereal

w_2=share of root /tuber

w_3=share of legume

w_4= share of meat

w_5=share of fruits and vegetables

w_6=share of fats and oils

w_7= share of other foods (sweeteners, beverages, non-alcoholic drinks and condiments).

Prices and Quantity of food groups

p_i=price of food group i (₦/ kg), for i=1, ……. 7

p_1=share of cereal and

p_2=share of root /tuber

p_3=share of legume

p_4= share of meat

p_5=share of fruits and vegetables

p_6=share of fats and oils

p_7= share of other foods

m= aggregate expenditure on all food (₦/week)

z_s= socioeconomic and demographic variables, which include:

X_1= age (years),

X_2= sex (male=1; 0= otherwise),

X_3= marital status (married= 1; 0= otherwise),

X_4= occupational status (formal sector =1, 0= otherwise)

X_5= educational status (formal =1; no formal= 0),

X_6= household size (number),

X_7 = household income (Naira)

X_8= urbanicity index (number)

X_9= membership of social group (yes=1; no=0)

ε_i = error term.

The independent variables specified in the model were chosen based on extensive review of the previous literature. The variables, their predicted effect and application in the literature are shown in Table 2.

Table 2: A priori Expectation for Food Demand and Explanatory Variables

Code	Variable	Expected sign	Empirical evidence
X_1	Age	+	Obayelu et al. (2009); Pangaribowo and Tsegai (2011);
		-	Ashagidigbi et al. (2012); Olorunfemi (2013); Babalola and Isitor (2014)
X_2	Sex	+	Obayelu et al. (2009)
		-	Pangaribowo and Tsegai (2011); Rizov et al. (2015)
X_3	Marital status	+	Ashagidigbi et al. (2012) ; Udoh et al. (2013)
		-	Obayelu et al. (2009)
X_4	Occupational status	+	Obayelu et al. (2009) ; Ashagidigbi et al. (2012)
X_5	Educational status	+	Obayelu, et al.(2009); Pangaribowo and Tsegai (2011); Udoh et al. (2013)
X_6	Household size	+	Olorunfemi (2013)
		-	Rizov et al. (2015) ; Van Oordt (2016)
X_7	Household income	+	Obayelu et al. (2009); Udoh et al. (2013); Babalola and Isitor (2014)
X_8	Urbanicity index	+	Mittal (2010); Pangaribowo and Tsegai (2011)
X_9	Membership of social group	+	Ashagidigbi et al. (2012)

3.4.3.2 **Elasticities of demand**

The post-estimation from QUAIDS generated the expenditure and price elasticities at sample means. Expenditure elasticity determines the nature of food groups such as luxury, necessities and inferior, if values are greater than one, less than one and less than zero, respectively (Obayelu et al., 2009). Price elasticity explains own-price and cross-price effects. The own-price effect describes the elastic or inelastic effect of quantity demanded of a commodity, while the magnitude and patterns of cross-price elasticity is explained by the substitution and complementary effect from both Marshallian and Hicksian demand equation (PangaribowoandTsegai, 2011; Van Oordt, 2016).

3.4.4 **Dietary diversity pattern**

Dietary diversity pattern entails the extent of diet diversification as well as their determinants. Berry Index was used to derive the index of diet diversity, which shows the extent to which food consumed by households is diversified. It is the distributional measure of diversity (Drescher and Goddard, 2011; Akerele and Odeniyi, 2015; Cockx, 2017; Ogundari, 2017). It is expressed as:

$$BI = 1 - \sum_{i=1}^{n} s_i^{\,2} \qquad (64)$$

s_i represents the expenditure share of each food group i in the aggregate food expenditure.

The dietary diversity index (DDI) ranges from zero (0) to 1- (1/n), where n is the total number of food groups consumed. If the value assumes 0, it indicates only one food group was consumed while 1- (1/n) means that food groups were consumed at equal share (Kumbarov and Zemke, 2014). The DDI provides a better framework for measuring urban household dietary diversity (Ogundari, 2017) and it is an improvement on count measure, which neglects relative share of food items (Drescher and Goddard, 2011).

In estimating dietary diversity among households, reference period over which diet diversity is measured is important, as consumption of diversified diet tends to reflect various patterns. With respect to this, Moon et al. (2002) observe that weekly and monthly time dimensions appeared to exhibit a similar pattern compared to daily consumption. This study, therefore, used a seven-day reference period, following Magrini and Vigani (2014) and in consonance with the reference period by FAO (2011). Furthermore, food groups were used as it better predicts dietary pattern than food items(Ruel, 2003). The seven (7) food groups reported in Appendix 2 were further broken down into 12 groups, namely; cereals, vegetables, fruits, meat, egg, fish and other seafood, legumes, roots and tubers, milk and milk products, oils and fats, sweetners, and beverages to calculate DDI. This grouping was in line with the recommended FAO standard in calculating dietary diversity at household level (Swindale and Bilinsky, 2006; Smith and Subandoro, 2007; FAO, 2012). Also, food items in each group were in line with the NBS's food composition tables (NBS, 2012).

An increase in the average number of food groups consumed is assumed to supply important micronutrients (Swindale and Bilinsky, 2006). Also, Magrini and Vigani (2014) assert that the index provides a quantitative measure of diversity in diets of household. Households can, therefore be distributed into groups of interest, such as wealth or dietary diversity category. Following the FAO grouping, households that consumed food groups below four, between five and nine and above 10 were classified as low-, medium- and high-dietary diversity, respectively (Swindale and Bilinsky, 2006).

3.4.4.1 **Quantile regression**

In order to examine the factors influencing urban households dietary pattern, quantile regression analysis was employed. Drescher and Goddard (2011) and Das (2014) observe that, since diversity is sensitive to smaller changes, the ordinary least square (OLS) might not be adequate for estimating parameter estimates. Quantile regression reveals the relationship between the dependent variable *y* (dietary diversity index)and the independent variables at different points of the diversity distribution. The unique characteristic of this method is that there are multiple slopes (β) across quantiles, giving better estimates of dietary diversity (Petscher and Logan, 2014). Quantile regression was performed at 0.1, 0.5 and 0.9 quantiles using STATA's QREG command. The dietary diversity index is the dependent variable that is explained by a set of socioeconomic variables. It is expressed as follows:

$$Q\tau(D_i) = \alpha\tau + \beta\tau X_i + \ell_i \qquad (65)$$

where$D_i$represents the dietary diversity index, $\alpha\tau$ describes the constant coefficient at quantile, $\beta\tau X_i$is coefficient vector at predetermined quantiles of the distribution. $X_i$are control variables included in the regression, which are:

X_1= age (years),

X_2= sex (male=1; 0= otherwise),

X_3= marital status (married= 1; 0= otherwise),

X_4= dependents (ratio)

X_5= educational status (formal =1; no formal= 0),

X_6= household size (number),

X_7= urbanicity index (number)

X_8= membership of social association (yes=1; no=0)

X_9= household asset index (number)

X_{10}=employment status (yes=1; no=0)

X_{11}= household income

ℓ_i = error term.

Based on extensive review of the previous literature, the explanatory variables, their predicted effect and application in the literature are shown in Table 3.

Table 3: A priori Expectation for Dietary Diversity and Explanatory Variables

Code	Variable	Expected sign	Empirical evidence
X_1	Age	+	Das (2014); Akerele and Odeniyi (2015)
		-	Ogundari (2013)
X_2	Sex	+	Akerele and Odeniyi (2015)
		-	Das (2014)
X_3	Marital status	+	Das (2014)
X_4	Dependency ratio	+	Das (2014)
X_5	Educational status	+	Rashid et al. (2011); Ecker et al.(2013); Das (2014); Akerele and Odeniyi (2015).
X_6	Household size	+	Das (2014); Rizov et al. (2015); Ogundari (2017);
		-	Moon et al. (2002); Akerele and Odeniyi (2015)
X_7	Urbanicity index	+	Zhou and Awokuse (2014)
X_8	Social capital	-	Das (2014)
X_9	Household asset	+	Qineti et al. (2017)
X_{10}	Employment status	+	Langat et al. (2012); Das (2014)
X_{11}	Income	+	Langat et al. (2012); Ogundari (2013); Woldehanna and Behrman (2013); Das (2014); Rizov etal. (2014); Akerele and Odeniyi, (2015)

3.4.5 **Multinomial logistic regression**

3.4.5.1 **Harmonization of food security indicators**

Given the multidimensional nature of food security, there is the need for a more encompassing measurement that comprises all aspects of food security, as emphasised by Coates and Maxwell (2012).However, a single measure of food security might not incorporate all the dimensions of food security (Magrini and Vigani, 2014). Variouscomponents must be taken into consideration. The essence of the combined indicator is to give better understanding for comparison of the characteristics of each food security group across households.

This study extends the work of Smith and Sunbadoro (2007) and Ogundari (2017) by combining two indicators that represent food access and food utilization to generate urban household food security status. This study consequently used two-thirds of the mean monthly per capita food expenditure to construct the food security line among urban households (representing food access) and dietary diversity index derived from household expenditure from the twelve (12) food groups (representing food utilization) stated earlier. Households with per capita food expenditure (FEXP) greater (or less) than weighted two-thirds of mean of per capita expenditure was referred to as food-secure (or food-insecure), while households above the mean DDI was referred to as food-secure and below the mean DDI as food-insecure.

Factors that determine household's food security status were estimated using a multinomial logit model (MNL). This method is well suited when the dependent variables are more than two categories and in estimating used the likelihood of occurrence based on multiple independent variables (Rose and Chariton, 2002). Implicitly, the model can be expressed as:

$$(y) = \ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 x_1 + \ldots + \beta_k x_k \tag{66}$$

$$= \frac{\ell^{\alpha+\beta_1 x_1+\ldots+\beta_1 x_2}}{1+\ell^{\alpha+\beta_1 x_1+\ldots+\beta_1 x_2}} = \frac{1}{\ell^{-(\alpha+\beta_1 x_1+\ldots+\beta_1 x_2)}} \tag{67}$$

The MNL performs better in discrete choice models and is computationally simple since it does not assume normality, linearity, or homoscedasticity (Starkweather and Moske, 2011). It is preferred to the ordered models in this study because the food security categories were mutually exclusive and not ordered. Following Greene (2008), the probability that any urban household belong to the k_{th} four food security status is P_{ij}. This probability (P_{ij}) is represented by the identified thresholds discussed above, where households were grouped into four mutually exclusive food security levels. These were (i) completely food-insecure status based on both DDI and FEXP; (ii) partially food-insecure by DDI but food-secure based on FEXP; (iii) partially food-secure by DDI but food-insecure based on FEXP; and (iv) completely food-secure status based on both DDI and FEXP. The probability of the urban household being in the other three categories (k = 2 or 3 or 4) relative to completely food insecure households (based on DDI and FEXP) can be estimated as:

$$P_{ij} = \frac{\exp(\beta_k X_i)}{1 + \sum_{k=1}^{4} \exp(\beta)} \text{ for k=,2,3,4} \qquad (68)$$

The four-food security categorisation, therefore represents the dependent variable (P_{ij}). Vector of socioeconomic characteristics of the i_{th} is denoted by x_i. β_k represents parameter estimates associated with alternative *k*, the food security status categories. $X_i$is the socioeconomic characteristics considered included sex, age, household size, marital and educational status, engagement in employment activities, household income, membership of social group, occupational status and urbanicity index. Detailed description of the socioeconomic characteristics used are presented in Table 4.

By differentiating the probability of any category with respect to the covariate variables, the marginal effects of the household characteristics on these probabilities can be estimated as:

$$\frac{\partial P_k}{\partial X_i} = P_k\left[\beta_k - \sum_{k=1}^{4} P_k \beta_k\right] = P_k\left[\beta_k - \overline{\beta}\right] \qquad (69)$$

These represents the probability of the household being in any of the four categories (Greene 2008). Since the parameter estimates were relative to the reference group, the estimated interpretation of the MNL would be that, for a unit change in the predictor variable, the logit of outcome *n* relative to the reference group was expected to change by its respective parameter estimate given that the variables in the model are held constant.

3.5 **Limitations of the study**

Resource constraint in terms of fund, time frame and unavailability of some required data on urban indicators were major limitations to this study. Also, some respondents were sceptical in giving information on necessary questions in the survey; gaining access to some households was difficult due to security reasons. Also, some respondents could not recall their food and non-food expenditures and unit of measurement used to quantify food consumed within the reference period. Regardless of these limitations, this study gives a sense of direction about what is happening within urban household food consumption patterns.

