DEMAND, SUPPLY RESPONSE AND PREFERENCE SWITCH FOR RICE IN NIGERIA

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A Thesis in the Department of Agricultural Economics submitted to the College of Agriculture and Forestry in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY, UNIVERSITY OF IBADAN

February, 2014

DEDICATION

This research is heartily dedicated to 'my father', Professor Fatai Lekan Ayanwale, former Vice President, World Veterinary Association, and lecturer, Tuskegee University, Alabama, U.S.A., for taking full responsibility of my postgraduate studies; and all those who showed concern in the pursuit of my Ph.D programme.

ABSTRACT

The phenomenon of increasing rice importation defying several policy interventions has been of great concern in Nigeria. This rising importation is however driven by increasing demand, shortage in domestic supply and consumers' preference for imported rice. Yet, comprehensive national studies on determinants of demand, supply response and preference switch for rice are scarce. Thus, the determinants of demand, supply response and preference switch for rice were investigated.

Secondary data from the Nigeria Living Standard Survey (NLSS) of 2004 conducted by the National Bureau of Statistics (NBS) and time series data from the official records of International Rice Research Institute (IRRI), 1960-2008 were used. Due to elimination of households with missing values on variables of interest, a total of 18,861 out of 21,900 households were used in the NLSS. Variables used in NLSS included Household Size (HS), Non-Food Total Expenditure (NFTE), Years of Education (YE), sector (urban/rural), occupation (farming/non-farming) and Membership of Association (MA) which were hypothesized to influence household expenditures on Imported Rice (IR), Improved Domestic Rice (IDR) and Local Rice (LR). Data on area cultivated, level of import, fertilizer consumption and prices were used in IRRI rice statistics and these variables were also hypothesized to influence supply (output) of rice. Data were analysed using descriptive statistics, Tobit regression model, vector error correction model and generalised least square regression at p= 0.05.

The HS and YE were 4.9±2.9 and 6.8±6.3 years, respectively. Rural dwellers, farmers and members of association constituted 76.1%, 82.7% and 54.2%, respectively. Monthly rice expenditure was ₦2, 712.40, representing 25.0% of total monthly food expenditure. The expenditure share of IR (45.0%) was higher than IDR (30.0%) and LR (25.0%). Urban sector, YE, HS and NFTE increased the demand for IR by 4.0×10^{-03}, 2.0×10^{-04}, 1.0×10^{-03} and 1.0×10^{-09}, respectively, while Farming Occupation (FO) reduced it by 9.0×10^{-03}. Also, FO increased IDR demand by 8.0×10^{-03}. Conversely, HS, NFTE, and MA reduced IDR demand by 9.0×10^{-04}, 2.0×10^{-08} and 1.0×10^{-09}, respectively. Also, NFTE and MA, respectively, increased LR demand by 6.0×10^{-09} and 4.0×10^{-03}. Price elasticities of IR, IDR and LR which were -3.0×10^{-03}, -7.0×10^{-04} and -2.0×10^{-03}, respectively implied that rice was price inelastic. Also, income elasticities of IR, IDR and LR which were, respectively, 7.0×10^{-08}, 2.0×10^{-07} and 1.0×10^{-07} classified rice as 'necessities' and 'normal' good. In the long-run, area cultivated and fertilizer consumption increased rice output by 2.8 and 2.3 respectively. Rural Sector (RS), HS, FO, and price of IR increased consumers' switch from IR to IDR by 55.1, 6.6, 130.4, and 30.7, respectively, while price of IDR reduced it by 19.4. Price of IR and RS positively influenced switch from IR to LR by 2.0 and 70.2, respectively, while price of LR reduced it by 16.3.

Education and urban livelihood increased demand for imported rice. Increasing rice area cultivated and usage of fertilizer may boost domestic rice supply. Price reduction will be a veritable tool in switching consumers' preference from imported to improved domestic and local rice.

Keywords: Rice demand, Supply response, Preference switch, Imported rice
Word count: 486

ACKNOWLEDGEMENTS

All praises, gratitude and adoration belong first to the Almighty Allah for his immeasurable favour on me throughout the course of this project. I glorify Him equal to the number of His creatures; I thank Him as much as it pleases him; my gratitude to Him is as enormous as the adornment of His throne and equal to the number of His words.

My hearty and sincere appreciation goes to my able and capable supervisor, Professor V.O. Akinyosoye, for his inspiration, fatherly concern, intellectual guidance, data gathering assistance, psychological and moral support throughout this research. I cannot thank him enough for his patience and understanding despite his tight schedule. He is just more than a supervisor. I am greatly indebted to Dr. S.A. Yusuf, my co-supervisor, who doubled as the chairman departmental postgraduate committee, for providing a viable complementary supervisorial role by providing the necessary guidance and direction at every stage of the research; he was indeed more than a co-supervisor. Also, the efforts of Dr. O.A. Oni as the second co-supervisor can never be forgotten. He created time out of none to assist in perusing my write-ups and served as motivator along the course of the research.

I will forever be grateful to the Head of Department, Professor V.O. Okoruwa for his support, encouragement and official roles played throughout the Ph.D programme. The Departmental Postgraduate Co-ordinator, Dr. K.K. Salimonu, is highly appreciated for his formal and informal roles in facilitating the completion of this programme, especially from the abstract stage. Other faculty members, such as Professor J.K. Olayemi (Rtd.), Professor A.O. Falusi (Rtd.), Professor M.A.Y. Rahji, Dr. T.T. Awoyemi, Dr. B.T. Omonona, Dr. (Mrs) Adenegan, Dr (Mrs) Adeoti, Dr. A.S Oyekale, Dr (Mrs) Obayelu, Dr (Mrs) Adepoju, late Dr (Mrs) Ajani and others are acknowledged for their support, encouragement and statutory roles in seeing this work to completion.

Mr Alabi of the GIS unit, International Institute of Tropical Agriculture is acknowledged for assisting me in providing the needed climate data. I equally extend my gratitude to the Director and staff of National Food Reserve Agency (NFRA) and the head and staff of Planning Research and Statistics Department of OGADEP, Abeokuta for providing me with needed data. My academic benefactors and mentors: Dr. Taofiq Azeez, of University of Abuja; Professor L.O. Sanni, Dr. I.A. Ayinde and Dr. K. Adebayo, of the University of Agriculture, Abeokuta; Prof. A.A. Tijani of Obafemi Awolowo University, Ile Ife; Dr.

Ibrahim Uthman, of University of Ibadan; Alhaji S.A. Akinwunmi, of Olabisi Onabanjo University Teaching Hospital and Dr. GBK Ajayi, of Ojulowo Eye Clinic, Ibadan, are immeasurably appreciated for their academic, financial, moral and spiritual support.

I sincerely appreciate the following friends, colleagues, classmates and associates for the assistance rendered during the conception of the research work, data mining, data analysis, write-up reviews, financial and moral support: Dr F. Ogundele (NISER); Dr. Dontsop (IITA); Dr. Idowu and Dr. O.C. Ologbon (OOU); Dr. W. Ashagidigbi; Dr. Balogun and Dr. F. Sowunmi (U.I); Dr. T. Dauda (IAR&T); Mr. Omoniyi (Redeemers College); Dr. S. Karim , Dr. Dele Akinbode, Dr. R. Adebowale, Dr. S.A. Adewuyi, Dr. K. Bello, Dr. R. Bello and Dr. S. Iposu, all of UNAAB; Dr. R. Karim (Crescent University); Dr. L. Akinola (Fountain University); Dr. (Mrs) G. Adeshina-Uthman (NOUN); Dr. Wale Olayide, Dr Wole Ogunyemi, Mr Monsuru Muritala and Mr Saheed Olatunji (U.I); Mr AbdulRauf Oyedele; Engineer and Mrs Oketokun; Mr. M. Zakariyah; Mr. D. Oladunni; Mr. Y. Oke; Mr T. Olaiwola; and others too numerous to mention. I am indeed grateful to the departmental secretary, Mrs F.M Oladejo, Mrs Atanda, Mr Lawrence, Mr Lekan Animasaun, Mrs Nike Olawande and other administrative staff of the Department of Agricultural Economics for the roles they played in the course of my Ph.D programme.

This acknowledgment will be incomplete without appreciating my lovely family: my darling, caring and enduring wife, Azeezat Adesola Amope, who gave all support and encouragement in pursuing this programme; my children- Ghalib Adesina, Mujibah Adeola and Mazeedah Adebola; my dear mother, Alhaja Aduke Ayanwale; and my late father, Alhaji Raimi Ayanwale of blessed memory, for their patience and perseverance throughout my academic pursuit. I am greatly indebted to my elder brothers and sisters: Alhaji Rasaq Ayanwale, Late Alhaji Ganiu Ayanwale, Alhaja Taibat Ologunebi, Professor Lekan Ayanwale, Mr. Musibau Ayanwale, Alhaji Osuolale Ayanwale, Engineer Leye Ayanwale and Dr Jibola Ayanwale; and my siblings- Mr. Akeem, Mr. Moruf and Alhaji Bashir Ayanwale- for their perseverance, moral, spiritual and financial support throughout my protracted educational career.

I equally thank my bosses- Mr. Moses Ebikwo, Engnr. A. Akinola and Mr I.E Sotiyo and other colleagues at work for granting me the needed time and support to pursue this PhD programme. May Allah grant all of the mentioned and the unmentioned their heartfelt desires.

CERTIFICATION

I certify that the research culminating in this thesis was carried out by Abiodun Olayinka Samsideen Ayanwale under my supervision in the Department of Agricultural Economics, University of Ibadan, Nigeria.

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ABREVIATIONS AND ACRONYMS

ADF–Augmented Dickey-Fuller

AIDS–Almost Ideal Demand System

AR–Autoregressive

ARIMA–Autoregressive Integrated Moving Average

ATA–Agricultural Transformation Agenda

CBN–Central Bank of Nigeria

CE–Cointegrating Equation

DF–Dickey-Fuller

DW– Durbin-Watson

DADTCO–Dutch Agricultural Development and Trading Company

FAO–Food and Agricultural Organisation

FAOSTAT–Food and Agricultural Organisation Statistics

FIML–Full Information Maximum Likelihood

FMWA–Federal Ministry of Women Affairs

FMAWRD–Federal Ministry of Agriculture, Water and Rural Development

GNP– Gross National Product

IRRI–International Rice Research Institute

IDR–Improved Domestic Rice

IR–Imported Rice

LAIDS–Linearized Almost Ideal Demand System

LES–Linear Expenditure System

LR–Likelihood Ratio

LR–Local Rice

NAMIS–National Agricultural Market Information System

NCRI– National Cereals Research Institute

NBS–National Bureau of Statistics

NERICA– New Rice for Africa

NFRA–National Food Reserve Agency

NISER– National Institute of Social and Economic Research

NLSS–Nigeria Living Standards Survey

PCU–Project Coordinating Unit

QUES– Quadratic Expenditure Demand System

RIFAN–Rice Farmers Association of Nigeria

SCPZs–Staple Crop Processing Zones

SURE–Seemingly Unrelated Regression

TIN–Trade Investment Nigeria

TDS–Translog Demand System

UNEP–United Nations Environment Programme

UNIDO–United Nation Industrial Development Organisation

USDA–United State Development Agency

VAR–Vector Autoregressive

VECM–Vector Error Correction model (VECM)

WARDA–West African Rice Development Agency

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

The agricultural food sub-sector in Nigeria parades a large array of staple crops,made possible by the diversity of agro-ecological production systems. The major food crops are cereals, such as sorghum, maize, millet, rice, wheat; tubers, such as yam, cassava; legumes, like groundnut, cowpeas; and others such as vegetables (Akande, 2007). These are the commodities that are of considerable importance for food security and incomes of households. Rice is one of the leading staple food crops in Nigeria. It is cultivated in virtually all the agro-ecological zones of Nigeria, from the mangrove and swamps environment of the coastal areas, to the dry zones of the Sahel in the North (Akande, 2007). In 2007, about 1.7 million hectares were under rice cultivation in Nigeria with estimated national production of 3.4 million metric tons, representing 22% increase over 2006 level and a growth rate of 0.6 percent from 1999 (National Food Reserve Agency, NFRA, 2008). NFRA (2008) also notes that rice yield in the same year was estimated at 2 metric tons per hectare, a negligible decrease of 0.03 percent over 2006 and 1 percent annual growth rate from 1999. Also, National Bureau of Statistics (NBS) claims that 4. 5 million metric tons of rice was produced in 2010 as against the 3.2 million metric tons (from 1.84ha) and 3.1 million metric tons (from 1.77ha) reported by Food and Agricultural Organisation (2014) for 2010 and 2011, respectively. IRRI (2014) equally reported a contrastingly lower output of 2.85 million metric tons for rice in Nigeria in 2012.

The demand for rice has been soaring over the years. Since the mid-1970s, rice consumption in Nigeria has risen tremendously, growing by 10.3% per annum, a result of accelerating population growth rate of 2.8% per annum, increasing per capita consumption of 7.3% per annum, rapid urbanisation, increased income levels, and associated changes in family occupational structures (Akpokodje *et al.*, 2001; UNEP,2005; Akande, 2007, Bashorun, 2010; Oyinbo *et al.*, 2013). The ease with which rice is prepared fits into urban lifestyle, where households rush up daily to catch up with career demands (Oguntona and Akinyosoye, 1986; Bamidele *et al.*, 2010; Oyinbo *et al.*, 2013). The average rice consumption expenditure represents 60% of the total expenditure on cereals and 17% of expenditure share on food commodities (NLSS; NBS 2004). The demand for rice in Nigeria amounts to 4.1 million metric tons in 2002 (Akande, 2007) and has risen astronomically to 5.2 million metric tons and 5.9 million metric tons in 2011 and 2012, respectively (IRRI, 2014).

The foregoing notwithstanding, the production increase has been unable to match the consumption increase (Okoruwa *et al.*, 2006; Rahji *et al.*, 2008) and domestic production capacity is below the national requirements for rice (Rahji and Adewumi, 2008). Nigeria is the largest producer of rice in West Africa, but the country with a population of over 150 million people still relies on massive rice importation (Bello, 2004; Okoruwa *et al.*, 2006; Rahji *et al.*, 2008). Bello (2004) states that Nigeria imports US$700 million worth of rice in 2003. It also accounts for 20% of sub-Saharan Africa's rice imports (Omotola and Ikechukwu, 2006). Similarly, Workman (2008) reports that Nigeria imported 1.4 million tons of rice, equivalent to 4.8 percent of global rice imports and therefore tops the list of rice importers in the year 2007. Nigeria also expends US$1.3 billion every year to import 2.2 billion kg of rice in order to fulfil its domestic requirements (Akosile, 2009). It also spends whooping ₦630 billion annually on the importation of agricultural products, of which rice gulps ₦75 billion, following wheat and fish as the most imported agricultural products (Sanusi 2011). These imports represent a substantial foreign exchange outlay for the Nigerian economy. Given the size and value of the imports, there is considerable policy interest in reducing rice imports by promoting domestic rice production and consumption (Sanusi, 2003; Omotola and Ikechukwu, 2006).

Thus, rice has become a strategic commodity in the Nigerian economy. The Nigerian government has the objective of self-sufficiency in rice high on its agenda as epitomised by the intermittent import bans, government's attention on varietal improvement, seed multiplication, varying tariff regimes on imported rice in the past (Akpokodje *et al.*, 2001; Erenstein *et al.*, 2004; Akande, 2007), more recent special rice projects, import substitution policies, presidential initiative on rice (NFRA, 2008; Akosile, 2009) as well as Agricultural Transformation Agenda (ATA) that targets 2018 for self-sufficiency in rice production (Akinwunmi, 2012; Adeyeye, 2012). The Nigerian government has intervened in the rice sector in the past few decades, yet domestic production has been unable to catch up with demand, resulting in continuous importation of milled rice. Given this scenario, self-sufficiency (a balanced ratio of domestic supply to demand) in rice remains a proximate objective of the Nigerian government.

1.2 Statement of the Problem

In the 1960s, Nigeria was 99 percent self-sufficient in the rice consumed by its citizens. In the following two decades (1970s and 1980s), self-sufficiency declined to 38 percent, resulting from demand outstripping supply (Akande, 2007). The 360,000 tons of rice produced in the 1960s was enough to meet local demand, but the 1.45 million tons produced in the 1990s was not (IRRI, 1991; IRRI, 1995). Thus, importation of rice rose from an annual average of 7,000 tons in the 1960s to 657,000 tons in the 1990s (IRRI, 1995). In1999, the value of import was US$259 million, partly leading to a drain on Nigeria's foreign exchange reserve, which stood at US$407.5 million in the 1960s but dropped to US$58 million in the 1990s (IRRI, 1999). Also, between 1961 and 1999,Nigeria had spent $4 billion on rice importation alone, an average annual import value of US$102 million (RIFAN, 2006). The Central Bank of Nigeria (2002) also notes that US$578 million worth of rice was imported in 2002. Nigeria expends ₦250 billion annually on agricultural products, rice alone gulps ₦60 billion (NAMIS, 2004). The rice importation bill has risen to US$1.3 billion annually (Akosile, 2009). Worse still, Nigeria's rice import burden was predicted to swell, as demand was estimated to double supply growth in 2013 (TIN, 2010). Given the precarious balance of payment position of the country, rice import has become a major source of concern.