Table 4: Household SocioeconomicCharacteristics Definition, Measures and A priori Expectations for Food Security

Explanatory variables	Variable meaning	Type of measure	Expected sign	Literatures
Sex	Household is male headed or otherwise (female headed)	Dummy (male=1, otherwise=0)	+	Omonona and Agoi (2007)
Age	Age of household head in years	Discrete , number of years	+ -	Iorlamen et al. (2014); Ogundari (2017) Omonona and Agoi (2007)
Marital status	Household head is married or otherwise (single, divorced and widowed)	Dummy (married=1, otherwise=0)	+	Codjoe et al. (2016)
Household size	Number of persons in the household	Discrete, measured by number	-	Iorlamen et al. (2014); Akinboade et al. (2016); Ogundari (2017)
Membership in social organization	Household head being in a social group (professional, cooperative societies, religious, non-governmental organization) or not	Dummy (member=1, otherwise=0)	+	Omonona and Agoi (2007)
Educational status	Household head level of education being formal (primary, secondary and tertiary) or otherwise (non-formal)	Dummy (formal=1, otherwise=0)	+	Akinboade et al.(2016)
Engaged in employment activities	Household head engagement in one form of income generating activities or not	Dummy (engaged=1, otherwise=0)	+	Qineti et al.(2017)
Average monthly income	Income earned by household head monthly	Continuous, measured in Naira	+	Iorlamen et al. (2014); Ogundari (2017)
Occupational status	Occupational type of household head is in formal sector (government worker, private organizations) or otherwise (traders, farmers, artisans)	Dummy (formal sector=1, otherwise=0)	+	Qineti et al.(2017)
Urbanicity index	Measure extent of urbanisation	Continuous, an index	+	Codjoe et al.,(2016); Ogundari (2017)

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results of the analysis and discussion on them. It is divided into four subsections. These are: characterization and distribution of households by socioeconomics and extent of urbanisation; estimation of food demand among household; extent of dietary diversity among household and its determinants, and food security status among urban households.

4.1 Characterization and distribution of urban household by socioeconomics and extent of urbanisation

This section centres on categorization of urban households by extent of urbanisation using urbanicity index and distribution of household socioeconomic characteristics by extent of urbanisation.

4.1.1 Categorization of household by extent of urbanisation

Inorder to categorize the households based on extent of urbanisation, principal component analysis (PCA) was used. The results of computed urbanicity index across low and high urban population density areas are presented in Table 5. The results revealed that the average urbanicity index was 0.46. Furthermore, while comparing index across urban areas, it was observed that there was difference between low and high urban population density areas, which was significant at mean (5% level). This suggests variation in terms of level of use of urban functional characteristics in the study areas and was consistent with studies that observed locational differences within urban areas (Jie, et al., 2013; Gupta, 2013; Mehaina, et al., 2016). This could be as a result of population density, economic and administrative activities, heterogeneity in socioeconomic level of these urban areas.

To test the robustness for PCA, Kaiser-Meyer-Olkin (KMO) was conducted and a value of 0.8475 was obtained significant at 1%, indicating that the variables used were adequate in explaining urbanicity index. Furthermore, the Bartlett's test of sphericity chi square value of 17851.47 revealed that the correlation matrix was uncorrelated and significant at 1%. TheFactor Analysis Explained Variance (FAEV) value (0.7084) implied that the selected indicators

Table 5: Mean and Percentage Distribution ofHouseholds by Extent of Urbanisation across Urban Areas

Category by quantile	Low urban population density area N=163	High urban population density area N= 282	All	Range (%)
Low urban category (%)	42.04	30.96	34.93	0 - 34.9
Middle urbancategory(%)	38.22	41.99	40.64	35.0 - 64.9
High urban category (%)	19.74	27.05	24.43	65.0 - 100.0
Mean urbanicity index	0.44	0.48	0.46	
	(0.16)	(0.17)	(0.16)	
t test for mean		2.47**		
KMO	0.8475***			
Barlett test	17851.47***			
FAEV	0.7084			
Cronbach alpha	0.8318			

Figures in parentheses are standard deviation. Statistical significance level: ***1% **5%

describe almost 71% of the urbanicity level in the study area. Also, the Cronbach alpha value of 0.8318 obtained showed that the variables used in the construction of the index was reliable.

The results obtained from test of robustness revealed that the constructed index was valid and reliable. This agrees with studies that maintained index validity (Van de Poel et al., 2008; Mehaina et al. 2016; Szabo, 2016).

Based on the urbanicity index obtained, households were distributed into terciles of low, medium and high urban areas, as presented in Table 5, using composite score (OECD, 2008; Mehaina et al., 2016). This grouping was similar to the work of Liaoet al. (2016), who categorised urban areas into low, medium and high urban groups using principal components in China. This was necessary in order to understand changing patterns of urbanisation in each urban area. Using this categorization, it was observed, that, on aggregate, more population were within the middle urban category (40.6%) with lesser population in high urban category (24.4%). A better picture can be observed from the percentage distribution in Figure 5. It was observed that the low urban population density area had more population in the low urban category, while the high urban population density area had more population in the middle category. The result showed that variation existed within urban settings. It isevident from the results that categorizing households within urban settings could help to delineate food consumption patterns by being location-specific. They also show future food security hotspots.

4.1.2 **Distribution of household characteristics by urbanicity index categorization**

Family head is an important role in decision-making and also facilitates provision of food, which could influence household consumption pattern. Table 6 presents the socioeconomic characteristics of the households by urbanicity categories as well as their respective test of difference. The characteristics considered for description included sex, age, marital status, educational status, occupational status, employment status, membership of social group, income of household head and household size.

In Table 6, it could be observed across urban categories that the households had more male-headed than female-headed, the percentage was higher in high urban category. Age difference within a family structure could influence the nature of household food consumption patterns.

The mean age was similar across categories, about 47- 48 years. More population were in the 41-50 range and lesser population in 30 and less.

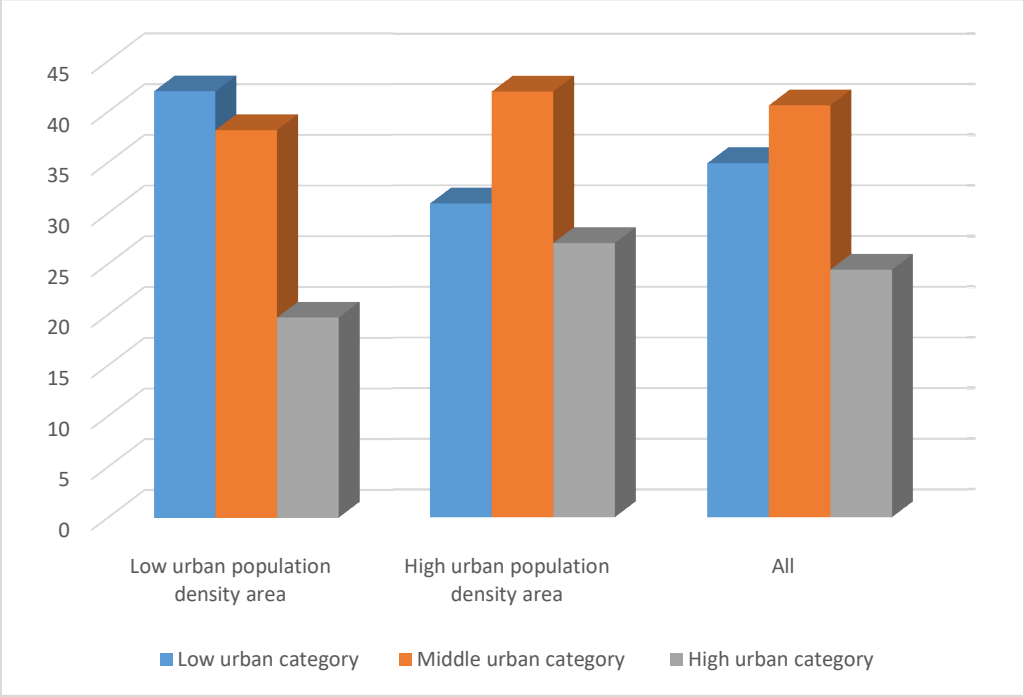

Figure 5: Percentage Distribution of Households by Urbanicity Index

Table 6: Socioeconomic Distribution of Household Heads by Urban Category

Variables	Low urban category	Medium urban category	High urban category	Difference test
Sex				
Male	65.36	67.42	74.77	
Female	34.64	32.58	25.23	2.72
Age in years				
≤ 30	1.96	3.93	6.54	
31 – 40	21.57	26.97	24.30	
41 -50	37.25	29.78	38.32	
50 –60	32.68	25.84	14.95	
>60	6.54	13.48	15.89	1.06
Mean age	48 (9.11)	47 (11.37)	47 (11.98)	1.90
Marital status				
Married	75.16	76.40	72.90	
Single	10.46	16.29	17.76	
Divorced	6.54	1.12	1.87	
Widowed	7.84	6.18	7.48	0.44
Household size in number				
≤4	42.48	46.07	57.94	
5– 7	53.59	51.12	39.25	
>8	3.92	2.81	2.80	6.12**
Mean household size	5 (1.45)	5 (1.56)	4 (1.63)	11.99***
Educational status				
No formal	0.65	1.69	0.00	
Primary education	2.61	1.12	0.93	
Secondary education	20.92	16.29	20.56	
Tertiary education	75.82	80.90	78.50	1.26
Occupational status				
Government jobs	46.55	34.35	32.24	
Private organization	20.69	30.35	36.92	
Trader/Artisan	20.69	18.63	15.42	
Agricultural-based	4.31	6.86	5.14	
Others	7.76	9.80	10.28	3.58
Engaged in employment activities				
Yes	92.16	89.89	83.18	
No	7.84	10.11	16.82	5.41
Membership of social group				
Yes	77.12	74.72	82.24	
No	34.81	39.23	25.96	2.16
Average monthly income in naira				
<40,000	41.12	29.21	25.49	
40001 – 60,000	37.38	43.26	39.22	
60,001- 80,000	14.95	21.91	24.84	
>80,000	6.54	5.62	10.46	9.09**
Mean average monthly income	47711.31 (17,212.65)	50,076 (17,147.84)	54,730 (18,445.45)	12.39***

Source:Field survey, 2016; Figures in parentheses are standard deviation. Statistical significance level: ***1%, **5%

This indicates that most urban household heads were still in their active and productive years, which suggests that more food is needed for physical and mental activities (Dudek, 2011).

Marital status often influences food consumption practices because of varieties of food demanded by different members of the household. Over 70% of the household heads across the urban categories were married, while the least were widowed. Household composition is an important variable in food consumption, as it often determines total food expenditure and extent of diverse diets which subsequently influences household food security. The mean household size for low and middle urban categories was 5 persons, while that of high urban category was 4 persons. Households of 5-7 were more in low and medium urban areas, while households with 4 or less were more in the high urban category (58%). This finding was similar to the work of Bopape and Myers (2007), who found similar family size in urban areas.

Education as an important socioeconomic factor often influences households' awareness, perception and consumption of food. A greater percentage (76-81%) of the household heads were better educated beyond primary and secondary level and a little percentage of them were with no formal education. This indicates that the household heads were literate and could process dietary information, as observed by Ogundari (2017).

Furthermore, social groups could serve as a channel through which information on nutrition and issues relating to food consumption practices could be disseminated to members, which could influence the pattern of food demand and dietary diversity. It was observed across the urban categories that about three quarters of the household heads associated towards social capital. The level of employment of the household head reveals the financial position which may have effect on level of food demanded and also determine food security status. Across the urban categories, more than 80% of the household heads engaged in one income-earning activity or the other. Likewise, type of occupation determines the level of income earned and indicates a steady flow of income, which might facilitate food consumption purposes. A greater percentage of the population were in formal-sector occupation across all categories, but high urban areas had more population in private organizations (37.1%).

Household income affects the type and quantity of foods consumed in most food-consumption practices. Significant difference was observed across the urban categories in the household head's average monthly income. A greater proportion of the household heads were in the average monthly income ₦60,000 downwards and this cut across all the urban categories. This study used the three urban categories; namely low urban, medium urban and high urban categories, as basis for analysis and discussion of results.

In summary, this section revealed information on urban household socioeconomic characteristics by extent of urbanisation. This is essential in understanding the pattern of household food demand and dietary diversity across urban categories in the context of rapid urbanisation(Codjoe et al., 2016). Categorization of households by urbanicity index revealed that household head income, and household size significantly differ across urban categories. This differential could affect their food consumption pattern.

4.2 **Estimation analysis of household food demand**

Tables 7 to 18 present results of household's responsiveness to food demand obtained from QUAIDS. This include the household food budget share estimates, the demand elasticities and their determinants across the classified urban categories.

4.2.1 **Budget share estimates of food consumed by households**

Table 7 captures the result of household budget share by food groups and their test of difference across urban categories. From the pooled results, roots and tubers had the highest (29.4%) budget share of food expenditure, while legume had the least share of about 3.3%. A similar pattern was also observed across the urban categories, which showed that the households expended more on roots and tubers, attracting almost a quarter of the total food expenditure. There were significant differences in budget share estimates across each area regarding to expenditure on food groups, with the exception of legumes and fat and oils. Across the urban categories, households in high urban categories expended more money on meat and its products and increased from low to high urban category as supported by Adetunji and Rauf (2012). The findings from budget share estimates was supported by Pangaribowo and Tsegai, (2011) and Cheng and Larochelle, (2016), who found that budget shares significantly differ between urban areas which could be as a result of differences in food preferences and food availability.

Table 7: Budget Share Estimates of Food Consumed by Household

Food group	Low urban category	Middle urban category	High urban category	Difference test	Total
Cereal	0.2267	0.2194	0.2423	14.26***	0.2268
	(0.1301)	(0.1094)	(0.1601)		(0.1433)
Roots and tuber	0.3396	0.2612	0.2824	14.67***	0.2937
	(0.1637)	(0.1287)	(0.1762)		(0.1649)
Legume	0.0368	0.0298	0.0346	2.24	0.0326
	(0.0334)	(0.0168)	(0.0473)		(0.0292)
Meat and its product	0.1357	0.1943	0.1980	29.01***	0.1757
	(0.1088)	(0.1249)	(0.1282)		(0.1245)
Fats and oil	0.0324	0.0327	0.0389	2.12	0.0356
	(0.0321)	(0.0319)	(0.0315)		(0.0325)
Fruits/vegetables	0.1733	0.2150	0.1241	19.5***	0.1728
	(0.1244)	(0.1349)	(0.1486)		(0.1408)
Other foods	0.0455	0.0474	0.0804	15.39**	0.0577
	(0.0492)	(0.0598)	(0.0661)		(0.0605)

Source: Output from QUAIDS analysis.

Figures in parentheses are standard deviation. Statistical significance level: ***1%, **5%.

Other foods include sugar, non-alcoholic drinks, spice, beverages, can foods, snacks etc

4.2.2 **Elasticities estimates of households' food demand**

This subsection explains the expenditure and price effect estimates of urban household food demand by urban categories. It includes estimates of quadratic term for expenditure across urban categories and household expenditure and price elasticities estimates.To show the acceptability of QUAIDS model, Wald test was used to test its significance. The result presented in Table 8 indicated that the quadratic term in the demand equation was jointly and significantly different from zero, suggesting that QUAIDS was more reliable than the linear AIDS model. Furthermore, the quadratic estimates for most of the food groups were significant, which confirmed the nonlinearity in food demand with respect to total food expenditure, as equally observed by Olorunfemi, (2013).

4.2.2.1 **Estimates of household expenditure elasticities**

The expenditure elasticity of demand, a proxy for the income elasticity, provides more consistent information, especially in household surveys. The signs of expenditure elasticities show the type of commodities, while the absolute value shows magnitude of elasticities (Van Oordt, 2016).

The results of urban household expenditure elasticities for aggregate and across the three urban categories are presented in Table 9. Expenditure estimates for all food groups were positive, indicating normal goods, as equally observed by Olorunfemi, (2013) and Rivoz et al. (2015). However, notable differences existed in magnitude across the three urban categories. Estimates for the aggregate result showed that the cereal group, being a luxury good had its expenditure elasticity coefficient above one (2.48), indicating that a 10% increase in household income leads to an increase of 24.8% in the demand for cereal. Across urban categories, some notable differences were observed, as expenditure elasticities for cereal in high urban group (1.17) was smaller in magnitude than other categories. This is also similar to the findings of Akerele et al.(2013) and Guo (2016), who noted that cereals are luxury goods among households in the low and middle urban category. This suggests that an average household in these urban categorises will increase consumption of cereals if household income improves. This finding was in contrast with Rizov et al. (2015), who found cereals to be necessity among households inSlovakia.

Table 8: Parameter Estimates of Expenditure and its Quadratic term by Urban Categories

	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other foods
			All				
Expenditure	0.1222***	-0.2743***	0.0112*	0.0555***	0.0207***	0.0619***	0.0027
	(0.0082)	(0.0087)	(0.0062)	(0.0207)	(0.0619)	(0.0113)	(0.0078)
Expenditure squared	0.0107***	-0.0089***	0.0005***	-0.0005**	-0.0001	-0.0008***	-0.0010***
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
High urban category							
Expenditure	0.1562***	-0.2850***	0.0274***	0.0489***	0.0127***	0.0462***	-0.0063
	(0.0062)	(0.0034)	(0.0074)	(0.0057)	(0.0041)	(0.0054)	(0.0039)
Expenditure squared	0.0236***	-0.0195***	0.0016***	-0.0006	-0.0002	-0.0024***	0.0024***
	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0005)	(0.0006)	(0.0003)
Middle urban category							
Expenditure	0.0761***	-0.2875***	0.0214***	0.1174***	-0.0024	0.0458***	0.0289***
	(0.0087)	(0.0051)	(0.0053)	(0.0077)	(0.0053)	(0.089)	(0.0054)
Expenditure squared	0.0004	-0.0167***	0.0003	0.0185***	-0.0013***	-0.0043***	0.0031***
	(0.009)	(0.0007)	(0.0004)	(0.0005)	(0.0005)	(0.0009)	(0.0005)
Low urban category							
Expenditure	0.1586***	-0.2818***	0.0369***	0.0456***	0.0174***	0.0330***	-0.0097
	(0.0114)	(0.0057)	(0.0077)	(0.0086)	(0.0066)	(0.0078)	(0.0073)
Expenditure squared	0.0234***	-0.0200***	0.0021***	0.0005	-0.0006	-0.0027***	-0.0026***
	(0.0009)	(0.0011)	(0.0008)	(0.0009)	(0.0008)	(0.0009)	(0.0007)
Wald test	chi2 (6) = 2634.85***						

Source: Output from QUAIDS analysis. Figures in parentheses are standard error. Statistical significance: * 1%, ** 5%, * 10%. Note: Other foods include sugar, non-alcoholic drinks, beverages, can foods, condiments.**

Table 9: Parameter Estimates of Household Expenditure Elasticities

	Expenditure elasticity			
Food groups	**Low urban category**	**Middle urban category**	**High urban category**	**Total**
Cereal	2.64	2.76	1.17	2.48
Root and tuber	0.45	0.66	0.31	0.51
Legume	1.69	1.95	1.93	2.24
Meat	1.16	1.41	2.42	1.27
Fat and oil	1.51	1.04	1.06	1.31
Fruit and vegetable	1.42	1.14	1.34	1.14
Other foods	0.45	1.11	1.18	0.45

Source: Output from QUAIDS analysis.

Expenditure elasticities estimate for roots and tubers for the pooled analysis and across the urban categories were found to be less than unity, thus indicating necessity and implying that their demand increases less proportionately as income increases, as obtained by Obayelu et al.(2009). However, the magnitude was high in both medium and low urban categories, suggesting them to be a basic food commodity among urban households. With respect to legumes, the pooled result estimate showed them to be a luxury food commodity because their value (2.24) was greater than unity, implying that a 10% increase in household income would lead to an increase of 22.0% in aggregate demand for legumes.A similar trend was observed across the urban categories for this food group with respect to their magnitude, indicating that almost all households had a higher rate of legume consumption. This suggests that they are a cheap source of protein, as observed by Obayelu et al. (2009) and Olorunfemi (2013).

Expenditure estimates for meat and its products for the pooled analysis and across urban categories showed them to be luxury whose demand increases more proportionately as household income increases, as similarly reported by Guo, (2016) and Van Oordt (2016). This finding suggests that meat and its products are becoming relevant in food intake of urban households as evident in their budget share. With respect to pooled results and across urban categories, expenditure elasticity estimates for fat and oil group were found to be greater than unity; thus they are luxury, implying that demand for this food group increases as income improves. This was equally obtained by Pangaribowo and Tsegai (2011) and Guo, (2016). However, this is contrary to Obayelu et al. (2009), who claim that fat and oil are necessity commodity. However, their magnitude was higher in low urban area relative to other urban categories.

Furthermore, expenditure elasticities estimate for fruits and vegetables for the pooled analysis and across categories was above unity; thus they are luxury with magnitude not too different in each urban area. This could be as a result of the health benefits attached to their consumption as a source of micronutrients. Expenditure elasticity estimate for the pooled results for other food groups was below unity, indicating necessity and implying that their demand increases less than proportionately as income increases. Comparing across urban categories, the food group was a necessity at low urban category and luxury at both medium and high urban categories, indicating the flexibility characteristics of QUAIDS, which allowsa good to change from necessity (0.45) to luxury (1.18) as income changes (Zhou et al., 2014).

As other foods (sugar, processed foods, snacks, beverages and non-alcoholic drinks) are gaining importance in the consumption table across the urban households especially in medium and high

urban areas, the health implications should also be anticipated. Pangaribowo and Tsegai, (2011) and Awosan et al. (2013) found that increased demand and intake of highly processed foods, especially in urban households, could result in non-communicable diseases.

4.2.2.2 **Price elasticities estimates of household by urban categories**

This subsection presents the price elasticities which provide information on how consumers respond to quantity demanded as price and income changes. Tables 10 to 14 present the results of compensated (Hicksian) and uncompensated (Marshallian) price elasticities for both pooled results and across the three urban categories. The pooled results from Table 10 showed that the own-price elasticities for Marshallian and Hicksian diagonal matrix for all food groups, with the exception of cereal in the Hicksian were negative. Therefore, the negativity property of own-price effects was established, which also confirmed an inverse relationship between price and quantity demanded across food groups, as observed by Van Oordt (2016). In absolute terms, own-price values were inelastic for all food groups except roots and tubers, which were elastic in Hicksian matrix. This finding indicates that a proportionate increase in the prices of all the food groups would result in less than one percent decrease in the demand of all food groups with the exception of roots and tubers whose quantity demanded tends to decrease by more than one percent. This finding corroborates those of Erhabor and Ojogho (2011), Olorunfemi (2013) andRono et al. (2016)

However, cross-price elasticity estimates for pooled analysis revealed that the uncompensated effect on most food groups were complements due to the negative sign of the coefficients. It was observed that legumes had the strongest complementary effect with cereals (-0.43), implying a 10 percent rise in price of legumes reduces the demand for cereals by about 42.7% in household consumption. With respect to compensated cross price elasticities, it was found that cereals and roots and tuber group showed substitution response to the price of legumes by 0.07 and 0.57, respectively. This implies that an increase in price of legume by 10 percent corresponds to an increase in the consumption of cereals by 0.7% and roots and tubers by 5.7%. Price elasticity effects on aggregate level revealed that cross-price elasticity values in absolute

Table 10: Price Elasticity Estimates of Household (All)

Food group	Marshallian/Uncompensated						
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	-0.2992						
Roots and tuber	-0.1113	-0.8787					
Legumes	-0.4270	-0.0742	-0.1094				
Meat and its products	-0.2203	-0.3327	-0.0354	-0.4654			
Fat and oil	-0.2663	-0.3861	0.0158	-0.1324	-0.4536		
Fruits and vegetable	-0.2752	-0.4572	-0.0099	-0.0569	0.0029	-0.3304	
Other food	-0.2482	-0.7746	0.0904	0.2926	0.0969	0.3624	-0.2975
Hicksian/Compensated							
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	0.2628						
Roots and tuber	-0.2190	-1.0181					
Legumes	0.0722	0.5724	-0.0377				
Meat and its products	0.0672	0.0398	0.0060	-0.2553			
Fat and oil	0.0293	-0.0033	0.0583	0.0835	-0.4071		
Fruits and vegetable	-0.0164	-0.1219	0.0272	0.1323	0.0436	-0.1046	
Other food	-0.1377	-0.6315	0.1063	0.3733	0.1143	0.4589	-0.2742

Source: Output from QUAIDS analysis

terms had lesser value than own-price elasticity, suggesting that the urban households were more responsive to own-price effects relative to price of other products.