According to RIFAN (2006), as at 2003, demand for rice was estimated at 5 million metric tons while production was 3 million metric tons of rice; a short-fall of 2 million metric tons, which was augmented by importation. The 2 million metric tons importation out of 5 million metric tons demand at a cost of US$300 million dampened the hope of possible improvement in the level of domestic rice production.The target during the first national conference on harmonisation for sustainability of self-sufficiency in rice productionheld in Abuja, Nigeria’s capital, in 2003, was that, by November 2005, locally produced rice would be 4.2 million metric tons leaving a gap of 800,000 metric tons to fill the vacuum created by domestic demand, but this target was not attained (RIFAN, 2006). Nigeria, which is about one-fifth of the population in the sub-Saharan Africa, consumes the highest volume of rice within the region (Momoh, 2007). Rice is now a staple food for over 60 percent Nigerians (RIFAN, 2006).The inadequate level of cereal production to match demand in Nigeria is manifested in high prices and an annual increasing expenditure on importation (CBN, 2000; Bashorun, 2013). This rising demand for rice is a function of several price and non-price factors that need to be identified and managed.

Nigeria has suitable ecologies and a potential land area for rice production.The potential of riceyield has not been fully realised inspite of increasing area of cultivation (Akpokodje *et al.*, 2001; Akande, 2007). The risk and uncertainty faced by agricultural firms is much higher than that faced by other standard firms. The agricultural sector is characterised by high imperfection in price and other information.As a result, the production behaviour of agricultural firms greatly differs from that of other firms, yet risk factors are often neglected in the analysis of supply response and dynamic modelling has not been employed in most cases (McKay *et al.*, 1999; Muchapondwa, 2008). Similarly, little has been done in Nigeria to capture the impact of non -price factors(such as, climate, area and import level) on supply (Rahji and Adewumi, 2008).This is a gap that needs to be filled.

Numerous general and specific agricultural research, policies and programmes in Nigeria such as, previous import bans, government's attention on varietal improvement, seed multiplication, varying tariff regimes on imported rice, special rice projects, multinational NERICA rice dissemination project, import substitution policies, presidential initiative on rice and Agricultural Transformation Agenda (Akpokodje *et al.*, 2001; Erenstein *et al.*, 2004; Akande, 2007; NFRA, 2008; Tiamiyu, 2009; Akosile, 2009; Adeyeye, 2012; Akinwumi, 2012) have been executed in Nigeria over time.However, local rice production has not kept up with the domestic demands of the Nigerian populace and, consequently, rice is still massively imported (Rahji and Adewumi, 2008). This calls for the reexamination of the effectiveness of these policies.

Also, with increased production of local rice, it is still not certain that consumers will purchase local rice if there is preference for imported rice (Sanusi, 2003), thus, defeating the goal of self-sufficiency in the face of increased production. Socioeconomic factors play a key role in determining the direction of preference for various rice commodities. Researches in the area of consumer preference and switching factors for rice, especially at the national level, have received little attention, a gap filled by this study. Similarly, recent development in the fast food industry that involves the promotion of consumption of local foods including local rice, and the inclusion of local rice in ceremonial delicacies point to the fact that the Nigerian consumers have tendency to switch to local food if it is made acceptable and competitive enough through improved processing and quality enhancement. This further necessitates a study on the determinants of preference switch from foreign to local rice and vice versa.

In line with these facts, the following research questions become fundamental in this study.

1. What is the pattern of rice consumption in Nigeria?
2. Which trend does rice self-sufficiency ratio follow in Nigeria?
3. What are the factors that determine the demand for rice in Nigeria?
4. Does domestic rice supply respond to price and non-price factors in the short run and the long run?
5. Are there socioeconomic factors that switch consumers' preference from foreign to domestically produced rice or vice versa?

1.3 Objectives of the study

The main objective of this study was to determine the factors that influence the demand, supply response and preference switch for rice in Nigeria.

The specific objectives were to:

1. describe the expenditure pattern of rice in Nigeria.
2. examine the self-sufficiency ratio of rice in Nigeria.
3. estimate a demand model for rice in Nigeria.
4. analyse the supply response of rice in Nigeria.
5. isolate the determinants of preference switch from foreign to domestically produced rice and vice versa.

1.4 Hypotheses of the study

The following hypotheses were tested:

Ho: There is no significant relationship between the demand for rice and socioeconomic factors in Nigeria.

Ho:Rice supply does not respond to price and non-price factors in the short run and the long run.

Ho:Socioeconomic factors do not determine the preference switch from foreign to local rice and vice versa.

1.5 Justification of the study

In view of the ever-increasing demand for rice and the inability of local rice supply to meet demand that necessitates continuous importation of milled rice at a cost that drains Nigeria's foreign exchange earnings(Okoruwa and Ogundele, 2006; Momoh, 2007; TIN, 2010), a study of this nature, that estimates the determinants of demand for rice in a bid to stimulate domestic rice consumption and increase the market share of domestically processed rice as stipulated in the Agricultural Transformation Agenda, is relevant to save the nation'sforeign exchange reserve. Estimation of demand functions is also useful as they provide us with income and price elasticities which are required for the design of different policies; for example, policy design for indirect taxation and subsidies requires knowledge of these elasticities for tradable commodities and services (Deaton, 1988).

Most past Nigerian studies on rice like Imolehin and Wada (2000), Akpokodje *et al.* (2001), Kebbeh *et al.*(2003), Ajetomobi (2005)**,**Okoruwa and Ogundele (2006), Okoruwa *et al.* (2006), Tijani*et al.* (2006), Bamidele *et al.* (2010), Bamba *et al.* (2010), Adeyeye *et al.* (2012) and Oyinbo *et al.* (2013)dealt with either the supply or the demand side of the rice sector, only very few studies that combine demand and supply response have been carried out in Nigeria (Rahji and Adewumi, 2008). This study combined the two sides of the rice market to bring about a holistic view of the Nigerian rice economy, thus contributing to the literature in this regard and assisting in designing policies on the attainment of rice self-sufficiency from a comprehensive perspective.

Furthermore, most supply response studies in Nigeria, such as Rahji *et al.*(2008), limited their analysis of supply response to price factors, yet rice supply has been hypothesized to be a function of several price and non-price factors.This study specified a supply response function for rice, inclusive of price and non-price factors in both the short run and the long run, thereby exposing the response of rice to non-price factors. This will provide additional information on policy design for rice production, especially when rice is non-responsive to price.

Unlike previous studies on supply response in Nigeria (such as Abalu, 1974; Ajakaye, 1987; Oyejide, 1990; Yunus, 1993; Koc, 1998 and Rahji *et al.*, 2008), which paid less attention to the impact of risk and uncertainty on agricultural production, this study captured the influence of rainfall- a critical climate variable (non-price factor) on rice supply in Nigeria.

It has also been established that there are variations in the demand and supply of rice in different regions and geopolitical zones in Nigeria (NLSS, 2004; Erenstein *et al.*, 2004; NFRA, 2008; Bashorun, 2013; Adeyeye, 2012). This study analysed demand from the perspective of geopolitical zone. This will enable the problem of disequilibrium in supply and demand of rice to be examined on regional basis rather than the conventional approach of focusing on the national level on the assumption that there are no ecological and cultural variations among the people of Nigeria.

In addition, this study will also provide insight into the extent to which government policies (trade liberalisation and importation) are effective in impacting rice supply in Nigeria. Agricultural response in the form of increased food production could assist in moderating inflation and thus contribute to the process of internal adjustment (Muchapondwa, 2008).

Furthermore, as long as consumers continue to exhibit preference for foreign rice above local rice, the goal of rice self-sufficiency may not be totally met. Thus, consumer preferences and switching factors which are analysed in this study are very vital. This is an area which has receivedvery littleattention in Nigerian studies at the national level (Nwachukwu *et al.*, 2008; Agwu, *et al.*, 2009, Adeyeye, 2012).

Methodologically, the strength of this study lies in the use of co-integration and error correction procedure in modelling supply response in Nigeria as against the traditional Nerlove's model. McKay *et al.*(1998) asserts that the advantage of using Error Correction Model (ECM) include the fact that spurious regression problems are bypassed, and that ECM offers a means to incorporate the levels of the variables *x* and *y* alongside their differences. The ECM also conveys information on both short-run and long-run dynamics. Nickel (1985) demonstrates that the ECM specification represents forward-looking behaviour, such that the solution of a dynamic optimisation problem can be represented by an Error Correction Model. The ECM can, thus, be interpreted as describing farmers reacting to 'moving' targets and optimising their objective function under dynamic conditions.

In summary, this research isolated the factors that affect demand, supply response as well as preference switches of rice and generated policy measures to effectively manage demand and boost domestic supply, as contributions to the goal of attaining rice self-sufficiency in Nigeria.This is in consonance with the broad agricultural policy objectives of thevarious tiers of government, which include the attainment of self-sufficiency in food and fibre,improvement in the socio-economic welfare of the people, reduction in the rate of food price inflation, diversification of the country's sources of foreign exchange earnings through the rejuvenation of agricultural export commodities and the production of raw materials for local agro-based industries.It is also in tune with the ongoing Agricultural Transformation Agenda in the country(Sanusi, 2003; Bello, 2004, Akinwumi, 2012).

1.6 Organisation of the study

The thesis is structured into five chapters.The first chapter is the introductory chapter and contains the background, statement of the problem, objectives, hypotheses and justification of the study. The second chapter reviews concepts, theories and existing literature relating to demand, supply and preference switch of rice. Chapter three presents the research methodology consisting of the study area, data and sampling procedure as well as analytical techniques employed. In the fourth chapter, the results of the analysis on socioeconomics, determinants of demand, supply response and preference switch are presented and discussed in detail. The final chapter is the inferential part, where summary, conclusion, policy implications, recommendations and area of further research were rendered.

CHAPTER TWO

THEORETICAL/CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

This chapter presents the basic concepts and theories of demand, supply and preference for commodities. It further reviews the methodologies of demand analysis and issues in supply response analysis. The chapter also covers empirical review on rice demand, supply and import trends as well as determinants of rice demand, preference switch and supply response.

2.1 Theoretical and conceptual reviews

This section reviews theories and concepts of demand, supply and preference for food.

2.1.1 Concept and theory of food demand

Seale *et al.* (2003) described demand analysis as a science of consumer choice or preferences among different goods and services. Since the demand for any good or group of goods is dependent on the price and availability of other products, analysing consumer demand is essentially the act of analysing consumer preferences, that is, how the consumer chooses to allocate his income among different products. Economists often use the concept of utility to define the level of satisfaction or welfare that comes from a specific allocation of income among different products. Deaton and Muellbauer (1980) states that the basis of demand analysis is the problem of how to maximise utility subject to a given level of income, the latter also being known as budget constraint. This can be expressed as:

$$Maximize\ U = \upsilon\ (q_1, q_2 \ldots\ldots\ldots q_n) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Subject to $\sum p_k, q_{k-x}$

where U is a utility function of the quantities of goods consumed, x is total income, and p and q are prices and quantities,respectively. Solving this maximisation problem by setting up the Langrangean function will lead to a set of demand equations that expresses the quantity demanded for each good as a function of the price and total income:

$$q_{i-}\ g_i(x, P) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

where P is the vector of commodity prices

This type of demand function, based on utility maximisation, is known as a Marshallian or uncompensated demand function. For a logarithmic utility function, both income and price elasticity can be calculated by taking the derivative of the Langrangean function, resulting in the following equation:

$$dlogq_i - \eta_i dlogx = \sum_{j=1}^{n} \mu_{ij}\, dlogp_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

where η_i is the income elasticity and μ_{ij} are the uncompensated price elasticities. So that changes in prices and total expenditure do not violate the budget constraint in the demand function, the following conditions on the elasticities must hold,

$$\sum_{j=i}^{n} w_j \eta_i - 1 \; and \; \sum_{j=i}^{n} w_i \mu_{ij} + w_j - 0 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

where w is the budget share. These two conditions are known as Engel and Cournot aggregation, respectively, and together are sometimes referred to as the adding up restriction. The Marshallian demand function is the solution to the consumer's problem of maximising utility subject to the budget constraint. However, the consumer's problem can also be expressed as one of minimising total expenditures or costs subject to a predetermined utility level or,

$$Minimize\ x - \sum p_k q_k\, subject\ to\ v(q_1, q_2 \dots\dots\dots q_n) - u \dots\dots\dots\dots\dots\dots\dots (5)$$

The solution to the problem is the Hicksian demand function, which is equivalent to the Marshallian demand function when evaluated at the optimal utility level

$$q_i - h_i(u,p) - g_i(x,p) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

The Hicksian demand function is also known as the compensated demand function, since it represents demand when utility is held constant. Price elasticities derived from the Hicksian demand function are called "compensated" or " Slutsky" price elasticities and are equal to the uncompensated price elasticity (also called ''Cournot'' price elasticities) plus the product of the income elasticity and the budget share. This is stated thus:

$$\varepsilon_{ij} = \mu_{ij} + \eta_i w_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

where ε_{ij} is the Slutsky price elasticity

In this study, we follow the assertion of Attanasio (1999) and Olayemi (2004b), that effective food demand is equal to food consumption. Food consumption is a component of the food system at which people's nutritional needs are met at individual or household level.

Familiarity with modern consumption research requires understanding of three fundamental modules: Keynes's Absolute Income Hypothesis (AIH), Friedman's Permanent Income Hypothesis (PIH) and Modigliani's Life Cycle Hypothesis (LCH). Modern consumption research is however based, to varying degrees, on at least one of these approaches. The concept of consumer demand refers to the variations in the quantities of a commodity that a consumer is expected to buy at specified (different) prices and time period, assuming that his income, prices of other (substitute) commodities, tastes and preferences, and all other pertinent factors remain constant.

In mathematical form:

$$Q_d = f(p, y, p^*, a, z) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (8)$$

where:

Q_d = quantity of commodity demanded,

p = price of commodity,

y = consumer's income,

a = taste and preferences

p* = prices of related commodities (substitute or complement),

z = other factors.

According to Olayemi (2004b), demand theory suggests an inverse (negative) relationship between the quantities demanded of that product and its (own) price. The relationship between the quantity demanded of one commodity and price of other commodities may be positive, negative or zero. This is called a cross-price effect. Relationships are expected to be positive for substitute products. For complementary products, the relationship is expected to be negative. That is, an increase in the price of one commodity may lead to a decrease in demand for the other. The relationship is expected to be zero for independent products, meaning that the price of one product does not affect the demand for the other.

Also predicted by economic theory is a direct relationship between the consumer's income and the quantity demanded of a product at any given price, that is, as consumer's income (y) increases, quantity demanded (q) is expected to increase. But based on Engel's surveys of families' budget and expenditure patterns, Engel (1974) notes that, with rising incomes, the share of expenditures for food products declines. The resulting shift in expenditure affects demand patterns and employment structures but Engel's law does not suggest that the consumption of food products remains unchanged as income increases. It suggests that the consumers increase their expenditures for food products (in percentage terms) less than their increased income. The poorer a family is, according to Engel's law, the greater the proportion of the total amount of money that must be used for food. Within a country, the poor spend a higher proportion of their income on food than the rich in the same society, and at the aggregate level, poor countries spend more of their Gross National Product (GNP) on food than wealthy ones. Several factors may affect a product's elasticity of demand, but, generally, it is true to say that essential goods have inelastic demand, while luxury goods have elastic demand. Since food is regarded as an essential good, human beings need food in order to live. Once humans have enough food to satisfy their needs, they do not generally buy more food. So, consumers demand for food is income-inelastic. As consumers' incomes increase, households spend their money on luxuries (such as manufactured goods, holidays, and so on). The producers of these products, in turn, receive higher incomes (one person's spending is another person's income). Another noticeable economic theory suggests that as output or supply of a product increases, its price will fall. As the price of a product falls, normally consumers will demand more of it, but the demand for food is price inelastic. In fact, any fall in the price of food effectively increases consumers' disposable income, and they are likely to spend that money on more luxuries (Olayemi, 2004b).

Consumers may continue to make purchases on the basis of habit if prices have changed. Tastes and preferences of individual consumers may change for a variety of reasons such as age, education and social status. For example, consumer education about health and nutrition may influence the type of foods purchased. Similarly nutritional knowledge of household head plays an important role in the consumption of food items(Agwu *et al.*, 2009).

In line with the foregoing, this study considered the effect of price, income and other socioeconomic factors on rice demand and preference switch.Relevant elasticities were also computed in this regard. Since it has also been established that demand is also a function of tastes and preferences borne out of socio-cultural affiliations, a geopolitical zone analysis of factors affecting demand is relevant in Nigeria, as considered in this study.

2.1.2 Supply response theory

As stated by Muchapondwa (2008), the modelling of the aggregate supply response has its foundations in the theory of the firm. The interest is on the output supply function, and not on input demand functions. Hence, the commonly used approach of expressing the firm's problem in an output perspective is usually employed. Such an approach assumes that optimisation has already been achieved in the input space and that the firm uses the least cost combinations for the production of any output level. This least cost approach is conceptually plausible because producers would just want to produce a given output with the minimum cost outlay rather than try to directly optimise in the input space by equating marginal factor productivity to marginal factor cost. Producers are only aware of the costs they pay for inputs and do not generally have an idea of the input marginal productivities. A profit maximising firm produces output up to the point where it equates marginal revenue to its marginal cost. When producers are price-takers, as the general case for farmers, profit maximisation behaviour equates the marginal cost to price. As such, the firm's supply function is simply its marginal cost function. The supply function is defined only in the range where price is greater or equal to the minimum of the average variable cost. Hence, the quantity of a product produced and supplied depends on its own price, the prices of substitute and complementary products, and the prices of inputs(McKay *et al.*, 1999). Supply can, thus, be expressed as the inverse of the marginal cost function. The fundamental result from the theory of the firm is that price is the most important determinant of supply (Rahji, 1999; Begum *et al.*, 2002). Therefore, the price of rice is included in the analysis.