Across urban categories, Table 11 presents results of price elasticities for households in high urban category, which showed that own-price elasticities for both uncompensated and compensated elasticities for all food groups, with the exception of cereals, in the Hicksian matrix were negative as expected in economic theory (Van Oordt, 2016). However, it was observed that absolute value of own-price estimates for uncompensated and compensated elasticities for all food groups was inelastic, implying that a percent increase in the prices of the all food groups would lead to less than one percent decrease in their demand.

Furthermore, the cross-price effects indicate substitution and complementary association for all food groups. With respect to uncompensated cross price effects, legumes complemented cereals and roots and tubers groups, indicating that a 10% change in the prices of legumes decreases demand for cereals and roots and tubers by 2.9% and 7.3%, respectively. However, compensated cross-price elasticity revealed substitution effect between cereals and fat and oil, implying that household consumption of cereals increases by 2.1% for a 10% change in the price of fat and oil.

The middle urban category results from Table 12 showed that the own-price elasticities for uncompensated and compensated for all food groups, except for cereals in compensated effect, were negative, confirming an inverse relationship between demand and price of food groups (Van Oordt, 2016). The value of the elasticities in compensated and uncompensated matrixes for all food groups was relatively inelastic, with the exception of roots and tubers. This implies that households would respond less than proportionately to changes in the prices of all foods with the exception of roots and tubers. From uncompensated cross price estimates, it was found that cereals and legumes groups were complements (-0.40), while roots and tubers complemented other food groups (-0.74). This indicates that a 10% change in the price of legumes decreases demand for cereals by 4% and change in prices of other food group decreases demand for roots and tubers by 7.4%.

Table 11: Price Elasticity Estimates of Households for High Urban Category

Food group	**Marshallian/Uncompensated**						
Price change	**Change in quantity**						
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	-0.2800						
Roots and tuber	-0.1089	-0.8348					
Legumes	-0.2913	-0.7342	-0.0814				
Meat and its products	-0.2793	-0.4687	-0.0131	-0.3221			
Fat and oil	-0.0477	0.0339	-0.0298	-0.3091	-0.6301		
Fruits and vegetable	-0.2413	-0.3371	-0.0317	-0.1699	-0.0192	-0.4741	
Other food	-0.2362	-0.6069	0.0416	0.2439	0.0010	0.2176	-0.2815
Hicksians/Compensated							
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	0.2709						
Roots and tuber	-0.2038	-0.9730					
Legumes	-0.0557	-0.3918	-0.0442				
Meat and its products	-0.0153	-0.0851	0.0252	-0.0975			
Fat and oil	0.2140	0.4142	0.0081	-0.0865	-0.5850		
Fruits and vegetable	0.0331	0.0617	0.0081	0.0635	0.0281	-0.2177	
Other food	0.1048	0.4159	0.0606	0.3557	0.0237	0.3405	-0.2545

Source: Output from QUAIDS analysis

Table 12: Price Elasticity Estimates of Households in Middle Urban Category

Food group	**Marshallian/Uncompensated**						
Price change	**Change in quantity**						
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	-0.2610						
Roots and tuber	-0.1249	-1.0507					
Legumes	-0.3952	0.1385	-0.2153				
Meat and its products	-0.1776	-0.3188	-0.0174	-0.4974			
Fat and oil	-0.3433	-0.1795	-0.0575	-0.4663	-0.3680		
Fruits and vegetable	-0.2916	-0.3909	-0.0288	-0.1503	-0.0129	-0.4024	
Other food	-0.2402	-0.7427	0.0727	0.2142	0.1025	0.3217	-0.3666
Hicksians/Compensated							
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	0.2873						
Roots and tuber	-0.2704	-1.2411					
Legumes	0.1391	0.8376	-0.1439				
Meat and its products	0.0827	0.0218	0.0174	-0.2819			
Fat and oil	0.0497	0.3347	-0.0049	-0.1409	-0.3034		
Fruits and vegetable	-0.0059	-0.0171	0.0094	0.0862	0.0341	-0.1454	
Other food	-0.0988	-0.5578	0.0916	0.3312	0.1257	0.4488	-0.3331

Source: Output from QUAIDS analysis

With respect to compensated cross-price estimates, substitution effect was observed in cereals group (0.14) in response to the price of legumes. This indicates that quantity demanded for cereals increases by 1.4% for a 10% price change in legumes. Also, increased consumption of roots and tubers by 8.4% in response to price change in legumes reveals substitution effects in the compensated cross price matrix. This further confirmed that roots and tubers groups arenecessity for households in the middle urban category and legumes, a luxury commodity whose quantity demanded increases as income increases.

The price elasticities result for the low urban category in Table 13 showed that own-price elasticities for uncompensated and compensated for all food groups, with the exception of legumes in both effects, and roots and tubers in Hicksian matrix, were negative. This satisfied the negativity property of own-price effects and confirmed an inverse relationship between price and quantity demanded across food groups, as observed by Van Oordt, (2016). It was observed that most food groups estimated values were less than unity, thus inelastic demand, except meat, which was elastic both in compensated and uncompensated. This impliesthat households respond more than proportionately to changes in the prices of meat food group but less proportionately in other food groups.

With respect to cross-price elasticity, the roots and tubers group showed complementary relationship with cereal groups, implying a 10% change in the price of roots and tubers decreases quantity demanded for cereals by 10.4%. However, compensated cross-price elasticity matrix showed substitution effect in quantity demand of cereals in response to the price of meat (0.94), indicating that increase in quantity demanded for cereals by 9.4% for a 10% price change for meat and its products.

Own-price elasticity estimates in Table 14 showed that across urban categories, almost all the food groups had the expected sign, suggesting that the households were responsive to changes in prices. The uncompensated and compensated own price elasticity indicated that all food groups were price inelastic,with the exception of meat and roots and tubersgroups in low urban and in middle urban categories, respectively. This indicates that a percentage increase in the prices of inelastic food groups will lead to less than one percent decrease in the demand of all food groups, with the exception of meat and roots and tubers, whose quantity demanded decreases by more than one percent increase in price.

Table 13: Price Elasticity Estimates of Households in Low Urban Category

Food group	**Marshallian/Uncompensated**						
Price change	**Change in quantity**						
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	-0.3627						
Roots and tuber	-1.0433	-0.4448					
Legumes	0.0308	-0.4926	0.1588				
Meat and its products	1.3025	0.1540	0.1810	-1.3447			
Fat and oil	-0.0154	-0.3287	0.0782	-0.4558	-0.3520		
Fruits and vegetable	-0.1226	-0.3265	-0.0067	-0.3238	-0.0068	-0.3417	
Other food	-0.1498	-0.2085	-0.0289	-0.1199	0.0073	-0.0587	-0.3024
Hicksians/Compensated							
	Cereal	Root/tuber	Legume	Meat	Fat/oil	Fruits/vegetable	Other food
Cereal	-0.1573						
Roots and tuber	-0.5773	0.1139					
Legumes	0.2402	-0.2416	0.1897				
Meat and its products	0.9356	-0.2859	0.1269	-1.5532			
Fat and oil	0.2453	-0.0161	0.1166	-0.3076	-0.3149		
Fruits and vegetable	0.1638	0.0168	0.0355	-0.1610	0.0339	-0.1037	
Other food	0.0618	0.0451	0.0023	0.0004	0.0373	0.1172	-0.2639

Source: Output from QUAIDS analysis

Table 14: Own-Price Elasticity Estimates of Household across Urban Category

Food groups	Low urban category		Middle urban category		High urban category	
	Uncompensated	Compensated	Uncompensated	Compensated	Uncompensated	Compensated
Cereal	-0.3627	-0.1573	-0.2610	0.2873	-0.2800	0.2709
Root and tuber	-0.4448	0.1139	-1.0507	-1.2411	-0.8348	-0.9730
Legume	0.1588	0.1897	-0.2153	-0.1439	-0.0814	-0.0442
Meat	-1.3447	-1.5532	-0.4974	-0.2819	-0.3221	-0.0975
Fat and oil	-0.3520	-0.3149	-0.3680	-0.3034	-0.6301	-0.5850
Fruits and vegetable	-0.3417	-0.1037	-0.4024	-0.1454	-0.4741	-0.2177
Other foods	-0.3024	-0.2639	-0.3666	-0.3331	-0.2815	-0.2545

Source: Output from QUAIDS analysis

Furthermore, it was observed in low urban category that a fall in prices of food groups by 10% would lead to increase in demand by 3.6%, 4.5%, 1.6%, 13.5%, 3.5%, 3.4%, 3.0% for cereal, root and tuber, legume, meat, fat and oil, fruit and vegetable and other food group, respectively.The total increase in demand was as a result of price effect from compensated own-price elasticity, while the income effect of the fall in price accounts for the remaining effect.It was observed across the three urban categories that compensated own-price elasticity was lower than the uncompensated. This implies that price responsiveness of food groups was dependent on income, thus income-generating policy is essential towards increased demand of foods.

4.2.3 **Determinants of household food demand**

This subsection discusses the influence and relevance of socioeconomic variables and urbanicity index to household food demand. Tables 15 to 18 present the results of estimated coefficients for the determinants of urban household food demand for aggregates and across the three urban categorises. The pooled result from Table 15 revealed that five variables were significant at different levels across food groups. These variables were occupational status, income, membership of a social group of household head, household size and the urbanicity index.

For the cereal group, household head's occupational status, income and membership in a social group had positive influence on the demand for cereals while household size influenced theirdemand negatively. This impliesthat all positive variables will increase the budget share on cereal consumption, as observed by Obayelu et al. (2009) and Ashagidigbi et al. (2012). With respect to roots and tubers, household income and urbanicity index negatively influenced the demand at 1% and 5% levels of significance, respectively; while household size increased its consumption at 1% significant level, as also obtained by Zheng et al. (2015), who found that demand for roots and tubers in urban areas decreased with rise in income and level of urbanisation.

Furthermore, it was observed that household income and urbanicity index positively influenced demand for legumes, which was significant at 1% and 10%, respectively.In the case of the meat group, occupational status of household head and urbanicity index positively influenced the demand for meat at 10% and 5% levels of significance. Membership of a social group by household head had negative effect on demand for fat and oil at 1% significant level. However,

Table 15: Parameter Estimates of the Determinants of Household Food Demand (All)

Variables	Cereals	Roots and tubers	Legumes	Meat	Fat and oil	Fruits/ vegetables	Other foods
Sex (1=male)	-0.0001	-0.0005	-0.0002	0.0008	-0.0003	0.0001	0.0001
	(0.0005)	(0.0004)	(0.0002)	(0.0005)	(0.0003)	(0.0006)	(0.0003)
Age (in years)	-0.0000	-0.0001	-0.0001	0.0003	0.0001	-0.0000	-0.0001
	(0.0001)	(0.0002)	(0.0001)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
Age squared(in years)	0.0041	0.0063	0.0019	-0.0111	-0.0021	-0.0033	0.0044
	(0.0045)	(0.0056)	(0.0036)	(0.0081)	(0.0036)	(0.0073)	(0.0050)
Household size (numbers)	-0.0006***	0.0006***	-0.0001	0.0002	0.0001	0.0008***	0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
Membership of social group	0.0021***	-0.0004	-0.0004	-0.0003	-0.0008***	-0.0007	-0.0002
(1=yes)	(0.0005)	(0.0005)	(0.0003)	(0.0006)	(0.000)	(0.0006)	(0.0004)
Education (1= formal)	0.0004	0.0003	-0.0003	-0.0003	-0.0001	0.0005	0.0005
	(0.0005)	(0.0004)	(0.0002)	(0.0006)	(0.0002)	(0.0006)	(0.0003)
Occupation (1=formal)	0.0012***	0.0004	-0.0002	0.0010*	0.0004	-0.0008	-0.0000
	(0.0005)	(0.0005)	(0.0003)	(0.0006)	(0.0003)	(0.006)	(0.0004)
Dependency ratio	-0.0012	0.0011	0.0001	0.0015	-0.0003	-0.0002	-0.0011
	(0.0010)	(0.008)	(0.0005)	(0.0011)	(0.0005)	(0.0010)	(0.0007)
Household income (Naira)	0.0012***	-0.0012***	0.0013***	-0.0009	-0.0003	-0.0008	0.0018***
	(0.0004)	(0.0005)	(0.0003)	(0.0006)	(0.0003)	(0.0006)	(0.0004)
Urbanicity index (number)	0.0002	-0.0011**	0.0005*	0.0014**	-0.0003	0.0014**	0.0007*
	(0.0005)	(0.0005)	(0.0003)	(0.0007)	(0.0003)	(0.0006)	(0.0004)

Source: Output from QUAIDS analysis. Figures in parentheses are standard error. Statistical significance: * 1%, ** 5%, * 10%. Note: Other foods include sugar, non alcoholic drinks, beverages, processed foods, condiment.**

household demand for fruit and vegetables was positively influenced by household size and urbanicity index at 1% and 5% levels of significance, as equally obtained by Mittal (2010), while demand for other food groups were found to be positively influenced by income and urbanicity index, significant at 1% and 10%, respectively.

Estimates for low urban category from Table 16 showed that demand for cereals was influenced positively by membership of household head in a social group and negatively by household size at 1% and 10% significant levels. This implies that cereal consumption decreases as household size increases. Membership of household head in social group positively influencedthe demand for roots and tubers, while occupational status had a negative effect on their demand, both at 1% significant level. However, income significantly increased the demand for legumes at 1% level of significance, while sex and membership of a social group had negative relationship with its demand at 10% and 5% levels of significance, respectively. This contradicts Obayelu et al. (2009).

Furthermore, household demand for meat was positively influenced by household heads with formal occupation at 5% significant level. With respect to fat and oil, three variables were found to influence its demand and were found to be significant at 5%. These were sex and social group membership of household head, which had negative effect on its demand while occupational status positively influenced its demand. The decrease in the consumption of fat and oil could be as a result of the health implications associated with high consumption of fatty foods, as observed by Awosan et al. (2013). Membership of social group by household head positively influenced demand for fruits and vegetables, while occupational status influenced their demand negatively. Quantity demanded with respect to other food group was positively influenced by household income at 10% level of significance.

The middle urban category estimates, from Table 17, revealed that demand for cereals was positively influenced by the educational status of household heads, while household size and presence of dependants negatively influenced the demand at 10% significant level. This implies that better educational attainment increases the budget share of cereal, while larger household size reduces its consumption.

Table 16: Parameter Estimates for the Determinants of Household Food Demand in Low Urban Category

Variables	Cereals	Roots and tubers	Legumes	Meat	Fat and oil	Fruits/ vegetables	Other foods
Sex (1=male)	-0.0007	0.0006	-0.0008*	0.0004	-0.0009**	0.0007	0.0006
	(0.0008)	(0.0007)	(0.0004)	(0.0008)	(0.0003)	(0.0005)	(0.0006)
Age (in years)	0.0004	0.0002	-0.0005	-0.0003	0.0001	0.0001	-0.0001
	(0.0005)	(0.0004)	(0.0003)	(0.0005)	(0.0002)	(0.0003)	(0.0004)
Age squared(in years)	-0.0115	-0.0021	0.0117	0.0072	-0.0034	-0.0016	-0.0002
	(0.0156)	(0.0117)	(0.0088)	(0.0153)	(0.0061)	(0.0086)	(0.0117)
Household size (numbers)	-0.0006*	0.0004	-0.0001	0.0001	0.0001	0.0002	-0.0002
	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
Membership of social group	0.0039***	0.0033***	-0.0010**	0.0003	-0.0007**	0.0027***	-0.0007
(1=yes)	(0.0009)	(0.0008)	(0.0005)	(0.0008)	(0.0003)	(0.0057))	(0.0006)
Education (1= formal)	-0.0006	0.0009	0.0000	-0.0009	-0.0001	0.0006	0.0000
	(0.0009)	(0.0009)	(0.0005)	(0.0008)	(0.0003)	(0.0005)	(0.0005)
Occupation (1=formal)	0.0014	-0.0028***	-0.0005	0.0022**	0.0008**	-0.0017***	0.0006
	(0.0010)	(0.0009)	(0.0006)	(0.0009)	(0.0004)	(0.0006)	(0.0007)
Dependency ratio	0.0006	-0.0002	-0.0008	0.0001	0.0006	-0.0002	-0.0000
	(0.0017)	(0.0014)	(0.0009)	(0.0015)	(0.0006)	(0.0010)	(0.0011)
Household income (Naira)	0.0010	0.0006	0.0018***	-0.0014	-0.0004	-0.0005	0.0011*
	(0.0009)	(0.0008)	(0.0006)	(0.0008)	(0.0004)	(0.0005)	(0.006)

Source: Output from QUAIDS analysis

Figures in parentheses are standard error. Note: Other foods include sugar, non-alcoholic drinks, beverages, processed foods, condiments

Table 17: Parameter Estimates for the Determinants of Household Food Demand in Middle Urban Category

Variables	Cereals	Roots and tubers	Legumes	Meat	Fat and oil	Fruits/ vegetables	Other foods
Sex (1=male)	-0.0015	0.0002	0.0004**	0.0001	0.0004	-0.0003	-0.0002
	(0.0007)	(0.0006)	(0.0002)	(0.0007)	(0.0003)	(0.0003)	(0.0004)
Age (in years)	-0.0002	-0.0002	0.0000	0.0005*	-0.0002	0.0001	-0.0000
	(0.0002)	(0.0002)	(0.0001)	(0.0003)	(0.0001)	(0.0001)	(0.0002)
Age squared(in years)	0.0084	0.0071	-0.0009	-0.0186*	0.0046	-0.0010	0.0005
	(0.0061)	(0.0077)	(0.0028)	(0.0102)	(0.0043)	(0.0035)	(0.0057)
Household size (numbers)	-0.0004*	-0.0007***	-0.0001	0.0000	-0.0001	0.0002	-0.0004**
	(0.0002)	(0.0004)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Membership of social group (1=yes)	0.0004	-0.0001	0.0001	0.0007	-0.0005	-0.0003	-0.0003
	(0.0006)	(0.0007)	(0.0002)	(0.0007)	(0.0003)	(0.0004)	(0.0004)
Education (1= formal)	0.0008*	-0.0012**	-0.0002	-0.0000	-0.0002	-0.0004	0.0004
	(0.0004)	(0.0005)	(0.0002)	(0.0006)	(0.0003)	(0.0004)	(0.0004)
Occupation (1=formal)	-0.0005	-0.0008	0.0001	0.0007	0.0003	-0.0001	0.0004
	(0.0005)	(0.0006)	(0.0002)	(0.0008)	(0.0003)	(0.0003)	(0.0005)
Number of dependant (ratio)	-0.0014*	0.0030***	0.0000	0.0006	-0.0007	0.0001	-0.0016**
	(0.0008)	(0.0011)	(0.0004)	(0.0014)	(0.0006)	(0.0005)	(0.0008)
Household income (Naira)	0.0004	0.0011	0.0008***	-0.0016*	0.0002	0.0001	-0.0011**
	(0.0006)	(0.0007)	(0.0002)	(0.0009)	(0.0004)	(0.0003)	(0.0005)

Source: Output from QUAIDS analysis

Figures in parentheses are standard error. Note: Other foods include sugar, non-alcoholic drinks, beverages, processed foods, condiments

With respect to the demand for roots and tubers, presence of dependants had a positive influence on consumption at 1% level of significance, while household size and level of education attained by head of households was found to reduce its demand, as observed by Codjoe et al.(2016).Furthermore, demand for legumes was positively influenced by sex and income of household head at 5% and 1% significant levels, respectively.

Age of household head positively influenced demand for meat,and age squared and household income negatively influenced its demand both at 10% level of significance. This confirmed the lifecycle hypothesis which implies that, as age increases, demand for meat will increase, but as household heads get older demand for meat would rise at a declining rate. This results in inverse relationship between consumption of meat and age of household head. Contrary to expectation, income negatively influenced demand for meat at 10% significant level. For other food groups, household size, income and dependants had a negative influence on their demand at 5% significance level, implying that a decline in the quantity demanded with respect to other food groups as household size, income of household head increases.

Estimates for high urban category, in Table 18, showed that age of household head positively influenced demand for cereals, while age squared negatively influenced the demand at 10% and 5% levels of significance, respectively.This implies that demand for cereals, would increase at a lessening rate as household head gets older. Other variables that influenced cereal consumption included membership of a social group and income of household head, significant at 1%, and presence of dependants, at 5% significant level.

With respect to the meat group, membership in social group and income of household head, both significant at 1% level influenced quantity of meat demanded among households; while larger household size decreased its demand at 5% level of significance. It was found that the positive effect household size had on demand for fat and oil was significant at 5% level. Sex of household head increased significantly demands for fruits and vegetables, while membership of social group and income of household head negatively influenced demand for fruits and vegetables at 1% level of significance; as observed by Zheng et al. (2015). Moreover, it was observed that membership in a social group reduced quantity demanded of other food groups at 5% level of significance.

Table 18: Parameter Estimates for the Determinants of Household Food Demand in High Urban Category

Variables	Cereal	Root and tuber	Legume	Meat	Fat and oil	Fruits/ vegetable	Other foods
Sex (1=male)	-0.0015	0.0003	-0.0006	-0.0006	-0.0010	0.0040***	-0.0006
	(0.0010)	(0.0014)	(0.0004)	(0.0009)	(0.0006)	(0.0011)	(0.0007)
Age (in years)	0.0005*	-0.0007	-0.0000	0.0003	0.0003	-0.0005	0.0002
	(0.0003)	(0.0005)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0003)
Age squared(in years)	-0.0208**	0.0260	0.0009	-0.0107	-0.0093	0.0178	-0.0039
	(0.0103)	(0.0166)	(0.0053)	(0.0102)	(0.0075)	(0.0140)	(0.0091)
Household size (numbers)	-0.0005	-0.0001	-0.0001	-0.0006**	0.0004**	0.0005	0.0003
	(0.0003)	(0.0004)	(0.0001)	(0.0003)	(0.0002)	(0.0004)	(0.0002)
Membership of social group	0.0035***	-0.0017	0.0004	0.0031***	-0.0004	-0.0031***	-0.0019***
(1=yes)	(0.0010)	(0.0014)	(0.0005)	(0.0006)	(0.0006)	(0.0012)	(0.0008)
Education (1= formal)	-0.0013	0.0005	0.0005	-0.0010	0.0001	0.0008	0.0005
	(0.0010)	(0.0013)	(0.0004)	(0.0009)	(0.0006)	(0.0011)	(0.0007)
Occupation (1=formal)	0.0004	0.0008	-0.0006	0.0001	0.0006	-0.0014	0.0003
	(0.0010)	(0.0013)	(0.0004)	(0.0008)	(0.0006)	(0.0011)	(0.0007)
Dependency ratio	0.0041**	-0.0040	0.0005	0.0023	-0.0008	-0.0031	0.0011
	(0.0021)	(0.0027)	(0.0009)	(0.0017)	(0.0013)	(0.0023)	(0.0015)
Household income (Naira)	0.0045***	-0.0017	0.0008	0.0030***	-0.0010	-0.0049***	-0.0001
	(0.0012)	(0.0014)	(0.0005)	(0.0011)	(0.0006)	(0.0012)	(0.0008)

Source: Output from QUAIDS analysis.

Figures in parentheses are standard error. Note: Other foods include sugar, non-alcoholic drinks, beverages, processed foods, condiments.

Findings from this subsection revealed that socioeconomic and locational factors of urban consumers had significant impact on various food demanded by urban households. In summary, food demand estimates for urban household indicated variation in terms of quantity and composition of food groups across urban categories. Own-price elasticities estimates were consistent with demand theory, while findings with respect to compensated cross-price elasticities effects confirmed the appropriateness of the classified food groups used for this study. Furthermore, categorization of urban households into urban groups revealed that locational differences and socioeconomic characteristics across various urban categories influenced type of food demanded, suggesting that households in the urban centres had different tastes. These findings about urban household demand behaviours would drive change in the food economy, and subsequently, food security status.

4.3 **Dietary diversity estimate of urban households**

This section discusses the dietary diversity patterns of households by urban categories. The results for extent of diet diversification as well as determinants of dietary pattern across urban categories are presented in Tables 19and20.

4.3.1**Analysis of household dietary diversity by urban category**

Table 19 presents the results of household extent of diet diversification for pooled and across urban categories using the Berry Index of diversification. The pooled result estimate showed that the mean household dietary diversity index was 0.72, implying that, on average, about seven (7) different food groups were consumed by the households in the study area. This result agreed with Akerele and Odeniyi (2015) and Codjoe et al.(2016), who reported almost similar results in Ghana and Nigeria, respectively.