Muchapondwa (2008) further claims that the analysis underlying the theory of the firm assumes instantaneous response between inputs and outputs, which is not applicable to agriculture. Firstly, the agricultural sector is characterised by biological lags between input application and output production. Secondly, for the agricultural firm, the technical rules imply that the production function may actually change during the course of the production process. Thirdly, for agricultural firms, there exist technological and institutional factors which prevent intended production decisions from being fully realised during some periods. Fourthly, the assumption of perfect knowledge and foresight is not valid for the majority of agricultural firms.The agricultural sector is characterised by high imperfections in price and other information. Finally, the risk and uncertainty faced by agricultural firms is much higher than that faced by other standard firms. As a result, the production behaviour of agricultural firms might be expected to divert from what the theory of the firm stipulates. For example, as a result of the presence of risk and uncertainty, farmers might not have the profit maximisation goal, but, rather, they might seek to minimise risks and maintain food security. Modifications and extensions to the theory of the firm would thus be needed to capture the realistic production processes of the agricultural firms in any attempt to model agricultural supply response. All the above problems have been dealt with in the literature in a number of ways. The generic solution to these problems has been the use of dynamic models in modelling agricultural supply response (Deb, 2003). This was adopted in this work. Risk, technical and institutional factors were also included in the analysis to reflect the peculiarity of the agricultural firm.

Cobweb theorem

The prices of agricultural goods fluctuate over time because of unplanned variations in supply and the difficulty of altering supply in the short run. This fluctuation in prices is explained by the Cobweb theorem, which represents a dynamic model, that farmers base their production decisions for next year (Q_{t+1}) on the current price (Pt). Generally, the higher the current price, the more they will be willing to produce next year. This implies that the quantity to be supplied next year is a function of the current price. This means that current supply quantity (Qt) is a function of last year`s price (P_{t-1}) and that current supply is not a function of current price. However, the current demand for the commodity is affected by and is a function of the current price. Over all, fluctuations in the price from one year to the other may steadily approach the equilibrium price, resulting in convergent cobweb model; or the fluctuations may become wider and wider over successive periods, leading to a divergent cobweb model (Gujarati, 2003; Olayemi, 2004a; Gujarati and Sangheeta, 2007; Rahji and Adewumi, 2008).

In line with the cobweb theorem, lag values of prices and output were included in the supply response analysis specification for this study.The coefficients of adjustment to equilibrium in our supply model were also estimated.

2.1.3 Consumption preference theory

The theory of household consumer behaviour is based on the concept of consumer preference and assumed existence of consumer utility functions. The theory assumes that, when a consumer is faced with alternative bundles or ‘baskets” of commodities each of which has some amounts of utility content, he/she will prefer a bundle with higher utility content to one with lower utility content. The consumer utility function defines the satisfaction which can be derived from various commodity bundles within his or her choice range, provided every consumer is a utility maximiser and there exists a perfect competition in the market (Olayemi, 2004b; Nwachukwu *et al.*, 2008).

Utility was originally based on the theory of cardinal utility, which assumes that utility is measurable on cardinal scale, that is, consumers are assumed to be able to assign numerical utility value to alternative bundles of commodities. This later developed into a simpler concept of ordinal utility and indifference curve. The concept of ordinal utility proposes that the consumer is assumed to be rational enough to, at least, be able to rank commodities in order of preference (Atanasio, 1999).The Indifference curve describes the locus of combination of commodities that gives the same level of satisfaction.

This concept of utility is relevant to this study as preference switch for different types of rice-'imported', 'improved domestic' and 'local'-were analysed based on the utility theory.

For the purpose of this study, the utility function is defined as follows:

$u_1 = f(q_1, q_2, q_3, q_4)$ ....(9)

where U_1= utility derived from rice consumption

q_1= Imported rice

q_2 = Agric. rice

q_3 = Local rice

q_4 = Other Food Commodities

This could be transformed as:

$u_2 = f(kq_1, kq_2, kq_3, kq_4)$ for $k > 0$ without changing the preference ranking…...………....(10)

Above all, the overriding assumption is still that the consumer is rational and has the objective of utility maximisation. However, consumption preferences have been hypothesized to be a function of many factors. Hence, utility maximization, in line with consumption preference, is constrained by income, price and other demographic/socioeconomic factors in this study.

2.2 Methodological review

In this section, various methods of analysing demand are discussed. Also, issues in time series modelling and methods of estimating supply response are explained in detail.

2.2.1 Estimation of demand

Estimation of demand for goods and services has attracted the attention of both theoreticians and empiricists, and very dense literature is available on this subject. Some of the past studies have ignored the required connections between the theory and empirical analysis, and concentrated on the estimation of single demand equations. Food demand analysis is dominated by the econometric estimation of demand systems based on aggregate market data and steady progress that have been made in analytical techniques (FAO, 2007). The main approaches are the use of simple Engel curves and the use of demand systems. Demand is empirically measured with the use of mathematical symbols involving the estimation of functional forms and it is the most straightforward and convenient way in demand estimation. Some of the existing models in use include the probability models, such as the Probit, and Logit models for qualitative dependent variables, Heckman two-stage model and the Tobit model applicable to continuous dependent variables of truncated or censored data(Tobin, 1958; Akinyosoye, 2007; FAO, 2007). Others are flexible functional forms that estimate completedemand systems,such as the Translog Demand System (TDS) of Christensen *et al.*(1975); Generalised Leontief Demand System and Linear Expenditure System (LES) proposed by Stone (1954); Quadratic Expenditure Demand System (QUES), Rotterdam Model of Theil (1965) and the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980). This new modelling has attracted a great deal of attention, and has been used extensively in empirical works. Moreover, extensions of the standard AIDS has been developed to make this modelling as rich as possible. Among these are Inverse AIDS, by Moschini and Vissa (1992), Quadratic AIDS, by Banks *et al.* (1997) and more recently Semi-Flexible Almost Ideal Demand System, by Moschini (1998).

In order to take care of the censored and truncated nature of the NLSS data, this study utilisedthe Tobit model to estimate the demand for rice for the entire data set and further tried the AIDS model on non–zero observations for flexibility of estimation. These will be fully discussed in the chapter three.

2.2.2 Methodological issues in time series modelling

(1) Serial correlation theory

A common finding in time series regressions is that the residuals are correlated with their own lagged values. This serial correlation violates the standard assumption of regression theory, that disturbances are not correlated with other disturbances. As a result, we find that OLS is no longer efficient among linear estimators; standard errors computed using classical OLS procedures are not correct, and are generally understated; and if there are lagged dependent variables on the right-hand side of the equation, OLS estimates are biased and inconsistent (Greene, 1997, Gujarati and Sangheeta, 2007).

In view of the problems of serial correlation in time series regression, it is important to examine the residuals of a regression equation for evidence of serial correlation before using an estimated equation for statistical inference (for example, hypothesis tests and forecasting).

The general specification of a regression with an autoregressive process of order p, AR(p) error is given by:

$$y_t = X\beta + \mu_t \qquad (11)$$

$$\mu_t = \rho_1\mu_{t-1} + \rho_2\mu_{t-2} + \dots + \rho_p\mu_{t-p} + e_t \qquad (12)$$

The autocorrelations (ρ_i) of a stationary AR(p) process gradually die out to zero, while the partial autocorrelations for lags larger than p are zero. The most widely used approach for testing for existence of serial correlation is the Durbin-Watson (DW) statistic. Other diagnostic tools include the Q-statistic and the Breusch-Godfrey LM test. The DW statistics tests for first-order serial correlation, AR(1), or linear association between adjacent residuals from a regression model. It is a test of the hypothesis: $\rho=0$ in the specification: $\mu_t = \rho\mu_{t-1} + e_t$, where the μ_t is the vector of OLS residuals in the regression. $y_t = X\beta + \mu_t$.

The test statistic is: $d = \sum_{t=2}^{N}(e_t - e_{t-1})^2 / \sum_{t=1}^{N} e_t^2$.

If there is no serial correlation, the DW statistic will be around 2. The DW statistic will fall below 2 if there is positive serial correlation (in the worst case, it will be near zero). If there is negative correlation, the statistic will lie somewhere between 2 and 4 (Greene, 1997)

Several techniques are available for estimating models containing autoregressive residual terms (AR models). The most widely used are the Cochrane-Orcutt and Prais-Winsten iterative procedures, which are multi-step approaches designed so that estimation can be performed using standard linear regression. However, as pointed out by Greene (1997), these approaches suffer from important drawbacks which occur when working with models containing lagged dependent variables as regressors, or models using higher-order AR specifications. Such problems are usually overcome by estimating the higher order AR (q) process by maximum likelihood techniques and, better still, by specification and estimation of autoregressive integrated moving average (ARIMA) model (Gujarati and Sangeetha, 2007). The fact that assumption of stationarity does not hold in this work and that ARIMA model is not based on proven theories consistent with the agricultural industry will not make the model applicable in this study.

(2) Problems with non-stationary time series

A number of approaches for modelling serially correlated time series, such as the ARIMA, are based on the assumption that the time series are stationary. A series is said to be (weakly or covariance) stationary if its mean, variance and covariance do not vary with time. Any series with time varying mean, variance and auto covariance is said to be non-stationary.The canonical example of a non-stationary series is found in the random walk:

$$y_t = \beta y_{t-1} + \varepsilon_t \quad \text{...(13)}$$

where ε_t is a stationary random disturbance term, and the AR(1) process is characterised by a unit root, that is, $\beta = 1$. The series y has a constant forecast value, conditional on t, and the variance is increasing over time. The random walk is a difference stationary series since the first difference of y is stationary:

$$y_t - y_{t-1} = \varepsilon_t \quad \text{...(14)}$$

A difference stationary series is said to be integrated and is denoted as I(d), where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one unit root, so it is an I(1) series. Similarly, a stationary series is I(0).

Standard inference procedures do not apply to regressions, which contain an integrated dependent variable or integrated regressors. This is because the application of least square regression to equations containing non-stationary series results in spurious regression (Granger and Newbold, 1974). It is a situation where such regression produces high R^2 and t-ratios that are biased towards rejection of the null hypothesis of no relationship even when there is relationship between the variables.Against this background, it has become necessary to check whether a series is stationary or not before using it in a regression. The formal method for testing the stationarity of a series is the unit root test: that is, a test that:

H_0: $\beta = 1$against

H_a: $\beta \neq 1$

in regressions $y_t = \beta y_{t-1} + \varepsilon_t$ involving a series y_t where ε_t is a stationary random disturbance term (Dickey and Fuller, 1981).

(3) Approaches to unit root testing

There are three widely used unit root tests: the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Others are Kwiatkowski-Philips-Schmidt-Shin, Elliot- Rothenberg-Stock point-optimal, Ng-Perron (Gujarati and Sangeetha, 2007; EViews, 2009). For a time series Y_t, two forms of the ADF test, which are based on t-test of significance of the coefficient associated with the lagged value of the series (Y_{t-1}) in any of the following two forms of ADF regression equations:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \text{......(15)}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \text{......(16)}$$

where ε_t for t = 1,…., N is assumed to be Gaussian white noise. Equation (15) is with no constant and trend while (16) is with both constant and trend. The number of lagged term p is chosen to ensure that the errors are uncorrelated. When $\alpha_1 = 0$, the time series is non-stationary so that standard asymptotic analysis cannot be used to obtain the distribution of the test statistics (Gujarati and Sangeetha, 2007). Various researchers (Fuller, 1976; Dickey and Fuller, 1981, Guilkey and Schmidt, 1989) have designed Monte Carlo experiments to generate critical values that can be used for testing purposes. As an alternative to the inclusion of lag terms to allow for serial correlation, Phillips and Perron (1988), cited in Gujarrati (2003)proposed a nonparametric method of controlling for higher-order serial correlation in a series. The test regression for the Phillips-Perron (PP) test is the AR(1) process:

$$\Delta y_t = \alpha + \beta y_{t-1} + \varepsilon_t \quad \text{……………………………..……..…………………………….(17)}$$

while the ADF test corrects for higher order serial correlation by adding lagged differenced terms on the right-hand side, the PP test makes a correction to the t-statistic of the coefficient of the lagged residual term in the AR(1) regression to account for the serial correlation in ε. A consortium of tests for stationarity as obtainable in EViews 5.0 version was employed in this study. They gave similar results. The ADF test was reported in this study because it caters for AR(n) process in case the model did not follow AR(1) and because of its wide usage and acceptability.

(4) Cointegration and error correction theory

The need to include non-stationary series in econometric models spurred the development of cointegration techniques pioneered by Granger (1969) and Engle and Granger (1987). Engle and Granger (1987), observe that a linear combination of two or more non-stationary series may, in fact, be stationary. Such a stationary linear combination of I(1) non-stationary time series are said to be **"cointegrated"**. The stationary linear combination is called the **"cointegration equation"** and may be interpreted as a long-run equilibrium relationship between the variables. Two or more variables would cointegrate, that is, exhibit long-run equilibrium relationship(s), if they share common trend(s) (Gujarati and Sangheeta, 2007), such that, even though the I(1) series may drift apart in the short run, a stable long-run relations is guaranteed between them. Further evidence from cointegration theory suggests that, if two variables are cointegrated, the finding of no causality in the relationship between themis ruled out (Granger, 1969; Granger and Newbold1974), just as the possibility of the estimated relationship being spurious is also ruled out (Gujarati and Sangheeta, 2007). As pointed out by Engle and Granger (1987), the relationship between two or more non-stationary economic variables that are co-integrated may be given an error correction representation.

To illustrate, suppose we seek to model a simple econometric relationship of the form:

$$Y_t = \alpha + \beta X_t + u_t \quad \text{……………………………..……………………………………….(18)}$$

and we know that both X and Y are non-stationary I(1) series that are cointegrated. The idea behind ECM is that short-term "shocks", like those occasioned by changes in policy environments, weather conditions and random factors disturb the long-term equilibrium relationship which exists between X and Y, after which the two variables returns to their equilibrium. Therefore, ECM tries to capture the short-term and long-term dynamics in the relationship, and a simplified representation for the cointegrating equation in (18) may be written as:

$$\Delta Y_t = \beta \Delta X_{t-1} + \rho(Y_{t-1} - \alpha - \gamma X_{t-1}) \quad \text{.......(19)}$$

In this simple ECM, $\hat{\beta}$ captures the short-term relationship between X and Y; $\hat{\alpha}$ and $\hat{\gamma}$ capture the long-term relationship between X and Y; while $\hat{\rho}$ gives the rate at which the model "re-equilibrates", that is, returns to its equilibrium. Formally, $\hat{\rho}$ tells us the proportion of the dis-equilibrium, which is corrected with each passing period. Noting that, the second term in the right hand side of (19) is simply ρu_{t-1}, where u_t is the stochastic error term in the cointegrating equation (18), the Engle and Granger (1987) approach to ECM consists of three steps:

1. Estimation of the cointegrating regression $Y_t = \alpha + \gamma X_t + e_t$
2. From these estimate, the residual term $\hat{e}_t = Yt - \hat{\alpha} - \hat{\gamma} X_t$ are generated; and
3. The residual term is included in the short-term equation $\Delta Y_t = \beta \Delta X_{t-1} + \rho \hat{e}_{t-1}$ as an "error correction term".

The coefficients $\hat{\beta}$, $\hat{\alpha}$, $\hat{\gamma}$ and $\hat{\rho}$ obtained in this process are then interpreted and used as earlier illustrated with the simplified ECM representation in (19). The Engle and Granger (1987) approach to testing for co-integration is to test for stationarity of the stochastic residuals generated in the second stage of the three stages ECM procedure.

(5) Vector autoregression and vector error correction modelling

According to Gujarati and Sangheeta (2007), the need to analyse the dynamics of simultaneous relations that often exists among economic time series led to the analysis of vector autoregressive model by incorporating co-integration and error correction mechanism into Vector Auto Regression (VAR). Cointegration and Vector Error Correction Modelling (VECM) have emerged as the currently dominant approach to econometric analysis of time series.VAR is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables (EViews, 1998, 2009). The VAR approach sidesteps the need for structural modelling, which is often complicated by the fact that endogenous variables may appear on both the left and right side of the equation, by modelling every endogenous variable in the system as a function of the lagged values of all the endogenous variables in the system.

The mathematical form of a VAR is:

$$y_t = A_1 y_{t-1} + \ldots\ldots + A_p y_{t-p} + Bx_t + e_t \qquad \ldots(20)$$

where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, $A_1 \ldots. A_p$ and B are matrices of coefficients to be estimated, and e_t is a vector of innovations (stochastic residual terms) that may be contemporaneously correlated with each other but are uncorrelated with their own lagged values, and uncorrelated with all of the right-hand side variables. Since only lagged values of the endogenous variables appear on the right-hand side of each equation, there is no issue of simultaneity, and OLS is the appropriate estimation technique. Note that the assumption that the disturbances are not serially correlated is not restrictive because any serial correlation could be absorbed by adding more lagged y's.

A Vector Error Correction model (VECM) is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with non-stationary series that are cointegrated. The VECM specification restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics (EViews, 1998; EViews, 2009).