Across urban categories, it was observed that the average dietary diversity index was not too different from the overall mean, suggesting similar food availability and preferences across the study area. Further results showed that significant differences in mean dietary diversity were found between medium and low urban categories. Furthermore, households were categorised into low, medium and high dietary diversity using the FAO classification (Gupta, 2016). Across these categories, it was observed that a greater percentage of the urban households, ranging from about 49.0% to 58.0%, had moderate dietary diversity. Less than 40% of the total population had high dietary diversity. Figure 6 presents a graphical representation of dietary diversity of urban categories.

Table 19: Mean and Percentage Distribution of Household Dietary Diversity Index by Urban Category

Category	Low urban category	Middle urban category	High urban category	Difference test	All	Range by food groups
	N=153	N=185	N=107			
Low dietary diversity (%)	16.34	6.18	6.54		10.11	0 – 4
Medium dietary diversity (%)	49.02	48.88	57.94		50.34	5 – 9
High dietary diversity (%)	34.64	44.94	35.51		39.55	10 - 12
Mean dietary diversity index	0.7143 (0.0670)	0.7315 (0.0574)	0.7223 (0.0594)	3.22**	0.7229 (0.0621)	
Difference test between categories	2.53**					

Source: Output from Berry index analysis

Figures in parentheses are standard deviation. Statistical significance for t test: ***1%, **5%

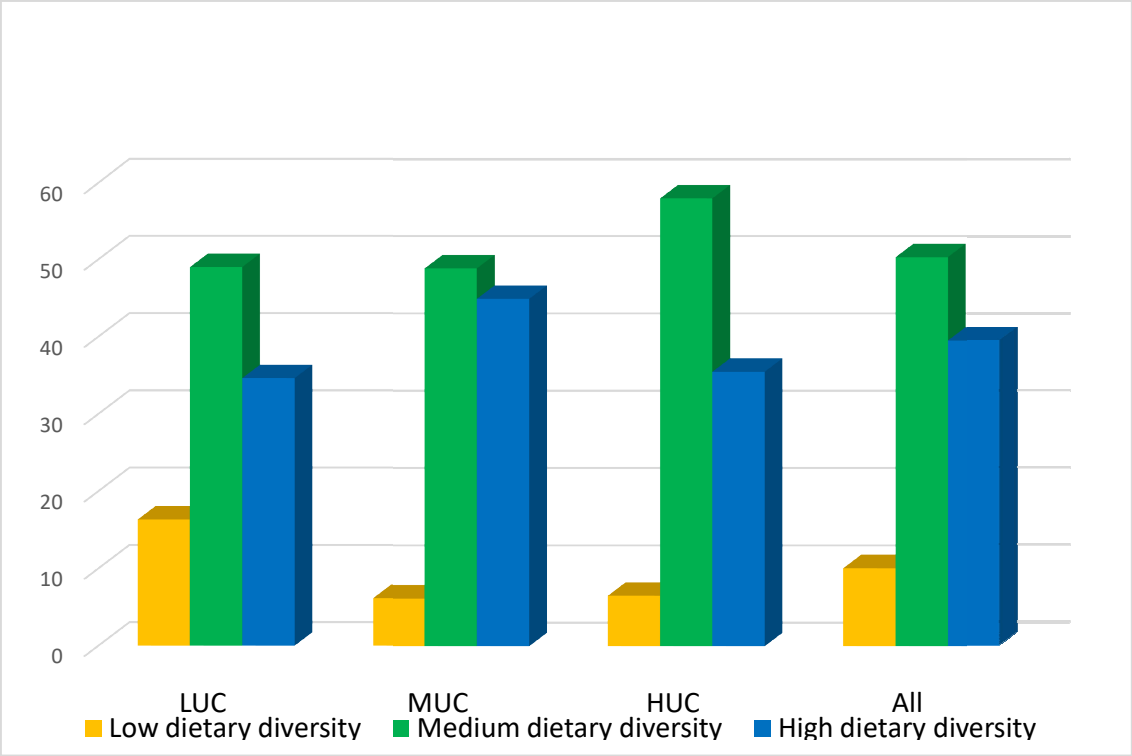

Figure 6: Percentage Distribution of Household Dietary Diversity Index by Urban Category

Note: **LUC- Low Urban Category**

MUC- Middle Urban Category

HUC- High Urban Category

It could be observed that, across categories, more population had medium diet diversity, with less population having low dietary diversity, especially in middle and high urban categories.

4.3.2 **Determinants of urban household dietary diversity pattern**

Table 20 captures the results of factors that influence household diet diversity pattern using quantile regression. The low Pseudo R^2 squared obtained between 3% and 8% was quite typical with cross-sectional data, as observed by Das (2014). The result obtained from the raw and minimum sum of deviations were consistent while the covariates were statistically different from zero, suggesting that each explanatory variable differs across diversity distribution. Estimates obtained from different diversity distribution underscores the robustness of the model used compared to mean distribution (OLS).

The significant variables across quantile distribution were sex, income, membership of social group, educational status, employment status, occupational status of household head, asset ownership, household size, and urbanicity categories. The result of low diversity quantile from Table 20 showed that household income and being in middle urban category positively influenced consumption of diversified diets at 10% and 5% level of significance, respectively. This implies that household consumption of nutrient-based foods improves as income increases, which agreed with the findings of Qineti et al. (2017).

However, household size negatively influenced diverse diets at 1% significant level, implying that an increase in household size increases money expended on food, which limits their access to nutrient-rich food. This may be basically due to the fact that it may be more expensive to have food diversity within very large household size as compared to small household size. This result contradicted the findings of Woldehanna and Behrman (2013) and Ecker et al. (2013) that larger household size had increased food diversity but agreed with that of Gaiha et al. (2013) and Rizov et al. (2015).

With respect to median diversity quantile, it was observed that income, membership of social group and being in middle urban category positively influenced diversified diets at 10% level of significance, while household size negatively influenced it at 1% significant level, contrary to what was observed by Drescher and Goddard (2011). Seven variables, namely sex of household head, andtheir educational, occupational, and employment status; asset ownership,

Table 20: Parameter Estimates of the Determinants of Household Dietary Diversity

	Quantile			OLS
	0.1	0.5	0.9	
Sex (male=1)	0.0017	0.0059	-0.0094**	-0.0029
	(0.0125)	(0.0061)	(0.0041)	(0.0051)
Age (in years)	0.0048	0.0025	0.0002	0.0050**
	(0.0061)	(0.0029)	(0.0020)	(0.0024)
Age squared	-0.1336	-0.0783	-0.0182	-0.1562**
	(0.1953)	(0.0950)	(0.0645)	(0.0788)
Education (1= formal)	0.0150	0.0026	0.0182***	0.0034
	(0.0161)	(0.0078)	(0.0053)	(0.0065)
Household size (number)	-0.0143***	-0.0053***	-0.0009	-0.0064***
	(0.0044)	(0.0022)	(0.0015)	(0.0017)
Occupation (1= formal)	-0.0006	0.0010	0.0202***	0.0100*
	(0.0145)	(0.0071)	(0.0048)	(0.0058)
Employment status (1=employed)	0.0343	-0.0125	0.0208***	-0.0066
	(0.0223)	(0.0109)	(0.0074)	(0.0090)
Urbanicity category (base=low)				
Medium	0.0305**	0.0108*	-0.0007	0.0127**
	(0.0131)	(0.0064)	(0.0043)	(0.0053)
High	0.0155	-0.0061	0.0108**	0.0038
	(0.0153)	(0.0074)	(0.0050)	(0.0062)
Asset index	-0.0012	-0.0014	0.0014*	-0.0007
	(0.0025)	(0.0012)	(0.0008)	(0.0010)
Membership of social group (1=yes)	0.0082	0.0083*	-0.0101**	0.0043
	(0.0135)	(0.0048)	(0.0045)	(0.0054)
Household Income (Naira)	0.0330*	0.0139*	0.0077	0.0211***
	(0.0191)	(0.0093)	(0.0063)	(0.0077)
Constant	0.4556***	0.7101***	0.8011***	0.7193***
	(0.3068)	(0.1492)	(0.1013)	(0.1238)
Pseudo R^2	0.0817	0.0352	0.0301	
Raw sum of deviations	8.8638	15.9445	5.8976	
Minimum sum of deviations	8.0914	15.4070	5.4523	
Adjusted R^2				0.0826
F test				3.17***

Source: Output from quantile regression analysis. Figures in parentheses are standard error. Statistical significance: ***1%, ** 5%, *10%

membership of social group and being in high urban categorywere found to influence diverse diets at the highest diversity quantile. Education, occupation, employment status significantly influenced diversified diets at 1%, coupled with asset ownership and being in high urban category at 10% and 5% significant levels, respectively.Better educated household head had the ability to process consumer dietary knowledge in food consumption.This agrees with Rizov et al.(2015).

Likewise, households in high urban category had better diverse diets relative to low urban category, implying thathouseholds in large cities tend to be more dietary-diverse in their food consumption. This could be as a result of increased food distribution through access to larger varieties of food and expansion of food choices, as noted by Ogundari (2017) and Akerele and Odeniyi (2015). However, these findings revealed that household dietary diversity is location-sensitive as suggested by Das (2014) and Seto and Ramankutty (2016). However, sex of household head and membership of social group negatively influenced consumption of diverse diets at 5% significant level. In summary, the findings revealed that urban households had moderate dietary diversity and illustrated the relative influence of socioeconomic characteristics and urbanisation factor on diet diversity across quantiles.

4.4 **Estimation analysis of urban household food security status**

This subsection focuses on the results for categorization of households into food security levels as well as their determinants. To assess the relationship between the combined indicators before classification into food security levels based on identified thresholds, the results of Spearman correlation between the two indicators (FEXP and DDI),in Table 21, gave an estimated coefficient of 0.1988 at 1% significant level, implying that the combined indicators were partially dependent measures of food security. This result confirmed the robustness of the two indicators in explaining various levels of food security among urban households. This finding agreed with Maxwell et al.(2013) and Ogundari (2017), who assert that strong correlations among two measures of food security suggest mutual relationship useful for measurements of food security.

Table 21: Percentage Distribution of Urban Household by Food Security Level across Urban Categories

Food security levels	Low urban category (N=153)	Middle urban category (N=185)	High urban category (N=107)	All	Discrete variable representing food security level
Completely food insecure by FEXP and DDI	33.99	15.73	17.69	13.71	FS _Level =1
Partially food secure by FEXP only	14.38	20.60	19.69	25.62	FS _Level =2
Partially food secure by DDI only	7.84	8.62	10.28	10.56	FS _Level =3
Completely food secure by FEXP and DDI	43.79	55.05	52.34	50.11	FS _Level =4
Spearman correlation for FEXP and DDI	0.1988***				

Figures in parentheses are number of observation

Note: A partially food secure households are those who are only food secure based on one indicator.

Completely food secure households imply that food security indicators satisfy the threshold and vice versa.

4.4.1 **Categorization of urban household by food security level across urban categories**

The categorised food security status from Table 21 indicated that about 13.7%, 25.6%, 10.6%, and 50.1% of the households were grouped into completely food-insecure households by FEXP

and DDI (FS_Level 1), partially food-secure households based on FEXP only (FS_Level 2), partially food-secure households based on DDI only (FS_Level 3), and completely food-secure households from on both FEXP and DDI measures (FS_Level 4), respectively. Across the urban categories, greater percentage of the population were completely food-secure, ranging from about 43.8% to 55.1%; those partially food-secure by DDI had the least proportion.

With respect to the partial group, more population were found in FEXP (25.6%) compared to DDI (10.6%), implying that households were better off in food access relative to food utilization. This finding supported by Liao et al. (2016), who aver that improved food distribution channel in high urbanized areas could improve level of food access. Furthermore, presence of food insecurity was also observed among urban household (13.7%) though more pronounced among households in the low urban category (34.0%). This could be as a result of incessant increase in food prices due to high transportation costs for most foods, especially during fuel scarcity (Babalola and Isitor, 2014). A better picture can be observed from the percentage distribution of household food security status across urban category in Figure 7. More households were completely food-secure across urban categories, while the low urban category had more population in completely food insecure level.

4.4.2 **Determinants of household food security status**

This sub section focuses on the factors that influence household food security status at different levels as defined by per capita food expenditure (FEXP) and dietary diversity index (DDI) using multinomial logit regression. The results of factors that influence urban household food security status are presented in Table 22. The log likelihood (-451.23) and LR chi2 of 144.93 of the MNL model was significant at 1%, implying that the model was well fitted when compared to the null model without predictor. Although the coefficient explained the direction of the explanatory variable on the dependent variable, the marginal effect was reported because it showed the actual magnitude of the change in probabilities. Therefore, the result presented the probability of being in any of the category relative to the reference group,

that is, completely food-insecure by FEXP and DDI, for a unit increase in the value of explanatory variables.

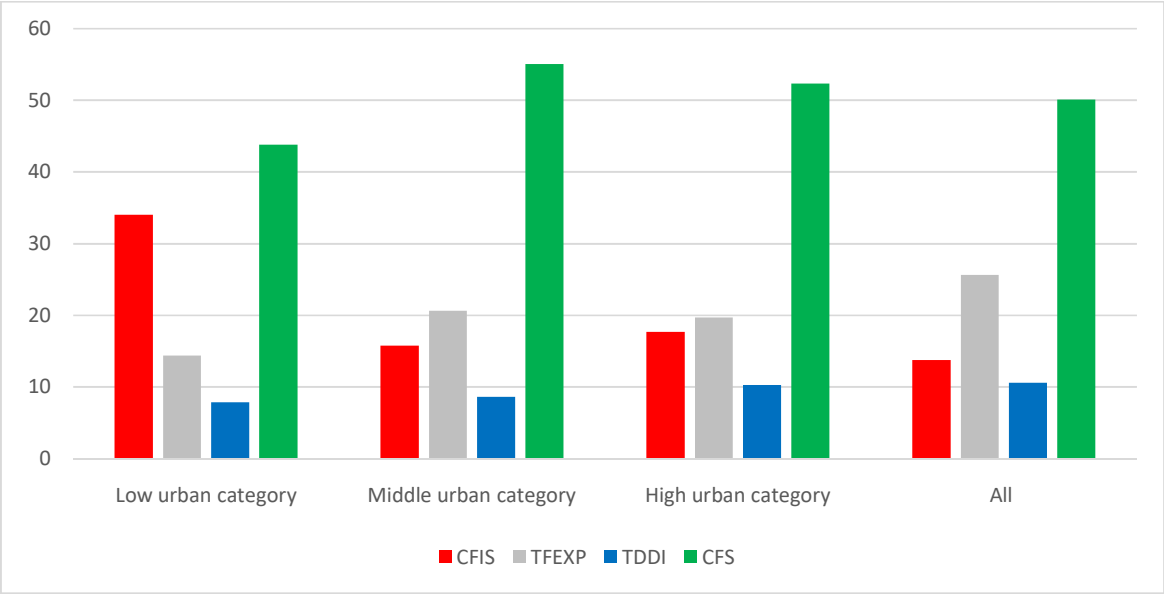

Figure 7: Percentage Distribution of Urban Household Food Security Status by Urban Category

Note: CFIS - Completely food-insecure households by DDI and FEXP

FEXP- Partially food-secure households-based on Per Capita Expenditure only

DDI- Partially food-secure households-based on Dietary Diversity Index only

CFS- Completely food-secure households by DDI and FEXP

Table 22: Parameter Estimates of the Determinants of Urban Household Food Security Status

	Food secured by food expenditure only			Food secured by dietary diversity only			Completely food secure from both expenditure and dietary diversity		
Variables	**Coefficient**	**Z statistics**	**Marginal Effect**	**Coefficient**	**Z statistic**	**Marginal Effect**	**Coefficient**	**Z statistics**	**Marginal Effect**
Sex (male=1)	0.8291**	2.16	0.0378	1.2830**	2.59	0.0494	0.6976**	2.10	0.0164
Marital status (married=1)	0.0556	0.12	0.0133	-0.1643	-0.31	-0.0153	0.0035	0.01	0.0020
Age in years	0.2683	1.36	0.0170	0.0874	0.36	-0.0099	0.2350	1.33	0.0198
Age squared	-8.5494	-1.34	-0.6323	-1.8127	-0.23	0.3678	-6.9502	-1.22	-0.5437
Engaged in employment activities (engaged=1)	-0.3951	-0.56	-0.0113	1.6475**	2.18	0.2035	0.033	0.05	0.1737
Educational status (formal=1)	0.1146	0.24	0.074	0.8580**	2.22	0.0406	0.7110**	2.14	0.0148
Household size in number	-0.0490	-0.36	-0.0381	-0.0432	-0.27	-0.0146	-0.3589***	-2.97	-0.0810
Average monthly income in Naira	0.5980	1.03	0.0847	1.6904**	2.23	0.2077	1.5535***	2.94	0.3222
Membership of social group (member=1)	1.3929***	3.48	0.4176	0.4543	0.90	0.0286	1.0123**	2.43	0.4300
Occupation (formal sector=1)	0.8831**	2.03	0.1107	0.5562	0.99	0.0148	0.2546	0.70	0.0698
Urbanicity index	1.8766***	3.74	0.2115	1.7380***	2.86	0.0659	0.7356	1.65	0.1411
Log likelihood	-451.23								
LR chi2 (33)	144.93***								
Pseudo R^2	0.14								
Number of observation	445								

Statistical significance level: *** p<0.01; ** p<0.05; * p<0.10

The results in Table 22 indicated that the probability of being food-secure based on FEXP only, DDI only and completely food secured (FEXP and DDI) relative to completely food-insecure increased significantly by 0.03, 0.05 and 0.02, respectively for male-headed households. Also, there is more likelihood for household heads who engaged in employment activities to be food-
secure through DDI only by 0.20. This conformed to the finding of Taruvinga et al. (2013), that households with heads engaged in income-earning activities which increase financial capacity are more likely to be food secured.

Resultsalso revealed that household heads having formal education had the likelihood of being food-secure by DDI only and completely food-secure by both measures (FEXP and DDI) relative to those completely food-insecure by 0.04 and 0.02, respectively. This suggests that being educated could help in assessing information about consumer dietary knowledge and its relevance to consumption of nutritious foods. In addition, ceteris paribus, education has a significant modifying impact on the relationship between urban growth and food security (Szabo, 2016).

Also, with respect to household size, the probability of households to be completely food-secure based on both measures (FEXP and DDI) relative to the reference group, decreased by 0.08. This implies that larger household sizes are less likely to have access to food and diverse diets which could reduce their nutritional status. This corroborates the findings of Ahmed and Napthali (2014) and Akinboade et al. (2016), who posit that larger households are less likely to be food-secure relative to completely food-insecure.

Likewise, a unit increase in household income level significantly raises the chance of being food-secure based on DDI only and by completely food secured (FEXP and DDI) by 0.20 and 0.32, respectively. Other results showed that household heads belonging to a social group were more food-secure based on FEXP only and completely food-secure (FEXP and DDI) by 0.42 and 0.43, respectively relative to the reference group. However, household heads with formal jobs had more likelihood of being food-secure based on FEXP only relative to the reference group by 0.11. This support the notion that different occupational types peculiar to urban centres often influence and changes the urban food environment. This sedentary lifestyle results in greater access to choice of food and also financial capacity, thus improving

food security status (Omonona and Agoi, 2007). Moreover, the extent to which a place urbanises significantly increases the possibility of household being food-secure in terms of FEXP and DDI by 0.21 and 0.07, respectively.

To sum up, disaggregation of the food security levels based on the combined indicator across the urban categories gives a better and holistic view of urban household food security status defined by more consistent measures of food security. Effects of urban household socio-economic characteristics in determining food security at various levels differ significantly, suggesting that the combined food security indicators better capture different food security statuses in urban Nigeria. This reveals a richer and potentially more effective basis for policy measures for supporting emergent food insecurity among urban households.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Summary of findings

The study investigated the effect of urbanisation on urban household food demand and dietary diversity in southwest Nigeria. The study was carried out in southwest Nigeria, with cross sectional data survey from two states, namely Oyo and Ekiti States, which represented high and low urban areas. A sampling technique involving four stages was employed for the study. Multivariate principal component analysis was employed in the study to construct urbanicity index which was used to profile extent of urbanisation in the study area by socioeconomic characteristics. To further assess the food demand pattern of urban households, quadratic almost ideal demand system (QUAIDS) was employed. Berry Index of diversification was employed to estimate dietary diversity extent among households, while quantile regression was used to isolate factors that influence dietary pattern among urban households. Factors that influence household food security status were determined by multinomial logit regression.

The results showed that the urbanicity index generated by the use of PCA revealed that the average urbanicity index was 0.46, with significant difference at mean across urban areas. The index was reclassified into low, medium and high urban categories using quantile procedure, which revealed that 40.6% of the urban households were in the middle urban category.

However, the study found that estimates of urban household food demand pattern using QUAIDS model revealed significant differences in food budget share across the three urban categories. In addition, expenditure elasticities estimates revealed that all food groups were normal goods with varying magnitudes across urban categories. Also, price elasticity estimates revealed that both compensated and uncompensated own-price elasticities were negative and, in absolute terms, all food groups were price inelastic;while cross-price effect showed a mix of substitute and complementary relationships. This study also found that factors that significantly influenced household food demand included sex, age, age squared,

education, occupation, income, membership of social group of household head, presence of dependants, household size and urbanicity index.

The results from extent of dietary diversity using Berry Index of diversification revealed that the mean dietary diversity index was 0.72, implying that, on average, about seven (7) food groups were consumed by the households in the study area, with significant differences across urban categories. Grouping of urban households into low, medium and high dietary diversity revealed that a greater percentage of urban householdswithin the range of 49.0% to 58.0%, had moderate dietary diversity across urban categories. The factors that significantly influenced household dietary diversity across different quantiles (0.1q, 0.5q and 0.9q) included sex, income, educational status, employment status, occupational status, membership of social group of household head, asset ownership, household size, and urbanicity categories.

The food expenditure (FEXP) and dietary diversity (DDI) used to categorise household food security status revealed that about 50.1%, 25.6%, 10.6%, and 13.7% were completely food-secure households by FEXP and DDI, partially food-secure households based on FEXP only, partially food-secure households based on DDI only, and completely food-insecure households by FEXP and DDI measures, respectively. Across urban categories, a greater percentage of the population was completely food-secure (43.8% to 55.1%), while those with partially DDI had the least population (7.8% to 10.3%). The characteristics that significantly influenced household food security status across three food security groups, namely completely food-secure, partially food-secure by DDI and partially food-secure by FEXP,relative to reference group were sex, income, education, employment status, membership of social group of household head and urbanicity index.

5.2 **Conclusion**

Empirical evidence from this study revealed that variation exists within urban areas with more households in middle urban category. However, household socioeconomic characteristics differ across the three urban categories. The differential pattern is important towards better understanding of location-specific food consumption pattern and overall food security status. The study concludedthat there was varying magnitude regarding urban household’s response to expenditure and price changes. Food demand estimates revealed

changes in terms of quantity and composition of food groups, which suggest presence of nutrition transition in food composition. Categorization of urban household into urban groups suggested that locational differences affected food demand, while socioeconomic variables played a major role in determining household food demand across urban categories. These findings, therefore, provide more insight to household consumption behaviours across urban categories, which is useful for marketing strategies of value-added food items, and also inform food policy measures.

Evidence from the extent of dietary diversity showed that urban households had moderate dietary diversity in food consumption pattern across urban categories. In addition, significant variables which are household income and urbanicity categories, influenced household diet diversity across quantiles. This is relevant for policy restructuring that could enhance increased consumption of nutrient-rich diet and hence improve food security and nutrition. Considering the food security status, the combined food security indicators defined by access to food and its utilization revealed four different food security levels; almost half of the households were completely food-secure, while partially dietary diversity level had the least population. This procedure offers a richer and potentially more effective basis for food policy measures, especially evolving urban food insecurity.

5.3 **Policy recommendations**

From the findings and conclusion from this study, the policy recommendations brought to the fore are as follows:

(i) Urbanicity index significantly influences urban household food demand, dietary pattern and food security status. Therefore, policies driven towards improving urban functional characteristics are highly recommended. These will create opportunities for all food chain actors through supply of value-added food products in urban areas. However, this calls for more in-depth policy integration to strengthen weak food chains which could hamper progress on food security and nutrition in urban areas.

(ii) Food demand analysis among urban household revealed preference towards meat and processed foods especially in urbanized area. This shift towards animal-based products due to their protein supply calls for policies that will improve the value chain through infrastructural development, such as processing and storage systems, cold

chain/refrigeration and packaging procedures. This will stimulate better consumption of locally-made food products which are more nutrient-based and also help to reduce vulnerability of urban households to international food price hike as a result of increased food import.