The general form of a VECM is obtained by rewriting the VAR in (20) as follows:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + Bx_t + e_t \qquad \ldots(21)$$

where $\Pi = \sum_{i=1}^{p} A_i - I$ and $\Gamma_i = -\sum_{j=i+1}^{p} A_j$

In this special case, y_t is a k-vector of non-stationary I(1) variables, x_t is a d vector of deterministic variables, such as a constant and/or trend terms, and e_t is a vector of innovations. Granger's representation theorem (E-views, 2009) asserts that, if the coefficient matrix Π in (21) has reduced rank r<k, which implies that r distinct linearly dependent

associations of endogenous variables in y_t exists, then there exist k x r matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. In this case, r is the number of cointegrating relations (the cointegrating rank), while each column of β is the cointegrating vector. The elements of α are the adjustment parameters in the vector error correction model.In testing for the number of cointegrating vectors among economic time series, Johansen's (1992, 1995) system approach is to estimate the Π matrix in an unrestricted form, and then test whether we can reject the restrictions implied by the reduced rank of Π. A vector error correction modelling is applicable to this study because of non-stationarity of the variables considered.

2.2.3 Methodological issues in measurement of supply response

Most empirical estimations of agricultural supply response are based on the Nerlove (1958) model, which captures the dynamics of agriculture by incorporating price expectations and/or adjustment costs. This model can be extended to include other expectational variables other than price to capture imperfect information on these variables. In the Nerlove's price expectations model, the desired output X_t^* is a function of price expectations P^e_t so that the supply function can be represented as:

$X_t^* = a + bP^e_t$ .. ……………………………………………………...………………(22)

where b is the long-run elasticity of output with respect to price. Assuming that price expectations are adaptive, then,

$P^e_t - P^e_{t-1} = \delta (P_{t-1} - P^e_{t-1})$…… ……………………..…………………………..…………….(23)

where P_{t-1} is the price in period $_{t-1}$.

Also assuming that $X_t^* = X_t$, that is, desired output is equal to realised output X_t in equilibrium and substituting for X_t^* and P^e_t from equation (23) into equation (22) gives

$X_t = a\delta + b\delta P_{t-1} + (1- \delta) X_{t-1}$ …..……….…………………………………………………(24)

This implies that output supplied can be expressed as a function of its own lagged value and price as in equation (24) with the short-run elasticity bδ.

Alternatively, the supply function can be derived from the partial adjustment perspective, that is, the actual change in output in one period is a fraction of α (such that 0 < α< 1) of the change required to achieve the desired output X*t. Thus:

$Xt = X_t^* + (1- \alpha) X_{t-1}$…..……………………..…………………………………………(25)

Assuming that $P^e_t = P_{t-1}$ and substituting equation (25) into equation (22) gives

$X_t = a\alpha + b\alpha P_{t-1} + (1- \alpha) X_{t-1}$……………………………………..………………………(26)

Thus the output supplied is expressed as a function of its lagged value and the lagged price just like in equation (24).

From both equations (24) and (26), the reduced form of the supply function in the Nerlove model is:

$X_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 X_{t-1}$.. …………………..…...……………….………………………(27)

As mentioned earlier, most empirical estimates have been based on the Nerlove model. Since only the actual output rather than the optimal output is observed in reality, only the reduced form equation (27) or its variation can be estimated. However, McKay *et al.* (1999) assert that estimating equation (27) makes it difficult to distinguish between δ and β when both adaptive expectations and partial adjustment are present. This implies that the long-run price elasticity cannot be estimated based on the Nerlove model unless assumptions are made on whether the model is a partial adjustment or price expectation model. Therefore, certain arbitrary restrictions often have to be made. Furthermore, the simple adjustment mechanism can be derived from the minimization of a single-period quadratic loss function with static expectations. This assumes no forward-looking behaviour by agriculture producers. In any case, output adjustment to annual price fluctuations is likely to be small since a strong response may come only if price changes are deemed permanent. Thus, the Nerlove model is unlikely to capture the full dynamics of agricultural supply hence biasing the elasticity estimates downwards (Thiele, 2000).

The methodology developed by Griliches (1960) is specifically for estimating aggregate supply response and based on the aggregation of input demand elasticities. A constant returns Cobb-Douglas production function with a vector of n inputs can be differentiated with respect to producer price, and reformulated in terms of elasticities. Assuming profit maximisation, the elasticity of output with respect to input, i can be estimated by the value share of input, i in total revenues (or total costs assuming that zero economic profits prevail at the equilibrium). The aggregate supply elasticity is then obtained by aggregating the input demand price elasticities in concordance with their factor shares in total costs or revenues. Lags in the input demand functions are introduced to estimate short-run and long-run elasticities. If we assume that the output reaches equilibrium only if all inputs are in equilibrium, then the short-run aggregate supply response to prices is obtained from the weighted aggregation of the short-run input demand elasticities, and the long-run supply response from the weighted aggregation of the long-run input demand elasticities.

To date, the Griliches method has been used for developed countries only as it demands an extensive dataset on input and output prices and quantities, not usually available for developing countries. It further assumes that the increased use of purchased inputs would increase aggregate supply, but does not account for essential inputs which are not purchased by farmers, such as family labour. The model also presupposes that resources supplied to the agricultural sector are perfectly elastic and always meet the farmer's demand at going prices, which is certainly not true for most developing countries. For example, when fertilizers and pesticides are imported, their supply is often constrained by shortages in foreign exchange. Finally, the method rests on the assumption that the underlying production function is of the Cobb-Douglas form, implying a unit elasticity of substitution between factors of production (one could argue that a Leontief specification, having a zero elasticity of substitution, is more appropriate for peasant farmers, at least in the short run) (McKay *et al.*, 1999).

An alternative to the Nerlove and Griliches models is the time-series analysis which is currently the most widely used approach for estimating supply response. Modern time series techniques offer a new promise. Cointegration analysis can be used with non-stationary data to avoid spurious regressions (Banerjee *et al.*, 1993). When combined with error correction models, it offers a means of obtaining consistent yet distinct estimates of both long-run and short-run elasticities. Mc Kay *et al.* (1998) note that Hallam and Zanoli (1993), Townsend and Thirtle (1994), Abdulai and Rieder (1995), and Townsend (1996), have used cointegration analysis and ECMs to estimate supply response at a commodity level, on the basis that they are preferable to the traditional partial adjustment model.

Since Nerlove model is unlikely to capture the full dynamics of agricultural supply and does not represent a forward-looking behaviour, this method was not used to analyse supply response in this study. Since our aim here is not to estimate aggregate supply response but commodity level response, and based on the data requirements and unrealistic assumptions that are not in conformity with the peculiarities of developing countries, the Griliches model was notemployed in this study. In line with recent studies, this study used the error correction model in a cointegration and vector autoregressive framework in estimating supply response while adding value through incorporation of non-price, risk and policy factor to take care of the peculiarities of the agricultural industry and enable us to measure the long-run elasticity along with the short-run elasticity.

2.3 Empirical reviews

Here,review of previous studies on relevant issues on rice demand, preference and supply as well as associated issues on rice self-sufficiency is the focus.

2.3.1 Trends inrice demand and preferencein Nigeria

Rice is the world's most important staple food crop consumed by more than half of the world population, as represented by over 4.8 billion people in 176 countries with over 2.89 billion people in Asia, over 150.3 million people in America and over 40 million people in Africa (IRRI, 2004). Cereals generally account for 49.7 percent of total expenditure on foods in Nigeria (NBS, 2012).Of all the staple crops,rice has risen to a position of preeminence. Rice has traditionally been an important basic food commodity for certain populations in sub-Saharan Africa particularly West Africa(Imolehin and Wada, 2000; Akpokodje *et al.*, 2001; Erenstein *et al.* 2004; Akande, 2007). In the past, ricewas been considered a luxury food for special occasions only, but with its increased availability, ithas become part of the everyday diet of many in Nigerians.

Since the mid-1970s, rice consumption in Nigeria has risen tremendously, at about 10% per annum owing to changing consumer preferences (Akande, 2007).Akpokodje *et al.* (2001) aver that the demand for rice has been increasing at a much faster rate in Nigeria than in other West African countries since the mid-1970s. For example, during the 1960's Nigeria had the lowest percapita annual consumption of rice in the sub-region (average of 3 kg). Since then, Nigerian percapita consumption levels have grown significantly at 7.3% per annum. Consequently, per-capita consumption during the 1980s averaged 18kg and reached 22 kg in 1995-1999 and 20.9kg by the year 2009 (Akande, 2007; IRRI, 2014)

A combination of various factors seems to have triggered the increase in rice consumption. Like elsewhere in West Africa, urbanisation appears to be the most important cause of the shift in consumer preferences for rice in Nigeria. Rice is easy to prepare compared to other traditional cereals, thereby reducing the chore of food preparation and fitting more easily into urban lifestyles of the rich and the poor alike (Bamidele, 2010; Oyinbo *et al.* 2013). Educated housewives in urban areas are completely detached from their mothers' kitchen and because of their work life cannot spend much time in the kitchen, so they opt for fast-cooking foods, one of which is rice(Oguntona and Akinyosoye, 1986). Rice is no longer a luxury food in Nigeria and has become a major source of calories for the urban poor. For example, the poorest third of urban households obtain 33% of their cereal-based calories from rice, and rice purchases represent a major component of cash expenditures on cereals (World Bank, 1996; Akpokodje *et al.*, 2001; Kebbeh *et al.*, 2003).

Recent important and major changes have led to increase in rice consumption in the sub-region, driven by a combination of population growth and substitution away from traditional coarse grains. The consumption of traditional cereals, mainly sorghum and millet, has fallen by 12 kg per capita, and their share in cereals used as food decreased from 61% in the early 1970s to 49% in the early 1990s. In contrast, the share of rice in cereals consumed has grown from 15% to 26% over the same period (Akande, 2007).The average Nigerian consumes 24.8kgof rice per year, representing 9% of total caloric intake (FAO Rice Web, 2001). Rice calorific intake has reached 9.35% in 2009 (IRRI, 2014).

As at 2003, demand for rice was put at 5million metric tons; rice is now the staple food for over 60% of Nigerian homes (RIFAN, 2006). The Philippines News Agency (2009) equally notes that the cost of broken rice shot up by 13% as a result of demands from Nigeria.Imported parboiled rice meets the consumer demand in urban areas where incomes are higher. Locally milled rice is of poor quality and is consumed mainly in the rural areas (Omotola and Ikechukwu, 2006). The trend in rice consumption in Nigeria, according to available statistics from Food and Agricultural Organisation from 1995- 2009, is illustrated in Figure 1.

The demerit of Nigeria's dependence on imported rice is more as the share of the imported rice in the Nigerian food market is far above that of the domestically produced rice. Rice imports have affected the domestic production and marketing of Nigeria's local rice. This is due to the decreased demand for local rice by Nigerians as opposed to the imported ones. The local Nigerian variety has a lower demand as a result of the high cost of production which isnot usually subsidized by the government. The non-competitiveness could also be due to poor processing resulting in a final product with a high percentage of broken grains, stones and debris (FAO, 2004). The foregoing, therefore, raises pertinent questions regarding the place of local Nigerian rice in the nutrition of the nation's households. It also raises questions as to the nature and pattern of local rice consumption in the country.

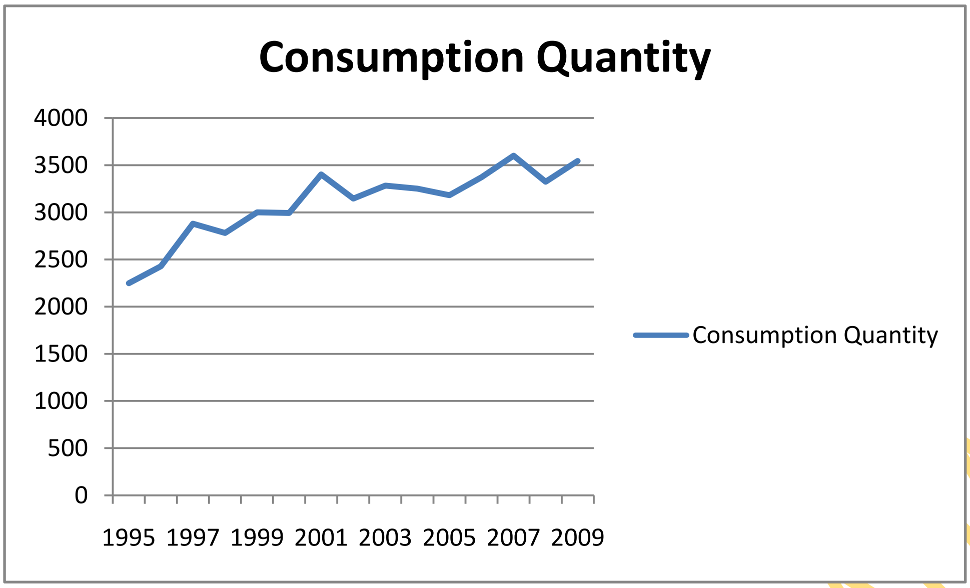


Figure 1: Rice Consumption Trend in Nigeria (1995-2009)
Source: Computed from IRRI; FAO World Rice Statistics (2014)

2.3.2 Rice production systems and processing

Nigeria has the capacity to be self-sufficient in rice production, as virtually all ecologies in the country are suitable for rice cultivation(Imolehin and Wada, 2000; Akpokodge *et al.*; 2001; Akande, 2007)-see appendix 1. In Nigeria, rice is typically planted between April and May and harvested between August and November. Rainfed upland rice accounts for approximately 25 percent of the harvested area; rainfed lowland systems account for 50 percent; irrigated systems account for 16 percent; and deepwater/mangrove swamps account for less than 10 percent of the total rice area. Rainfed lowland systems include the broad valley bottoms, or *fadama* (lowlands) in the north; and the flood plains along the Niger and Benue River systems. Irrigated systems include a few large-scale irrigation schemes in the north and small-scale systems located on the inland valley bottoms in the south (Imolehin and Wada, 2000;FAO rice web, 2001).

Imolehin and Wada (2000) further states thatrice is an increasingly important crop in Nigeria. It is relatively easy to produce and is grown for sale and for home consumption. In some areas, there is a long tradition of rice growing. There are many varieties of rice grown in Nigeria. Some of these are considered 'traditional' varieties; others have been introduced within the last twenty years. Rice is grown in paddies or on upland fields, depending on the requirements of the particular variety; there is limited mangrove cultivation. New varieties are produced and disseminated by research institutes, or are imported from Asia. The spread of these strains is determined by their perceived success, and farmers multiply seed for their own plots when they see a variety doing well in someone else's field, or if a variety is fetching a good price in the market. During the oil boom, many farmers had access to tractors, but most of them now undertake all land preparation and harvesting by hand. Generally, tasks are allocated along gender lines, but, in some areas, men and women work together. Women are typically responsible for the transplanting of seedlings to the fields and threshing, whilst it is often the men who do the most vigorous work. Most farmers produce one rice crop each year, but some have made irrigation channels which allow them to reap two or even three harvests in the year. This allows them to plant seedlings when there is less danger from disease or pests. At the same time, frequent planting exhausts the soil more quickly and, as fertilizers are expensive, many farmers are noticing the falling productivity of the soil. Some farmers use organic fertilizers, including a method of green manuring by which grass is allowed to grow and is then ploughed back into the soil. The use of organic fertilizers is time consuming, and not widespread, therefore, many farmers resign themselves to buying inorganic fertilizers, which they consider to be too expensive. Once the fields have enough water, the rice grows quickly with some varieties reaching maturity within three months. Some farmers grow the rice seedlings in nurseries and then transplant them into the main fields, as this reduces vulnerability to diseases. Others see the transplanting process as too time consuming. Varieties which mature quickly are preferred by farmers, as this reduces risk of exposure to disease and allows the land to be used for other crops. Whereas it was unusual for more than one crop of rice to be grown each year, many farmers relay rice with other crops, particularly sorghum.

The processing of rice generally takes place away from the farm. Many farmers are able to sell their rice before it is harvested, as traders come to the farms to negotiate prices. The rice is then taken away and parboiled to soften the husk, before it is milled and marketed. The parboiling is carried out in huge oil drums. After the rice has been parboiled, it is laid out on tarpaulins to dry. It is at this stage that there is a danger of small stones getting mixed up with the rice grains, reducing its marketability. Nigerian rice faces competition from imported rice, which is favoured for its long white regular grains. Imported rice, although widely considered less tasty, demands less preparation, as it contains no stones and has been better parboiled. Eliminating stones from Nigerian rice, by using a destoner or building designated threshing and drying floors, would allow Nigerian rice to compete with imported rice. Raising the quality of local rice might discourage rice importation, while boosting local production. Much of the milling is done by co-operatives, the largest of which is in Lafia, in Nassarawa State, where there are about 700 mills; rice milled here is transported to all parts of the country by truck (Omotola and Ikechukwu, 2006, Bashorun, 2013). Other government and private mills are springing up.Some of these will be mentioned in section 2.3.7.