(iii) Household income was a major significant factor that influenced urban household food demand, dietary pattern and food security. Hence, there should be income-earning policies, that will reduce high rate of unemployment through integration of agriculture and other sectors of the economy.This will guarantee financial security so as to cope with incessant food price increase, necessary for improved food access, utilization and, subsequently, improve urban food security.

(iv) The coefficient of household size was found to have negative influence on urban household demand for high value commodity, intake of well diverse diets and food security attainment in the study area. This suggests that larger household sizes are less likely to have access to food and diverse diets which could reduce their nutritional status and contribute to emergent food insecurity among urban households. It is, therefore, a key priority for stakeholders to sensitize households on family planning in order to have moderate family structure, which will help increase diverse diets and improve urban household food security.

5.4 **Areas for further research**

The approach used in this study to quantify the effect of urbanisation on urban household food security can be extended to the nation as a whole. This will offer a thorough assessment of the food demand, diet diversity and food security situation within Nigeria. This line of research better provides stakeholders and policymakers with sufficient information and sense of direction on interventions for food-secure citizens.

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APPENDIX 1

Analysis of Objectives

S/n	Objectives	Data Required	Methods of Data Analysis
1	Profile the extent of urbanisation in the study area	Data on urbanisation indicators.	PCA, Descriptive analysis
2	To estimate the food demand of households in the study area	Expenditure on food and non-food at household level	QUAIDS model
3	To examine dietary diversity pattern among households	Data on Expenditure shares of food consumed	Berry Index (BI), Quantile Regression (QRE)
4	To determine the factors influencing food security status among households in the study area.	Data on demographics, socioeconomic, urbanisation variables and food expenditure estimates	Multinomial Logit Regression (MNL)

APPENDIX 2

Food Group Aggregates

Food groups	Specific food items
Cereals	Maize, Maize flour, Rice, Guinea corn/sorghum, Millet, Millet flour, semovita, wheat flour, Other starchy products. Bread and other similar foods.
Legumes	Beans,, Soya beans, beans products, melon and Other pulses.
Root and Tubers	Yam flour, Cassava flour, Plantain flour, Cassava roots, Yam root, Gari, Plantain, Sweet potatoes, Fufu/(akpu) and other root and tubers
Meat and meat products	Chicken, Turkey, Eggs, Meats: Beef, Mutton, Pork, Bush Meat, Goat, Ponmo (Meat Skin); Snails, Fish, Crayfish, Shrimp. Other Seafood (Lobster, Crab, Prawns, Etc); Fresh Milk, Milk Powder, Milk Tinned (Unsweetened), Soya Milk, Yoghurt and Other Dairy Products.
Other foods	Beverages; Coffee, Chocolate Drinks (Including Milo), Bournvita, Ovaltine, Tea; Non-Alcoholic Drinks: Malt Drinks, Soft Drinks (Coca Cola, Sprite, Etc) bottled, Canned drinks. Sugar, Jams, Honey, snack, cakes. Spices, condiments (salt, garlic, curry, thyme), seasoning cubes and other processed foods: Canned food (titus, geisha,), canned meat, Baked Beans, Canned Beef, Canned Fish/Seafood, Tomatoe puree and Other canned vegetables, Ketcup, Salad Cream and Fruit juice canned. Noodles and pastas
Fats and oil	Palm oil, Butter/Margarine, Groundnut oil, Vegetable oil, Palm Kernel oil and Other oils and fats
Fruits and Vegetables	Bananas, Water melon, Orange, Tangerine, Mangoes, Pawpaw, Avocado pear, Pineapples, Tomatoes, Onions, Garden eggs/eggplant, Okro, Pepper Fresh, Pepper Dried, Cabbage, Lettuce, Cucumber , carrot and Other vegetables, spinach, green, water leaf

Source: NBS, (2012)

APPENDIX 3

Survey Questionnaire

UNIVERSITY OF IBADAN, IBADAN.
DEPARTMENT OF AGRICULTURAL ECONOMICS
URBANISATION AND HOUSEHOLD FOOD SECURITY IN SOUTHWEST NIGERIA

Dear respondent, this is a survey to examine the effect of urbanisation on household food demand, diet diversification and food security in Southwest Nigeria. Please answer the questions accurately. The information provided are confidential and for the purpose of research only. Thank you.

Questionnaire ID	
State	
LGA	
EA	
Street name	

SECTION A. SOCIO-ECONOMIC CHARACTERISTICS

	Items	Options			Response
1	Respondent	Household head=1; Spouse=2; Others=3			
2	Gender of household head	Male=1; Female=0			
3	Marital status	Married=1, Single=2, Divorced=3, Widowed=4			
4	Age of household head (in years)				
5	Education status of household head	No formal education =1, Primary=2, Secondary=3, Tertiary=4			
6	Number of dependents (persons below 14 and above 65 years)				
7	Household size				
8	Employment status	Employed = 1, Unemployed=0			
9	Type of occupation	Government job =1, Private job= 2, Artisan/Trader = 3, Agric-based=4, Others = 5 (specify)			
10	Average monthly income of household (₦)	<50,000 = 1 51,000 – 100,000 = 2 101,000 – 150,000 = 3 above 150,000 = 4			
11	Average monthly expenditure on food (₦)				
12	Average monthly expenditure on non-food items (₦)				
13	Household structure of members	Age (years)	Number of Male	Number of Female	
		≤5			
		6 – 14			
		15 - 65			
		>65			
14	Primary source of income				
15	Do you engage in other income generating activities? If yes, specify	Yes=1; No= 0			

16. Physical asset (Please tick the assets owned as applicable)

Assets	Yes=1 No= 0	Number
Vehicle		
Television		
Air condition		
Generator		
Cable TV		
Washing machine		
Refrigerator		
Microwave		
Gas cooker		
Other: please specify		
i)		
ii)		

17. Social capital (please provide information on the social groups that you belong to)

Association	Yes = 1; No = 0	Major activities	Benefits derived for being a member
Professional bodies			
Cooperative			
Religious group			
Community development			
NGO/Aid group			
Others: please specify			

SECTION B: FOOD CONSUMPTION

18. Household food consumption **(**Please provide information on consumption of the following food items)

Food groups	Did you consume any of these food items in the past 1 week? Yes =1 No =0	How many times do you consume these food items in a week? Daily=1 Thrice a week=2 Once a week=3 Rarely =4	Quantity consumed per week (Specify unit/measure)	Food expenditure per week Amount in Naira, (₦)
Starchy staples (Cereals/ Roots and Tubers)				
Rice				
Wheat				
Fufu				
Garri				
Yam				
Pounded yam				
Yam flour				
Plantain				
Semovita				
Others (specify):				
i)				
ii)				
Legumes, Pulses and Nuts:				
Beans				
Beans products (moinmoin,akara)				
Groundnut/coconut				
Melon (egusi)				
Others				

Food groups	Did you consume any of these food items in the past 1 week? Yes =1 No =0	How many times do you consume these food items in a week? Daily=1 Thrice a week=2 Once a week=3 Rarely =4	Quantity consumed per week (Specify unit/measure)	Food expenditure per week Amount in Naira, (₦)
Animal/Sea foods/ Dairy products and their products):				
Meat (beef, mutton, bush etc)				
Turkey				
Chicken				
Eggs				
Fish (dry, fresh, frozen, smoked etc)				
Shrimps				
Cray fish				
Snails				
Milk (liquid, skimmed or whole|)				
Cheese				
Yogurt				
Others: specify				
i)				
ii)				
Oil/Fats				
Oil: Red palm oil				
Vegetable oil				
Fats: Butter/margarine/mayonnaise				
Others (specify):				

Food groups	Did you consume any of these food items in the past 1 week? Yes =1 No =0	How many times do you consume these food items in a week? Daily=1 Thrice a week=2 Once a week=3 Rarely =4	Quantity consumed per week (Specify unit/measure)	Food expenditure per week Amount in Naira, (₦)
Fruits and Vegetables:				
Fruits: Orange/banana/pawpaw/mango/pineapple etc				
Leafy vegetables (Water leaf /bitter leaf /spinach/pumpkin and other local green vegetables)				
Others: tomatoes/pepper/onions/okra/carrots, cabbage, cucumber				
Sugars/Confectioneries/Pastas				
Sugar				
Honey				
Cakes				
Bread				
Sweet				
Ice cream				
Pizza				
Can foods (sardine, geisha, tin tomatoes, vegetables, meat, puree)				
Noodles				
Pasta				
Others (specify):				
Beverages/Drinks/ Condiments				
Beverages: milo, coffee, bournvita				
Water: sachet water/bottled water)				
Non-alcoholic drinks: soft drinks, malt, fruit				

juice)				
Alcoholic drinks: industrial beer, wines, spirits other locally brewed drinks.				
Seasoning cubes/powder(e.g curry, thyme, salt)				

19. Household Non Food Expenditure (Please supply information on your expenses for the following non-food items).

S/N	Items	Expenditure in 1 week Amount (₦)	Expenditure in 1 month Amount (₦)
1	Clothing (fabric, clothes, towels, beddings)		
2	Shoes and foot wares		
3	Hand set/ GSM recharge cards		
4	Health (medicine, hospital's charges)		
5	Transportation costs (public transport)		
6	Education (fees, books, school uniform)		
7	Generator set (fuel and services)		
8	Car expenses (fuel, repairs etc)		
9	Cooking cost (kerosene and gas)		
10	Newspaper/ postal charges/ internet charges		
11	House rent		
12	Electricity bill		
13	Other non food expense (please specify)		

20. Indicate your place of purchase of MOST food items and reasons for the choice.

Place of purchase of food items	Response	Reasons for choice of purchase	Response
Open market = 1 Supermarket =2 Retail shops =3 Farmers' market =4		Convenience =1 Quality =2 Taste/freshness =3 Price =4 Location =5 Varie-\ty =6 Availability =7	

21. Food Away from Home. (Please provide information on prepared food that you consumed away from home. i. e food eaten at restaurant/eateries in the past 7 days).

S/N	**Food items eaten outside**	**Total purchase in 7 days**	**Place of purchase** 1= food vendors 2= restaurants 3= fast food outlets 4= supermarket 5= shopping mall	**Reasons for consumption** 1= convenience 2= taste 3= nature of job 4= price 5= location 6= variety
1	Breakfast (e.g rice and stew with egg, pap and akara balls)			
2	Lunch (e.g amala with ewedu soup and meat/fish)			
3	Dinner (e.g moin moin and eko/akamu)			
4	Snacks (e.g biscuits, puff puff)			
5	Drinks (e.g alcoholic drinks, soft drinks)			
6	Other meals consumed (specify)			

SECTION C. URBANISATION INDICATORS

22. Please tick as applicable the facilities and services available and functional in your household/community.

Variables		Yes=1 No = 0
Access to mass media:	i) Radio	
	(ii) Newspaper	
	(iii) Television,	
	(iv)Internet service (computer)	
Types of road:	(i) Tarred (good)	
	(ii) Tarred with potholes	
	(iii) Untarred	
Means of transportation:	(i) Public transportation (buses, taxis),	
	(ii) Private (buses, cars)	
	(iii) Tricycle and motorbike	
	(iv) Others (bicycle etc)	
Access to health facilities:	i) public hospitals e.g Primary health centers (clinics)	
	(ii) General hospitals	
	(iii)Teaching hospitals	
	Private hospitals	
	Pharmacy shops (drug stores)	
Source of water:	(i) Piped borne water	
	(ii) Public tap	
	(iii) Borehole	
	(iv) Well	
Source of cooking energy:	(i) Gas	
	(ii) Kerosene	
	(iii) Firewood/ Charcoal	

Sanitary facility:	(i) Public flush toilets	
	(ii) Private flush toilets	
	(iii) Pit toilet	
	(iv) No facility (Open defeacation)	
	(v) waste disposal	
Source of power supply:	(i) Public electricity	
	(ii) Solar	
	(iii) Generator	
Access to Recreational centers	(i) Sport centers, amusement parks	
(ii) Parks, gardens , cinema etc		
(iii) Hotels		
Presence and functional educational facilities:		
Primary		
	Secondary	
	Tertiary	
	Vocational schools	
Markets services		
	Traditional (open) market	
	Retail shops	
	Supermarkets	
	Shopping malls	
	Fast food outlets	
	Other outdoor fixed eateries	

Thank You.