2.3.3 Rice production trend in Nigeria

Appendix 3 shows the area cultivated, output and yield of rice between 2002 and 2007 (NBS, 2009). As reported by NBS (2009), area of rice cultivated in 2002/03 was about 1.36 million hectares. This increased to 1.39 million hectares in 2003/04. By 2005/06 it increased to 1.59 million hectares. However, a slight drop in area cultivated (1.53million hectares) was witnessed in2006/07. Rice output in 2002/03 was 2.74 million metric tons. This increased to 2.98 million metric tons in 2003/04 and increasedto 3.33 million metric tons in 2006/07 (NBS, 2009). Similarly, rice yield has witnessed annual increase since 2002/03.A figure of

2.01kg/ha was estimated for 2002/03.There was a decrease in yield from 2.18kg/ha in 2003/04 to 2.04 kg/ha in 2005/06. This subsequently increased to2.18 kg/ha in 2006/07. Also NBS (2012b) statistics (appendix 4) reported an increase in rice output from 3.3 million metric tons in 2006 to 3.4 million metric tons in 2008 and 4.5million metric tons in 2010.

According to NFRA (2008), the land area cultivated to rice was about 1.7 million hectares in 2007, with an estimated national production of 3.4 million metric tons, which is about 22% increase over the 2006 level. However, the annual growth rate was 0.6% from 1999 (NFRA, 2008). Furthermore, NFRA (2008) estimated rice yield in 2007 at 2 metric tons per hectare, a negligible decrease (0.03%) over 2006; and about 1% growth rate from 1999. The Nigerian government aimed to have 3 million hectares under rice cultivation. Nigeria is the largest producer of rice in West Africa, but still relies on massive importation (Omotola and Ikechukwu, 2006). The government is promoting the adoption of the new hybrid rice varieties (such as, NERICA) to help boost rice production. These new varieties are high yielding, early maturing, disease resistant, and high in protein content (WARDA, 2008).

Figures 2-4, respectively, give further insight totrend in Area Cultivated (‘000ha), Output (‘000MT) and yield (tons/ha) of rice in Nigeria as reported by Food and Agricultural Organisation (2014).

Akpokodje *et al*., (2001) and Erenstein *et al.* (2004) observe that there is a great disparity between the states and regions of the federation in rice production both in terms of output and yield. In 2000, Kaduna State was the largest producer of rice, accounting for about 22% of the country’s rice output. This was followed by Niger State (16%) and Benue State (10%). During the dry season, Benue State accounted for the highest output (61%). On a geographical zone basis, the North Central zone was the largest producer of rice in Nigeria, accounting for 44% of total rice output in 2000. This was followed by the North West (29%), while the South West was the least (4%). Erenstein *et al*. (2004) also observed variation in seasonal production in rice production in Nigeria. The average national rice yield during the dry season (3.05 tons/ha) was higher than that of the wet season (1.85 tons/ha). This could be a confirmation of the higher yield acclaimed to be associated with irrigated rice production system. During the wet season there is considerable variation between states. States with relatively high yields include Enugu (3tons/ha), Imo (2.7 tons/ha), and Ebonyi (2.5 tons/ha). For the dry season, Benue (3.6 tons/ha) and Adamawa (3.3 tons/ha) had yield higher than the national average. On a zonal basis, during the wet season, the yield of rice was highest in

South East (2.4 tons/ha). This was followed by the North East (2.0 ton/ha) and the North Central zone(1.8 tons/ha) while the South West had the least (1.4 tons/ha). For the dry season, the yield was highest in the North Central zone (3.6 tons/ha) but lowest in the North West (1.74 tons/ha). In 2007, the leading six states that produced over200, 000 metric tons of rice were Niger, Kaduna, Benue, Taraba, Ebonyi and Kwara (NFRA, 2008).

The variation in rice production in various zones of Nigeria is a major argument for a regional analysis of rice demand and supply. Since water supply through rainfall/irrigation also makes significant difference in yield, considering water variable in a supply response model is very vital, as done in this study.

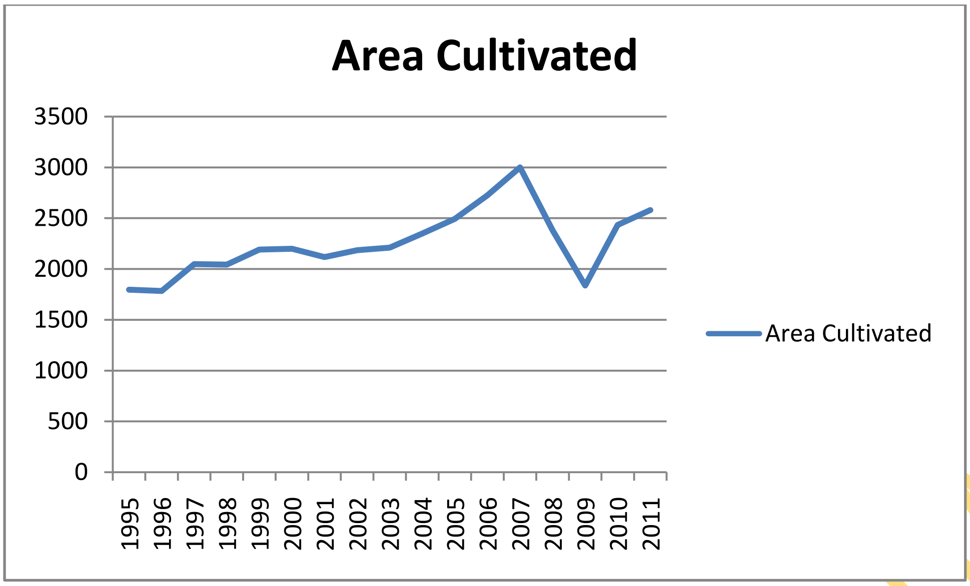


Figure 2: Rice Area Trend in Nigeria (1995-2011)
Source: Computed from IRRI; FAO World Rice Statistics (2014)

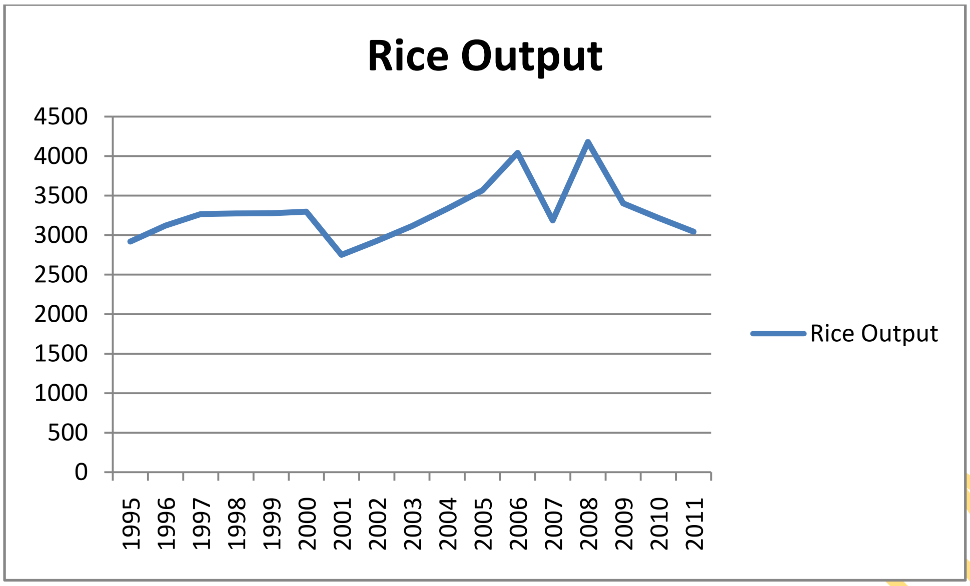


Fig 3: Rice Production Trend in Nigeria (1995-2011)
Source: Computed from IRRI; FAO World Rice Statistics (2014)

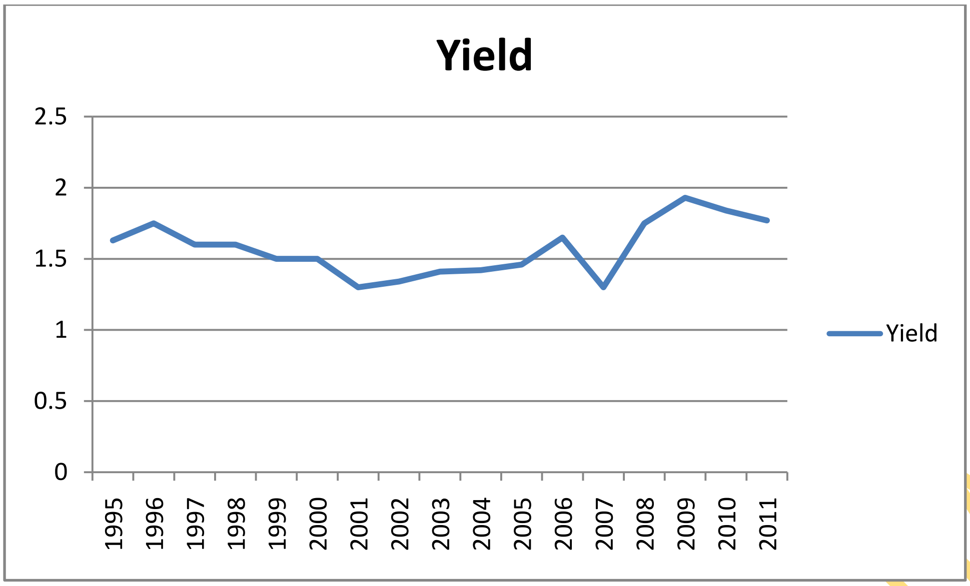


Fig 4: Rice Yield Trend in Nigeria (1995-2011)
Source: Computed from IRRI; FAO World Rice Statistics (2014)

2.3.4 Rice import trend in Nigeria

Owing to increasing demand, Nigeria has had to resort to importation of milled rice to bridge the gap between domestic demand and supply. Available statistics reveal that rice import was very insignificant in the 1960s and the early 1970s. However, there was a phenomenal rise in imports in 1977 as the quantity of rice imported in the year alone (45, 000 tons) was more than the combined quantity of rice imported during the 1961-1975 period. Also, between 1961 and 1999, Nigeria spent $4 billion on rice importation, an average annual import value of $102 million. Rice imports did not begin to decline until 1981 as a result of some policy measures put in place to check the importation of the commodity. Even then, the quantity imported on an annual basis was over 300,000 tons. Imports dropped significantly from 1985 when the ban was placed on rice. Although rice imports began to rise again in 1991, major importation did not begin until after the lifting of the ban in 1995 (Akande, 2007). Quantities imported have surged from 300,000 metric tons in 1995 to about 1 million metric tons in 2001 and 1.9 million metric tons in 2002-valued at approximately US$500million (USDA/FAS, 2003). From 1999, the value of rice imports rose steadily from US $259 million to US $655 million and US $756 million in 2001 and 2002, respectively (CBN, 2006). These estimates do not take into account the unrecorded smuggled rice imports into Nigeria (Rahji, 2005). Rice imports account for approximately one-third of Nigeria's rice supplies. In January 2001, the Nigerian government raised the rice import duty from 50 percent to 75 percent in order to protect local producers against massive imports. Despite the increase in import duty, the USDA/FAS (2003) raised the Nigerian rice imports estimate from 1.25 million tons for 2000/01 to 1.8 million for 2001/02.

The bulk of rice imports come from southeast Asia, with about 80 percent coming from Thailand, and smaller amounts from India and Vietnam (FAS attaché, 2001a). Although American rice has not made major inroads into the Nigerian market, it has market potential based on its high quality. Many Nigerians became familiar with US rice from the oil boom era of the 1970s and the early 1980s when branded Uncle Ben's rice was a household name. The return of Uncle Ben's brand in the late 1990s generated interest among Nigerian consumers, particularly the upper-income groups who enjoy the ability to pay for high-quality US rice (FAS attaché, 2001b).

Nigeria has, thus, become a major rice importer in the world market and second only to Indonesia from year 2000-2005 (Oyinbo *et al.*, 2013). Domestic production has never been able to meet the demand, leading to considerable imports which today stand at about 1,000,000 metric tons yearly. The imports are procured on the world market with Nigeria spending annually over US$300 million on rice imports alone (Akande, 2007).For instance, in year 2007, 1.6million tones were imported (FAOSTAT, 2008).

A survey conducted by the Dutch Agricultural Development and Trading Company (DADTCO), (2009) claims that Nigeria is currently spending an estimated $1.3 billion every year to import around 2.2 billion kg of rice in order to fulfil its domestic requirements. According to the Nigeria Agribusiness Report, the country's rice import bill is currently thought to be about US$1 billion (TIN, 2009). Bilateral trade between Nigeria and Thailand has been described as robust, as Nigeria imports one million tons of rice, valued at $700m or about ₦106 billion, from Thailand every year (Sams, 2010). Raji (2013) opines that the rate at which Nigeria imports food is not fiscally, economically or politically sustainable, noting that Nigeria is one of the largest food importers in the world. In 2010 alone, Nigeria spent N635 billion on import of wheat, N365 billion on importations of rice (that means Nigeria spent N1 billion per day on rice alone). The importation of rice to bridge the demand-supply gap is worth ₦365 billion(Ayanwale and Amusan, 2012). The cost of these rice imports represents a significant amount of lost earnings for the country in terms of jobs and income (Bamba *et al.*,2010). The Trend in Rice Import from 1995 to 2011 is illustrated in Figure 5:

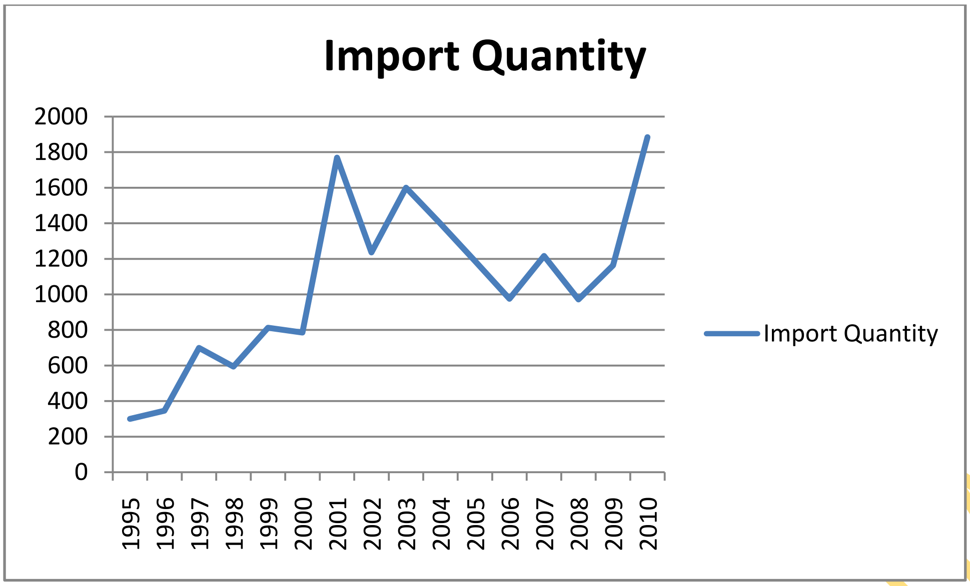


Fig 5: Trend in Rice Import in Nigeria (1995-2011)
Source: Computed from IRRI; FAO World Rice Statistics (2014)

2.3.5 Nigerian rice policy environment

According to Kebbeh *et al.* (2003), Akpokodje *et al.* (2004) and Akande (2007), from a historical perspective, Nigeria's rice policy can be discussed with reference to three important periods. These are the pre-ban, ban and post-ban periods. The pre-ban period was the era prior to the introduction of absolute quantitative restriction on rice imports (that is, 1971-1985). The period was largely characterisedby liberal policies on rice imports, though *adhoc* policies were put in place during times of interim shortages. Later, more stringent policies were instituted, though outright ban was not a major feature. In the ban period (that is, 1986-1995), it was illegal to import rice into the country, though illegal importation of the commodity through the country's porous borders thrived during this period. In the post-ban period (1995 to date), quantitative restrictions on rice importation were lifted while the country generally adopted a more liberal trade policy towards rice. During the pre-ban period (that is, before 1986), government policies had artificially lowered domestic rice and fertilizer prices relative to the world price level. This was achieved through:

- Massive importation of rice between 1975 and 1985, resulting in low price of domestically produced rice.

- Government involvement in the distribution, marketing of the imported rice with non-transferof actual costs of marketing to consumers but rather absorbed by government.

- Protection of elite urban consumers at the expense of farmers, leading to depressed farm gate prices.

- Protection of producers through input subsidies such that actual input costs were not translated into production decision-making process.

The ban on rice importation came into effect in 1985. It was anticipated to stimulate domestic production through increases in the price of the commodity. The introduction of the Structural Adjustment Program (SAP) in 1986 reinforced the ban already placed on rice import. Under SAP, various trade policies were put in place. This was in addition to the depreciation of the naira arising from exchange rate deregulation. The overvalued exchange rate had served as an implicit tax on rice producers as it cheapened imported rice relatively.

As reported by Bamidele *et al.* (2010), generally**,** as a response to the prevailing rice supply deficit situation in Nigeria, successive Nigerian governments intervened in the rice sector by increasing tariffs so that local production could be encouraged. This was expected to widen the home market for the nation's local rice. The government also established the Federal Rice

Research Station (FRRS) at Badeggi in 1970 and the National Cereal Research Institute (NCRI) in 1974. Also established were the National Seed Service (NSS), with the assistance of the Food and Agriculture Organization (FAO), in 1975, and Operation Feed the Nation (OFN), in 1976. Other government programmes were the River Basin Development Authority (RDBA), Agricultural Development Projects (ADP), the National Grain Production Programmes (NGPP), the Structural Adjustment Programmes (SAP), and the Presidential Initiative on Increased Rice Production, Processing and Export. The Presidential initiative was aimed at addressing the ever-widening demand-supply gap for rice and stimulating surplus rice harvest for export by the year 2007. The implementation of this initiative started in 2004 under which rice boxes containing 10 kg of rice seeds and enough agrochemicals for 0.25 hectares were sold to farmers in each state at N3, 500.00 per box. The idea was to encourage farmers in each beneficiary state to cultivate rice on at least 250 hectares of land. This initiative has encouraged farmers to go into the production of rice. The emergence of the VEETEE rice company was another way to boost local rice production in Nigeria. The company initiated a rice out-growers scheme with farmers to boost domestic output. The company has the facility for polishing rice, which means high quality of local rice (FAO, 2004). Despite the numerous Nigerian government policies on rice, the demand–supply gap for rice still persists. Here are some specific policies implemented over time to boost rice production:

Trade policy

Nigeria has employed various trade policy instruments, such as tariff, import restrictions, and outright ban on rice import at various times (see appendix 3). During the 1970s and the early 1980s, increased export earnings coupled with the highly over-valued naira exchange rate, made it possible for Nigeria to finance huge food imports. The high naira exchange rate cheapened food imports and consequently helped to depress domestic prices. Large importation of food items, especially rice, was allowed into the country at relatively cheap prices. This eroded the competitiveness of domestically produced rice and served as major disincentive to rice farmers (Akpokodje *et al.*, 2004; Akande, 2007).

Exchange rate policy

Before the introduction of SAP, exchange rate and foreign exchange allocation policies acted as a major source of price distortion and disincentive towards farming enterprises. Previous Nigerian governments had pursued exchange rate policies that kept nominal exchange rate constant, even in the face of widening gap and divergence between rising domestic inflation and relatively stable international price level. The extent of over-valuation of the local currency was put at 100% between 1970 and 1975; 200% between 1976 and 1979 and about 700-900% during the 1980-85 period (CBN/NISER, 1992). The over-valued exchange rates altered the competitiveness and profitability of farm business in favour of other activities. With regard to imports (including rice) exchange rate over-valuation helped to cheapen imports of competing food items. For example, it was cheaper to import rice for domestic consumption than grow it locally. The situation was exacerbated by the liberal food imports policy, especially during the 1970-1977 period,when there was little or no tariff on imported food items.

Fiscal policy

Public spending for agricultural development in Nigeria is undertaken mainly by the federal and state governments. The range of public sector efforts directed at promoting agricultural development can be classified into:

(a) direct expenditures of both tiers of government,

(b) provision of credit for investment through public agencies,

(c) direct credit by the Central Bank of Nigeria, and

(d) a wide range of financial incentives and related assistance.

Fertilizer policy

Nigeria has been largely an importer of fertilizer. Domestic production of fertilizer on a significant scale did not begin until 1987. Subsidy on fertilizer was introduced in 1976. By this, fertilizer, which was largely imported by the federal government, was distributed to farmers at prices below the cost of importation. Subsidy on fertilizer was completely removed in 1997 before the inauguration of the democratic government in May 1999. After the inauguration, however, the federalgovernment re-introduced fertilizer subsidy to the tune of 25%. After six months, in February 2000, government completely liberalised procurement, trade and distribution of agricultural inputs, including fertilizer. By this policy, the authority to import agricultural inputs, including fertilizer, became vested in the hands of private individuals and firms.

National seed policy and seed development plan

A policy that stresses the importance of ensuring adequate supply of good quality seeds at affordable prices is in place. The major objective of this policy is to provide a framework for future development of the seed sub-sector through:

-Establishment and governmental support of varietal improvement, registration, release and multiplication of released varieties;

-Re-organisation of both the public and private sectors involved in the seed industry; and,

-Encouragement of the private sector participation and take-over of the seed industry.

Land Policy

Land provides the source of livelihood to about 90 percent of Nigerians. This explains why the first law of society was land law. Prior to the promulgation of the Land Use Decree of 1978, different land laws operated among the regions of the federation. In the Northern Region, the land belonged to the state. The emirs and chief supervised the use of land and issued out certificates of occupancy. The people had the right to use the land but not to own it. But in the Eastern Region, there were individually owned small pieces of land. Also, the communal land was owned by the village, town or clan. The ownership of land in the Western Region was a bit similar to that of the East. There were the communal (held on tribal, village, clan or family basis), collective (a group of people buy and share land) and individual ownership. On the agricultural scene, millions of independent peasant farmers control their land and cultivate crops such as rice and a host of others. The Land Use Decree was promulgated in 1978. The decree did not alter the Northern region traditional land tenure system but changed the system that operated in the Eastern and Western Regions. The ownership of land in each state was vested in the state governments in trust for the people of the state.

International trade policies affecting Nigerian domestic rice production

There is virtually no international trade policy affecting rice production in Nigeria. Nigeria is an importing country and may be affected by international trade policies only to the extent that such policies affect countries from which Nigeria imports rice. Nigeria does not have the 'Agreement on Agriculture' reduction commitments. She does not have either regional or bilateral trade agreement that affects rice trade and production. But, as stated earlier, the Structural Adjustment Programme tended to have restored Nigeria's ability to produce rice, having created an environment that made local production somewhat profitable but not fully competitive with imports.

2.3.6 Nigeria and the quest for food self-sufficiency

The impact of the world food crisis was felt quickly in Nigeria owing to sudden scarcity and high increase in price of rice because of the reduction in rice export from Vietnam, India and United State of America, which cut their rice export in order to meet home demand (World Bank, 2008). According to FAO and UNIDO (2008), the global food prices increases started in 2006, doubling the price of major staple in 2007 and 2008.Theworld food price rise hit the developing countries harder, with these countries recording a 42 percent increase in 2008 over 2007 price compared to 19 percent increase for developed countries. In the same period, mostly affected are those countries that depend excessively on imported food from developed countries, such as Nigeria.

A major contemporary global problem is the predicament of rapidly increasing human population in the face of decreasing availability of food required to feed them. Nigeria is not exempted from this phenomenon. FAOSTAT (2006) putsNigeria's average population growth at 2.7 percent while food production grows at the rate of 2.6 percent per annum. The National Population Commission (NPC) recent report puts theNigeria's population growth rate at 3.2 percent per annum. All these point to the fact that population growth rate outweighs food production growth rate in the country. The implication of this is an impending food crisis in the near future.The apparent disparity between the rate of food production and demand for food in Nigeria has led to: (i) a widening gap between domestic food supply and the total food requirement;(ii) increased food importation; and (iii) high rates of increase in food prices (FMAWRRD, 1988).

Attainment of food self-sufficiency is a prominent development agenda facing most nations in the sub-Saharan Africa, including Nigeria.Self-sufficiency in food production has become an important economic goal that is high on the government agenda(Bello, 2004; Rahji and Adewumi, 2008). Since rice is a major staple of considerable importance to household food security in Nigeria, a study to examine rice demand and supply is crucial to the overall economic goal of food sufficiency in Nigeria.

2.3.7 The Agricultural Transformation Agenda (ATA)

According to Akinwumi (2012), the most recent effort at revamping the Nigerian agricultural sector is the Agricultural Transformation Agenda of the Nigerian government steered by the

Honourable Minister of Agriculture. The introduction of this agenda arose out of the concern for rising importation bills for food:

a. Nigeria's food imports are growing at an unsustainable rate of 11% per annum.
b. Relying on the import of expensive food on global markets fuels domestic inflation.
c. Excessive importis putting high pressure on the Naira and hurting the economy.
d. Nigeria is importing what it can produce in abundance.
e. Import dependency is hurting Nigerian farmers, displacing local production and creating rising unemployment.
f. Import dependency is neither acceptable, nor sustainable fiscally, economically or politically.

The key elements of ATA are:

1. Treating agriculture as a business,
2. Integrating food production, storage, food processing and industrial manufacturing by value chains ('farm to fork'),
3. Focusing on value chains where Nigeria has comparative advantage,
4. Using agriculture to create jobs, wealth and ensure food security,
5. Investment-driven strategic partnerships with the private sector, and
6. Investment drives to unlock potential of our States in agriculture (joint drives with State Governors).

The new policies, institutions and financing structures to drive sector growth are stated below:

1. Deregulation of seed and fertilizer sectors,
2. Marketing reforms to structure markets,
3. Innovative financing for agriculture, and
4. New agricultural investment framework.

Rice is one of the target crops under the Agricultural Transformation Agenda. The strategy is to increase rice production in Nigeria from 3.4 to 12.85million metric tons in 2015 and Nigeria to be self-sufficient in rice by 2018. The objectives include: to increase the market share of locally processed rice and to improve distribution networks both locally and internationally.

The federal government specifically planned to roll out modern mills to improve the processing of rice and produce high-quality Nigerian rice. The government new rice policies are yielding results; 210,000 metric tons of new rice capacity (10% of current imports) has been executed in the past one year. These include Atahi Rice, Jigawa (60,000MT per year); Ashi Feeds, Benue (10,000MT);Mikap, Benue (10,000MT); Dominion, Taraba (10,000MT); Gauri, Bauchi (10,000MT); Clysters, Nasarawa (10,000MT);Umza, Kano (60,000MT); Omor, Anambra (10,000MT); Kare Hi-Tech, Zamfara (9,000MT);Oni-MP Farms, Cross River (8,000MT); Al Uma, Taraba (8,000MT); Ebonyi Agro, Ebonyi (30,000MT) and Lagos, Lagos (5,000MT).

Also, the largest rice producer and processor in Kenya “Dominion Farms” invests in 30,000Ha Community Rice Project in Taraba State, which attracted additional local Nigerian investor wherein the first set of 50 young commercial farmers from Taraba were trained for 5 months in Kenya.

The focus of ATA is on food processing and manufacturing from local staple crops. This is as a result of rapid urbanisation, rising middle class incomes, supermarkets and demand for "easy to prepare foods”. The target commodities are maize, soybean, **rice**, yam, cassava, sweet potatoes and sorghum. In line with this, fourteen Staple Crop Processing Zone (SCPZs) sites have been established around the country. Sites are intended for the production and processing of priority agricultural products.

The selected anchor states and core investors for rice SCPZs are:
1. Kadawa Valley, Kano State - Dangoteiscoreinvestor.
2. Bidda-Badeggi, Niger State- Indicativeinterest from flour mills of Nigeria
3. Ikwo, Ebonyi State- Ebonyirice, Ebonyi Government,UNDP, SMEs
4. Gassol, Taraba State- Dominion Farms
5. Sokoto/Kebbi- Sokoto and Kebbi States, no core investor for now

In a bid to achieve rice self-sufficiency, in line with the rice transformation plan under ATA, the Ministry of Agriculture and Rural Development has rolled out a special intervention programme on dry season paddy production plan in 2013 (Fagbemi, 2012). The dry season paddy production is scheduled to take place across ten states of the federation namely: Kebbi, Zamfara, Kano, Jigawa, Sokoto, Katsina, Bauchi, Gombe and Kogi States.

2.3.8 Determinants of food demand and preference

The theory of demand has demonstrated convincingly that low-income earners devote high proportion of income to food, while at higher income level, expenditure on food consumption falls. Real per capita income is therefore a determinant of food consumption. This explains why any model that is used to capture food consumption must include the per capita income (Odusola, 1997). Using data from household surveys, numerous studies have attempted to estimate the determinants of food demand as well as their corresponding elasticities. Abdulai *et al.* (1999) in a food demand study in India,observes that demographic variables, such as region or location, household size, educational level of household head and seasonality also significantly affect food consumption. Heilig (1999) identifies population growth and age composition as major driving forces of food demand in China.

Choi and Lee (2000) identifies factors affecting food consumption in Korea to include household age, sex, composition and type of household and location of residence. According to Jensen (1995), general education of the household head has a positive and significant effect on nutritional status. Rahji and Adewumi (2008) estimated the demand for local rice in Nigeria and noted that the price elasticity of demand (η) is –0.8406. The demand for local rice was found to be price inelastic. This tends to reflect the reluctance of the consumers to change the quantity purchased in spite of price savings. The income elasticity of 0.3378 shows that local rice is a normal good but is income inelastic.

Nwachukwu *et al.* (2008)asserts that education, price, income and perception of grain size for foreign rice influence the attitude of consumers to purchasing foreign as against local rice. The long, bright and tasty grain properties are justifiable reasons why Nigerian consumers admire and patronise imported rice. In estimating the determinants of rice demand in Abia State, Agwu *et al.*(2009) found that age, price, income and household size are significant in determining the demand for rice. This resultagrees with a similar study by Babatunde *et al.* (2007) on Kwara state, Nigeria.

Bamidele *et al.* (2010) examined the nature and patterns of rice consumption in Nigeria, using Kwara State as a case study. The methodology they adoptedcomprised a two stage sampling technique which was used to survey 110 rice consumer households across two villages and six towns in Kwara State. The major factors that significantly influenced household preferences for either a combination of local and imported rice or the imported rice only to the local rice only were the income of the head of household, household size and the educational status of the heads of household.However, the price per unit kilogramme of rice was not a significant factor. The study, therefore, recommended that effort should be made to increase rice production, coupled with the provision of standard processing facilities. This will help to make the local rice sufficiently more competitive, thereby increasing its demand. Unlike Bamidele *et al.* (2010), Odusina (2008) found that the high price of imported rice will discourage its consumption.

In the estimation of consumer preference, for foreign rice, Agwu *et al.*, (2009) found age, price and education to be statistically significant in explaining the preference. This finding is also consistent with that of Nwachukwu *et al.* (2008). Age, price and household size were also isolated as factors determining the preference for local rice. Price and education were also found to be significant in determining the preference switch from foreign rice to local rice. In line with these findings, this study also included price, education, age, household size and income, among other socioeconomic variables, in estimating the demand and preference switch for rice in Nigeria.

In another research undertaken by Oyinbo *et al.* (2013) to determine consumption preference between imported rice and locally produced rice by households in Kaduna State and the factors that influenced the households' consumption preference between the two, it was revealed that the majority of the households in Sabon Gari (85%), Kaduna South (83%) and Soba (53%) Local Government Areas preferred consuming foreign rice to local rice types. From the pooled sample of households, a larger proportion (75%) preferred consuming foreign rice brands to local rice brands. However, local rice consumption had considerable preference among fewer households (25%). The factors found by Oyinbo *et al.* (2013) to significantly influence the households rice consumption preference are quality of rice ($p<0.01$), ease of preparation ($p<0.1$), price of rice ($p<0.1$), frequency of rice consumption, ($p<0.1$), household size ($p<0.1$), and household income ($p<0.05$). Becauseof the high significance of rice quality, it is recommended that huge investment on rice value chain should be pursued. This should be with emphasis on local rice processing by government and other stakeholders in the rice subsector to ensure that the quality of locally produced rice is improved to make local rice highly competitive with foreign rice. This will encourage shift in consumer preference from imported rice to locally produced rice. It will save the nation from continual loss of foreign exchange in the importation of foreign rice to meet local demand and create job opportunities in line with the rice transformation action plan.

Also, Bamba *et al.* (2010) note that consumers in large urban centres have a marked preference for high-quality imported rice. The significance of rice quality as a factor that favours foreign rice consumption implies that an improvement of the quality of local rice to attain the high quality desired by households would stimulate local rice consumption preference by households. This will stem the loss of earnings in the importation of foreign rice to bridge demand-supply gap and create opportunities for employment. Increasing production of higher quality rice will reduce imports and strengthen food security (Bamba *et al.*, 2010). Location factor was also one of the variables considered in this study.

Adeyeye (2012) conducted a research to evolve strategies to enhance the consumption of local rice. He found that rice consumption patternvaried across different zones of the country. The North Central zone was found to consume the highest quantity of local rice, while the South West zone consumed the highest quantity of imported rice. Adeyeye (2012) opines that, although the market for imported and locally produced rice in Nigeria appeared segmented, consumption of locally produced rice was on the increase as that of imported rice.The factors that were isolated to affect local rice consumption were: sex, age, level of education, total food expenditure, price of rice and prices of the substitute (sorghum). The consumer preference for local rice was influenced by level of education, length of residence in a zone and marital status. Other factors were income of household head, rate of breakages and price of local rice. Demand for local rice was found to be price elastic only in the North-East geopolitical zone. In essence, the three major limiting factors to local rice consumption are quality, income and price (Adeyeye, 2012). In line with this study and that of Oyinbo *et al*. (2013), household size, income and price were included in our model in this study.

2.3.9 Review of supply response studies

In a cointegration analysis framework of terms of trade and supply response of Indian agriculture,Deb (2003) observes that, owing to the fact that supply of land is relatively inelastic in many developing countries, the aggregate supply response may be low in countries with a large number of subsistence farmers. Nevertheless, the response of the price and price risk factors are both inelastic. In another work on the supply response of wheat in Bangladesh, Begum *et al.* (2002) reveal that, among different risk factors, fluctuation in price and yield were the major ones. They also identify non-price variables, such as weather, irrigation and technology as factors affecting acreage (supply) response. Miller (2002) states that general price levels are set by supply and demand. In the long run, if per capita income and other non-price factors annually shift demand faster than technology shifts supply, the price of the crops would trend upward.

Mckay *et al.*(1998) examined the supply response of agricultural output in Tanzania. Their estimates suggest that agricultural supply response is quite high so that the potential for agricultural sector response to liberalisation of agricultural prices and marketing may be quite significant. The long-run elasticity of food crop output to relative prices was almost unity; both food and aggregate short-run response was estimated at about 0.35. They suggest that liberalisation of agricultural markets, where it increases theeffective prices paid to farmers, can be effective in promoting production, although complementary interventions, to improve infrastructure, marketing, access to inputs and credit and improved production technology are probably necessary.

In another study, Muchapondwa (2008) usedtime series techniques on data spanning over different pricing regimes to estimate the aggregate agricultural supply response to price and non-price factors in Zimbabwe. The results confirmed that agricultural prices in Zimbabwe are endogenous and the variables are not integrated of the same order; hence,the use of the Auto Regressive Distributed Lag approach was worthwhile. The study found a long-run price elasticity of 0.18, confirming findings in the literature that aggregate agricultural supply response to price is inelastic in Zimbabwe. This result means that the agricultural price policy is rather a blunt instrument for effecting growth in aggregate agricultural supply in Zimbabwe. The provision of non-price incentives must play a key role in reviving the agricultural sector in Zimbabwe.

Ghatak and Seale (2001) obtained negative parameters on expected risk, claiming that an increase in expected risk (price variability) has a negative impact on acreage response. Incontrast to the above, Ajetomobi (2005) states that an increase in expected price risk has a positive effect on acreage response in his study on supply response, risk and institutional change in Nigerian agriculture.

In a Nigeria study, Rahji *et al.* (2008) examined the response of rice supply to price for the period 1967-2004 applying the Nerlovian adjustment model. The estimated trend equations showed that time had a significant effect on output, yield and area of rice over the period and sub-periods at 1% level. The short-run and the long-run price response elasticities were inelastic as they were less than one. The estimated coefficients of adjustment ranged between 0.23 and 0.33; hence, the speed of adjustment by the variables was said to be sluggish. Under this situation, achieving significant increases in output will be hard to attain. Measures that will lead to productivity increases in rice production were, therefore, recommended.

Most studies from the review above suggested an inelastic agricultural response in the short run and the long run. However, Mckay *et al.*(1999) refute this claim on the basis of data problem and methodology. To date, most Nigerian studies on supply response have utilised the Nerlove model.Perhaps, this was responsible for inelasticity of agricultural supply response. Since the Griliches model is out of reach in developing countries owing to data requirement, it is pertinent that an ECM-Cointegration analysis of supply response be carried out to confirm the inelasticity or otherwise of rice supply response in Nigeria. Price, non-price, risk and policy variables were also included to capture the response holistically.

2.4 Conceptual linkage

As earlier raised in the statement of the problem, the focus of this research is the problem of rising rice importation that has great implication for foreign exchange earnings and rice self-sufficiency in Nigeria. Rice self-sufficiency is a function of demand and supply for rice. As shown in Fig. 6, rice self-sufficiency is jointly influenced by rising demand, shortage in domestic supply and preference switch towards imported rice. Two sets of factors as depicted in Fig. 6; price and non-price factors drive the demand for rice in Nigeria. The demand for various rice commodities; imported or domestically produced rice is equally pulled by preference factor. Hence, factors affecting demand as well as preference switch from one rice commodity to the other constitute our research focus on one side. From the other angle, for every rise in demand, the supply has to respond adequately to meet up with demand to restore equilibrium (self-sufficiency). Hence, factors affecting supply were determined in the study. The factors that determine the supply of rice in Nigeria, as highlighted in Fig. 6 are essentially two sets; price and non-price factors, but because of our interest in capturing climate and policy variable, we included the two factors in the model.

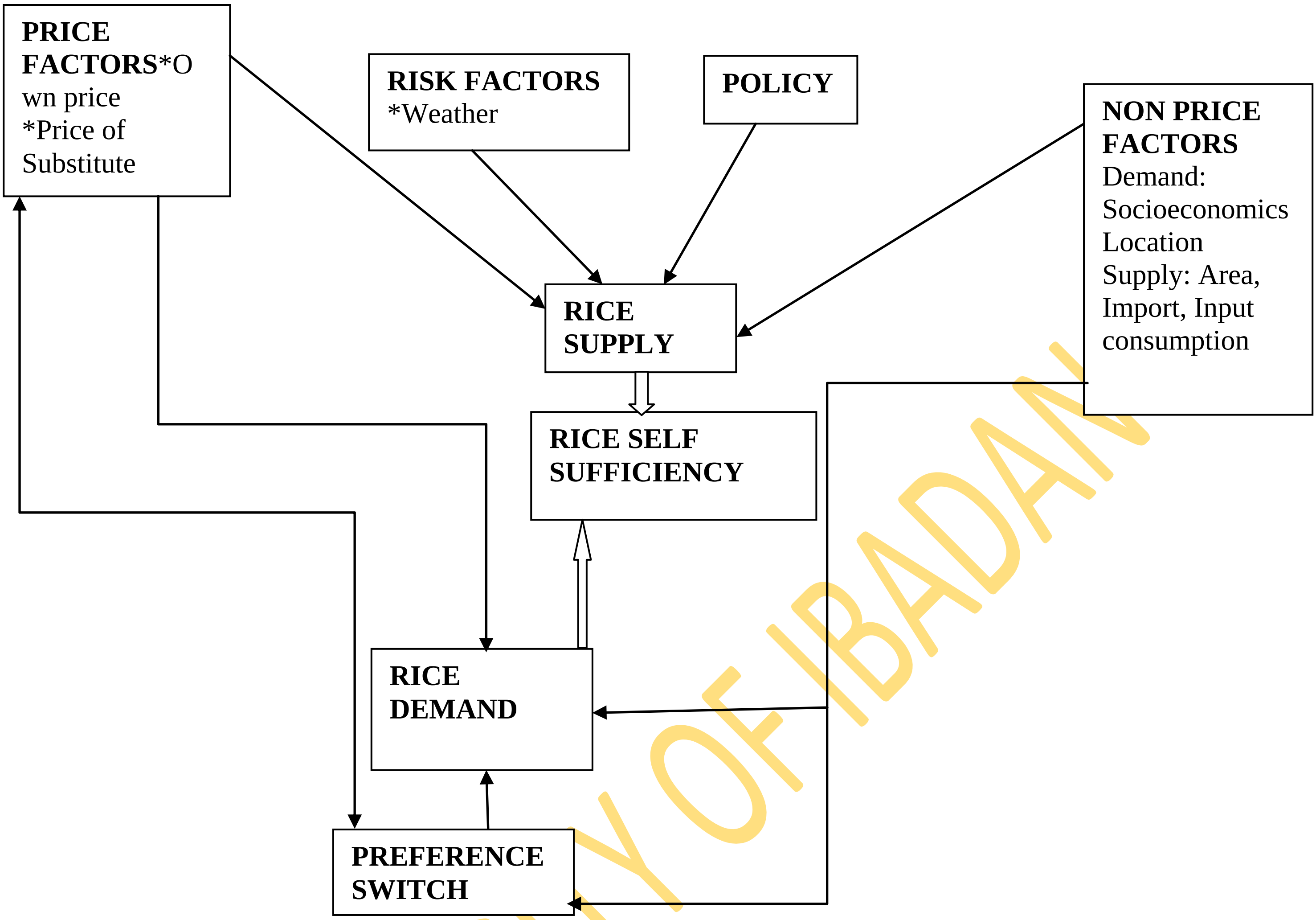


Fig 6: Conceptual Linkage

Source: Composed by the author from conceptual/literature review

CHAPTER THREE

RESEARCH METHODOLODY

In this chapter, the study area, sources and data type as well as the analytical tools employed to achieve the study objectives are fully expounded.

3.1 The study area

The study area was Nigeria, a sub-Saharan Africa (SSA) nation with an area of 923,769 square kilometres (made up of 909,890 square kilometres of land area and 13,879 square kilometers of water). Nigeria is situated between $3^0$and 14^0East Longitude and $4^0$and 14^0North Latitude. The longest distance from East to West is about 767 kilometres, and from North to South 1,805 kilometres (FMWA, 2004; NBS, 2009).The coast of Nigeria is a belt of mangrove swamps traversed by a network of creeks and rivers and the great Niger Delta. Beyond these are successive belts of tropical rain forests (that break into a more open woodland with hilly ranges) and the undulating plateau (with hills of granite and sandstone), rising from 809.6 metres on the average to 1,828.8 metres eastwards. Midway north of the country, the vegetation is grassland interspersed with trees and shrubs, which terminates in the Sahel Savannah region of the semi-arid north, north-east. The country has an estimated population of 140million people, by 2006 census, and a projected annual growth rate of 2.83 percent. The estimated current population in Nigeria is 167million (NPC, 2013). Nigeria is bounded in the west by Republic of Benin, in the east by the Chad Republic, in the North by Niger republic, and in the south by the Atlantic Ocean. Nigeria has over 350 ethnic groups and two major religions– Islam and Christianity. The country is divided into 36 states with a Federal Capital Territory and 774 local government areas (LGAs) (FMWA, 2004; NBS, 2009). The states are grouped into six geopolitical zones, as shown in Table 1.

Nigeria is also blessed with favourable and varied climatic conditions. The climate is equatorial and semi-equitorial in nature, characterised by high humidity and substantial rainfall. There are two seasons-wet and dry seasons. The wet seasons lasts from April to October, while the dry season lasts from November to March. The country has estimated total land area of 92 million hectares.The socio-economic setting of Nigeria is clearly dichotomized into rural and urban households, the rural population majors in agriculture as their economic mainstay, cultivating such food crops as maize, cassava, yam, sorghum, rice, millet, fruits, vegetable, pulses, cocoa, timber and rubber, among many other crops and livestock activities; while the urban sector majors in trading (FMWA,2004; NBS, 2009).

Table 1: Nigeria Geopolitical Zones

Zone	States within the Geopolitical Zone
South West	Ekiti, Lagos, Osun, Ondo, Ogun, Oyo
South East	Abia, Anambra, Ebonyi, Enugu, Imo
South-South	Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo, Rivers
North Central	Benue, FCT, Kogi, Kwara, Nasarawa, Niger, Plateau
North East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe
North West	Kaduna, Katsina, Kano, Kebbi, Sokoto, Jigawa,, Zamfara

Source: FMWA (2004)

Fig. 7: Map of Nigeria Showing States and Geopolitical Zones

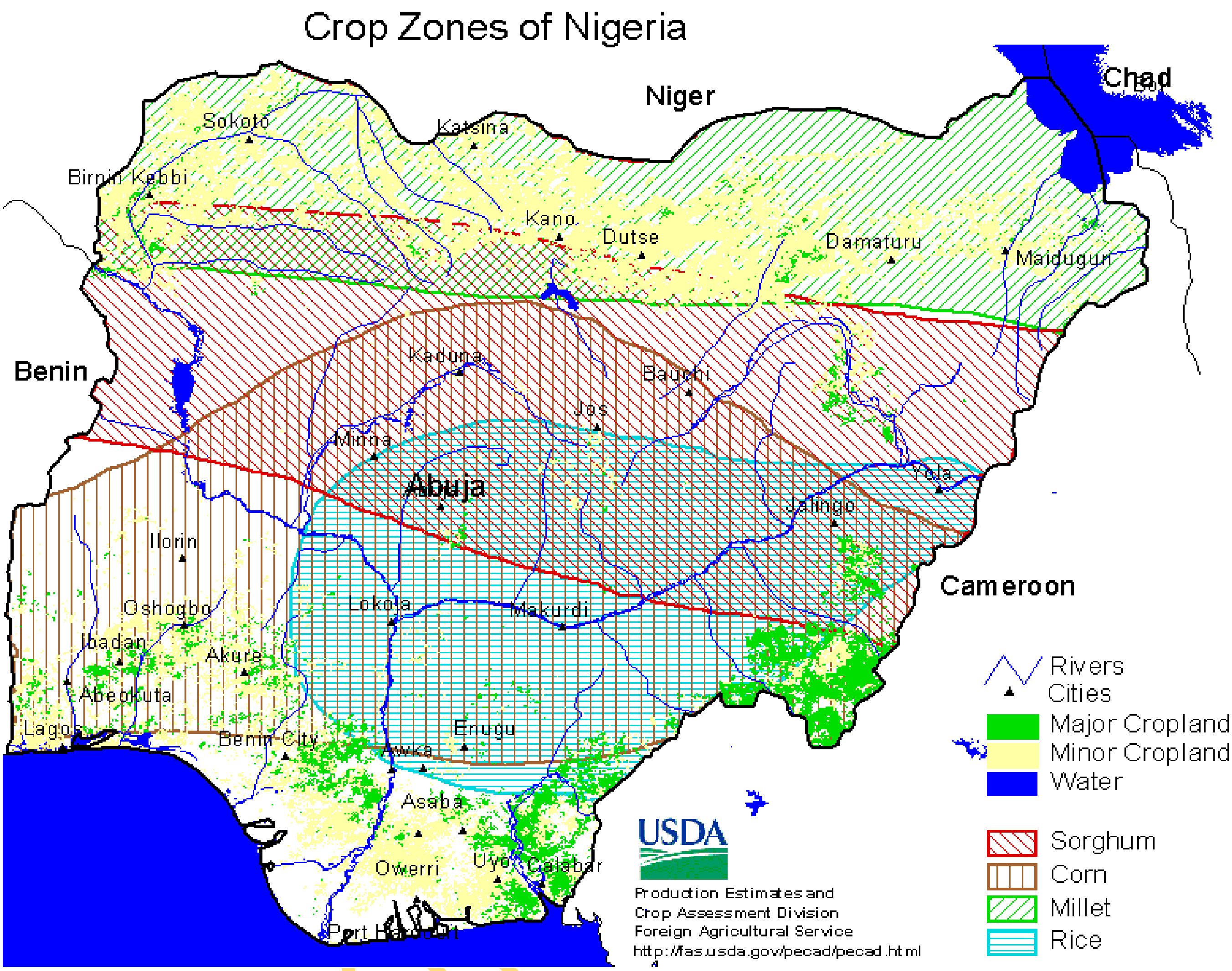


Fig 8: Map of Nigeria Showing Coarse Grain Crop Zones

3.2 Sources and type of data

The data set used for the estimation of demand and preference switch model in this study was extracted from the Nigerian Living Standard Survey (NLSS) of the National Bureau of Statistics (NBS)collected between September 2003 and August 2004. The NLSS was an extensive exercise in coverage and scope. The survey was based on the National Integrated Survey of Household (NISH) for running household-based surveys in the NBS, and was designed using the NISH master sample size of 2003/2004. The sample design followed a two-stage stratified procedure with the first stage based on the cluster of housing units known as Enumeration Areas (EAs) and the second stage was based on the Housing Units (HUs). One hundred and twenty (120) EAs were selected in 12 replicates in each of the 36 states of Nigeria and 60 EAs in the Federal Capital Territory (FCT). Five (5) HUs were scientifically selected in each EA. On the whole, fifty (50) HUs were covered in each state and 25 HUs in FCT per month. Each state, therefore, had a sample size of 600 HUs, and 300HUs in FCT. This implies that the survey had an anticipated national sample size of 21,900 HUs for the 12 months. The sample size was robust enough to provide reasonable estimate.

In addition to information on demographic and socioeconomic variables, the survey also obtained data on household expenditure on food (rice inclusive) and non-food items. The total number of households covered in this survey varied from one food item to the other. The households with consistent responses were selected for the final analysis. A total of 18,861 data points were selected across various zones as follows: 2854-South-South; 2681-South-East; 2993-South-West; 3331-North-Central; 3202-North-East, and 2800-North-West.

Since, household data prices were not collected for the NLSS and in view of the importance of price in demand analysis, the data was supplemented with 2004 average state level urban and rural price data from the statistical bulletin of the National Bureau of statistics. Our choice of NLSS data was informed by the intention to carry out a national rather than a localised or regional study and we were constrained by time and cost in conducting primary survey to obtain the needed comprehensive data set from all Nigerian states.

NLSS, 2004 was the most recent and comprehensive national data set at the time of analysis of this work, in 2009-2011. Nigeria data is periodically released by the Nigerian Bureau of Statistics; the 2004 edition came after the 1999 set released. The new set of data came much later in 2013, after the completion of this research. The NLSS, 2004 data is quite relevant in the current situation because of the relative stability of socioeconomic characteristics over time,which is of interest in this study. The data were mined and further variables of interest were constructed from the raw data set for our demand and preference switch analysis.

For the purpose of analysis of supply response, national level data on rice output, area, yield, price, and import level wasobtained from the International Rice Research Institute(IRRI); the United State Development Agency (USDA) version was chosen instead of the Food and Agricultural Organization (FAO) version contained in the IRRI statistics because it was better updated, comprehensive and consistent for the targeted time interval (1960-2008). Also locally available output and price data from National Food Reserve Agency (NFRA)-formerly Project Coordinating Unit (PCU) was not used because most states' Agricultural Development Agencies, which are the primary sources of PCU data aggregation, took off in 1986, hence, could not provide data spanning different pricing regimes (dated back to 1960) which is essential for a better long-run estimates of supply response. Such is the case for National Bureau of Statistics data that spanned from 1960-2008. The need to incorporate input consumption factor resulted in supplementing the above data with fertilizer consumption data from the Food and Agricultural Organization (FAO) version of the IRRI statistics with minimal interpolation. Since, rainfall is the most critical climatic factor in rice production in Nigeria, data was also obtained on mean annual rainfall from the GIS unit of the International Institute of Tropical Agriculture (IITA) (1960-2008) to account for the effect of water on rice output. Prices were deflated with official exchange rate.

3.3 Analytical tools and models

For this study, descriptive statistics, Tobit Regression Model, Linearised Almost Ideal demand System (LAIDS), Error Correction Model(ECM) in a Co-integration and Vector Autoregressive (VAR) framework, Paired Sample t–test Statistics and Generalised Least Square Regression were employed in the analysis of data.

3.3.1 Descriptive statistics

Descriptive statistics, such as tables and graphs of frequency, mean, mode, median, percentages and kurtosis, were used to describe the demographic characteristics of households, consumption expenditure pattern, and the self-sufficiency ratio of rice in the study area.

3.3.2 Tobit Regression Model

In estimating a demand function for rice in Nigeria, Tobit and AIDS regression models wereseparately employed. The use of the tobit model is justified on the ground that some households did not report the purchase of all ranges of products surveyed. When such truncated data are available for analysis, the recommended alternative analytical model to conventional regression model is the Tobit Model (Tobin, 1958). This analytical model has been widely used to estimate demand equations for survey data with zero consumption observations (Gil and Gracia, 2001; Fuller *et al.*, 2004, Akinyosoye, 2009).

The Tobit Model is built on the assumption that the observed consumption of a good by household i, Yi is determined by a latent factor measured by Yi* that can be represented as linear function of a vector of independent factors Xi, a vector of coefficients β and an error $\varepsilon_{i,}$ which has a normal distribution N (0, σ^2) which can be described as:

$$Y_i = Y_i^* = X_i\beta > -\varepsilon_i \quad \ldots\ldots\ldots\ldots (28)$$

$Y_i > 0$ if $X_i\beta < -\varepsilon_i$

The model was estimated over the entire selected survey sample using Maximum Likelihood estimator routine in LIMDEP (Vogelvang, 2005; Long and Freese, 2006). In the estimation of Tobit model, the conventional coefficient of determination R^2 is an inappropriate measure of goodness of fit (Vogelvang, 2005). To test the specification of such models, an LR-test is used by obtaining Lu, which is the value of the log-likelihood function of the unrestrictedly estimated model and L_R, the value of the log-likelihood function of the restricted estimated equation that has only the intercept as regresssor. Then, the LR-test statistic is LR = -2{ln (L_R – ln (L_U)}. LR has an asymptotic X^2(K-1)distribution under the null hypothesis of zero-slope coefficients. The LR-test statistic is usually a component of LIMDEP output when Tobit models are estimated with constant terms. The Pseudo-R^2 is also an accompanying result from LIMDEP output and its value indicates the robustness of the Tobit model estimates as it gets closer to unity. The marginal values directly generated by the Tobit model are estimates of elasticities.

Four separate Tobit regression models were estimated for aggregate and various rice commodities.

Variables description

The variables for the purpose of this study are specified as follows:

Y_i = F (P, Y, S, L, U)…...……………………,,…………………………………………(29)

Where Y_i = Expenditure share on rice commodities

P = Vector of price Variables

Y= Vector of Income Variable

S = Vector of Socioeconomic Variables

L= Locational Dummies

U= Stochastic Term

Definitions of dependent variables

Y_1 = Aggregate expenditure share ofrice (₦)

Y_2 = Expenditure share ofimported rice (₦)

Y_3 = Expenditure share ofimproved domestic (agric.) rice (₦)

Y_4 = Expenditure share of local rice (₦)

Note: within the context of this study, the followings are defined thus:

Imported rice: Rice varieties produced outside Nigeria, especially from Thailand and other Asian countries, polished, packaged and imported into the Nigerian market.

Improved Domestic Rice (Agric Rice): Rice varieties that are products of domestic varietal improvement, such as FARO series, Tox, ITA series and NERICA

Local Rice: Indigenous rice commodities grown domestically in Nigeria, such as *Ofada, Gboko, Abakaliki*

Definitions of explanatory variables

Socioeconomic variables

X_1–Household Head's Age (years)

X_2–Primary Occupation (D=1 farming, 0 if otherwise)

X_3–Household Size (number-Adult equivalent)

X_4–Education (No of years of education)

X_5–Marital Status (1-Married, 0 if otherwise)

X_6–Membership of Community Organization (1= Member, 0 if otherwise)

X_7–Total Asset Value (₦)

X_8–Non-Food Total Expenditure share (₦)

Locational variables

X_9–North-East Region (1, 0 otherwise)

X_{10}–North-West Region (1, 0 otherwise)

X_{11}–South-East Region (1, 0 otherwise)

X_{12}–South-South Region (1, 0 otherwise)

X_{13}–South-West Region (1, 0 otherwise)

X_{14}–Location dummy (D=1 Rural, 0 if otherwise)

Note: North–Central is chosen as the base and hence not included in the model

Income and price variables

X_{15}–Household total expenditure adjusted for regional cost difference (as a proxy for income) (₦/month)

X_{16}–Price of Imported Rice (₦/kg)

X_{17}–Price of Agric. Rice (₦/kg)

X_{18}–Price of Local Rice (₦/kg)

X_{19}–Price of Yellow Garri (₦/kg)

X_{20}–Price of White Garri (₦/kg)

X_{21}–Price of Yam Tuber (₦/kg)

X_{22}–Price of Brown Beans (₦/kg)

X_{23}–Price of White Beans (₦/kg)

X_{24}–Price of Millet (₦/kg)

X_{25}–Price of Guinea Corn (₦/kg)

X_{26}–Price of White Maize (₦/kg)

X_{27}–Price of Yellow Maize (₦/kg)

Note:

*Major food commodities consumed in Nigeria include root and tuber as well as cereals, thus the prices of major root and tuber products as well as other cereals within the limit imposed by the available prices in the NBS, 2004 price data were included in the demand analysis. Beans has often been traditionally associated with rice consumption, hence the need to include beans price in the demand model.

*A cross–sectional analysis is involved in this study; hence, there was no need for price deflation, trending or addition of seasonality variable in the demand analysis.

3.3.3 Linearized AIDS Model

In order to ensure a more flexible analysis of demand, this study equally tried theAlmost Ideal Demand System (AIDS) on non-zero observations of the NLSS data. AIDS model is a flexible functional form that is based on duality theory and a two-stage budgeting procedure. This model is quite useful for providing insight into how consumers allocate expenditure among disaggregated food commodities and how they make decisions concerning food purchases (Akbay and Boz, 2001).

Some important advantages of the AIDS model are that the expenditure function from which the AIDS model is derived is flexible. The model also allows for testing and imposition of homogeneity and symmetry restrictions, thus conserving degree of freedom. Furthermore, the model gives an arbitrary first-order approximation to any demand system, which satisfies the axioms of choice exactly and lastly the underlying class of preferences contains desirable aggregation properties, and largely avoids the need for nonlinear estimation (Deaton and Muellbauer, 1980).

The stochastic version of the AIDS budget share demand function can be written as:

$$\mathrm{e}w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij}\, lnp_j + \beta i \ln\left[\frac{M}{P}\right] + ei \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (30)$$

where w_i is the budget share of the ithgood, M is the total consumption expenditure, Pj is the price of the jthgood, P is a properly defined price aggregator. The AIDS model is based on the consumer's expenditure function, as seen clearly in equation 30. The equation expresses the budget share of a given commodity as a function of total expenditure and prices. The open form of the price aggregator is given by:

$$\ln p = \alpha_0 + \sum_{i=1}^{n} \alpha_i ln\, p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=i}^{n} \gamma_{ij}\, lnp_i\, lnp_j \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (31)$$

where the coefficients are coming from the expenditure function of an individual household. Because of the existence of non-linear parameters and difficulties in the estimation of constant term in the price index expressed in the preceding equation, it is difficult to achieve convergence. To circumvent these difficulties, the linear approximation AIDS (LAAIDS) model was substituted for the original model in many applied studies. This model involves the replacement of log P with simpler index used by Stone (1954) and Akbay and Boz (2001).

$$lnp = \sum_{i=1}^{n} \alpha_i ln\, p_i \text{ ....} (32)$$

With the following parameter restrictions, equation (31) satisfies the adding up, homogeneity and symmetry properties derived from the standard demand theory.

$\Sigma\, \alpha_i = 1$, $\Sigma\, \beta i = 0$, $\Sigma\, \gamma_{ij} = 0$, $\Sigma\, \gamma_{ji} = 0$ and $\gamma_{ij} = \gamma_{ji}$

Expenditure and price elasticities then can be easily derived as follows:

$$\eta_i = 1 + \beta_i/\omega_i \text{ ....} (33)$$

$$\mathcal{E}ii = -1 + (\gamma_{ij}/w_i) - \beta_i \text{ ....} (34)$$

$$\mathcal{E}ij = (\gamma_{ij}/w_i) - \beta_i w_j \text{ ....} (35)$$

where ηi is the expenditure elasticity, w_i is the budget share of good i, Ɛii is the own price elasticity and Ɛij represents the cross-price elasticity, in Marshalian terms (uncompensated). Compensated (Hicksian) price elasticities, eij, can be derived easily by using ηi,Ɛii and Ɛij and the following relation:

$$e_{ij} = \mathcal{E}ij + \eta_i * w_j \text{ ....} (36)$$

A system of share equations based on equation (30) and subject to the restrictions (adding-up, homogeneity, and symmetry) is estimated using iterative Seemingly Unrelated Regression (SURE) method of Zellner. This method is equivalent to Full Information Maximum Likelihood (FIML) estimation. The adding-up property of demand causes the error covariance matrix of system to be singular. So, one of the expenditure share equations is dropped from the system to avoid singularity problems. The estimates are invariant of which equation is deleted from the system. The coefficients pertaining to the expenditure share equation of local rice which is dropped from the system in the estimation stage are obtained by using the adding-up property. Symmetry is imposed during the estimation of the system of equations. The AIDS model in equation (30) is modified by the inclusion of some household variables, namely:

X_1–Household Head's Age (years)

X_2–Primary Occupation (D=1 farming, 0 if otherwise)

X_3–Household Size (number- Adult equivalent)

X_4–Education (No of years of education)

X_5–Marital Status (1-Married, 0 if otherwise)

X_6–Membership of Community Association (1= Member, 0 if otherwise)

X_7–Total Asset Value (₦)

X_8–Non-Food Total Expenditure share (₦)

X_9–Location dummy (D=1 Rural, 0 if otherwise)

X_{10}–Household total expenditure adjusted for regional cost difference (as a proxy for income) (₦/month)

X_{11}–Price of imported rice (₦/kg)

X_{12}–Price of agric. rice (₦/kg)

X_{13}–Price of local rice (₦/kg)

Table 2: *Apriori* Expectation for Demand Variables

Variables	Unit	Expected Signs	Authorities
Age	Years	-ve	Heilig(1999),Choi and Lee(2000) Agwu *et al.* (2009), Adeyeye (2012)
Primary Occupation	Dichotomous	+ve/-ve	
Household size	Country Adult Eqiv.	+ve	Abdulai *et al.* (1999), Choi and Lee(2000), Agwu *et al.* (2009), Bamidele *et al.* (2012), Oyinbo *et al.* (2013)
Education	Years of education	+ve	Jenson(1995); Babatunde *et al.* (2007), Nwachukwu *et al.* (2008), Agwu *et al.* (2009), Adeyeye (2012)
Marital Status	Dichotomous	+ve	Adeyeye (2012)
Membership of Comm.	Dichotomous	+ve	Abdulai *et al.* (1999)
Total asset	₦	+ve	
Non Food Total Exp.	₦	-ve	
Zonal Dummies/ Location	Dichotomous	+ve/-ve	Bamba *et al.* (2010), Adeyeye (2012)
Own Price	₦	-ve	Rahji and Adewumi (2008) Nwachukwu *et al.* (2008), Agwu *et al.* (2009),Akbay,and Boz (2001), Okoruwa *et al.* (2008), Odusina (2008), Adeyeye (2012), , Oyinbo *et al.* (2013)
Other Comm. Price	₦	+ve/-ve	Odusola(1997), Babatunde *et al.* (2008); Okoruwa *et al.* (2008), Adeyeye (2012)
Per Capita Expenditure (income)	₦	+ve	Agwu *et al.*(2009), Bamidele *et al.* (2010)

Note: All price and income Elasticities for rice are expected to be less than unity (i.e inelastic) in conformity with Engels law and past studies such as,Nwachukwu *et al.*(2008), Okoruwa *et al.* (2008), Agwu *et al.*(2009).

Source:**C**omposed by the author from literature review

3.3.4 Cointegration-ECM Analysis

This study estimated the responsiveness of rice supply to price and non- price factors by applying recent time series techniques and using data spanning different pricing regimes (pre-SAP and post-SAP regimes).This study improved upon the methodology ofMcKay *et al.* (1999) by making use of a more recent cointegration technique, the Vector Autoregressive Error Correction Model. The most widely known single equation approach to cointegration is the Engle-Granger two-step procedure. This approach has some limitations. Firstly, it ignores short-run dynamics when estimating the cointegrating vector. When short-run dynamics are complex, this biases the estimate of the long-run relationship in finite samples. To counter this, a test based on the coefficient of the lagged dependent variable in an autoregressive distributed lag framework has been proposed (Banerjee *et al*., 1998). However, the parameter estimates are only asymptotically efficient on the assumption of weak exogeneity of the regressors. McKay *et al.* (1999) adopted this approach but there are reasons to believe that agricultural prices may not be weakly exogenous, thus shading doubt on the asymptotic efficiency and consequently validity of their estimates. Secondly, the procedure only assumes that one cointegrating vector exists leading to inefficiency in estimation in the event that more than one cointegrating vector actually exists. The Johansen estimation procedure deals with this problem but, like the Engle-Granger procedure, it presupposes that the order of integration of all the variables is the same and known with certainty. In this study, Johansen method nested in vector error correction modelling was employed since there may be more than one cointegrating relationship and it is an improvement over the Engle-Granger traditional procedure.

1. Test of stationerity

The development in time series modelling points to the need to exercise some caution, by first examining the statistical properties of the series and incorporating these in the final model where necessary so as to guarantee non-spurious regression (Granger and Newbold,1974). The first step in the analysis is to identify the order of integration of the variables. The Dickey-Fuller (DF) approach and the Augmented Dickey-Fuller (ADF) can be applied to test the null hypothesis that a series contains a unit root (is non-stationary). In case of Dickey-Fuller, it involves estimating the equation below for each variable y_t and testing the null hypothesis approach:

H_0: $\rho = 1$ against the alternative H_1: $\rho < 1$.

$$\Delta y_t = \gamma + \tau t + (\rho - 1) y_{t-1} + \nu_t \qquad (37)$$

If the variable does not follow an AR(1) process but is AR (n), then the Augmented Dickey Fuller (ADF) test should be used; and in place of (37), we estimate:

$$\Delta y_t = \gamma + \tau t + (\rho - 1) y_{t-1} + \Sigma i \; l i \Delta y t\text{-}i + \nu t \qquad (38)$$

If H_o cannot be rejected, then y_t contains a unit root and hence is not stationary. If its first difference is then tested and found stationary, y_t is I(1). If not, y_t needs to be differenced further. In this study, the Augmented Dickey Fuller test was estimated and differenced further and until stationarity was attained in the variables.

2. Vector Auto Regressive Error Correction (VECM)

Having ascertained that most of the series in the economic model are non-stationary in their level, but stationary in their first difference and bearing in mind the need to accommodate the interdependence of relationships between most economic variables, the economic model was re-conceptualised as a vector autoregressive system, allowing for the possibility of cointegration among the endogenous variables.

$$\Delta y_t = Bx_t + \sum_{i=1}^{4} \Gamma_i \Delta y_{t-1} + \Pi y_{t-1} + e_t \qquad (39)$$

where

x is vector of deterministic variables, constant (C) and/or trend;

y is vector of I(1) endogenous variables – Output, Area, Price, Import, Fertilizer consumption, Rainfall, Policy

B, Γ and Π are matrices of coefficients to be estimated, while e is a vector of stochastic residuals.

Terms in B give the influence of the associated deterministic variables, while Γ represents short-term elasticities of response. And, where evidence of r<5 Cointegrating relations exist, by Granger causality theorem, $\Pi = \alpha\beta'$, in which β is the cointegrating vector (containing the long-run elasticities), while elements of α are the adjustment parameters in the vector error correction model.

3. Test for Cointegration

This test was implemented in EViews using procedures for Johansen's (1992, 1995b) system-based techniques. The test utilizes a trace statistic-based likelihood-ratio (LR) test for the number of cointegrating vectors in the system. In implementing the Johansen technique,however, two main issues have to be addressed. The first is the choice of the optimal lag length in the VAR system. Noting that the lag length ought to be set long enough to ensure that the residuals are white noise (EViews, 1998, EViews, 2009), and considering limitations imposed by the data (consumption of too much degree of freedom; and the result of the performance of additional lag from the Granger causality test), this study stuck to the use of one lag in the VAR.

A second issue that has to be addressed is whether deterministic variables, such as a constant and trend, should enter into the long-run cointegrating space or the short-run model. Gujarati and Sangeetha (2007) observe that there are, in general, three possible ways of incorporating these deterministic components into an analysis:

(a) That, if there are no linear trends in the levels of the data, a most restrictive specification would be to restrict the constant to lie in the cointegration space only, simply in order to account for the units of measurement of the variables.

(b) That, a less restrictive option would be to permit a constant in both the cointegration space and the short-run model in situations where linear trends are present in the levels of the data.

(c) That, with respect to the trend term, if quadratic deterministic trends are absent in the levels of the variables (which is not usually a possible long-run outcome), the least restrictive specification would be to force the trend term to lie in the cointegration space so that any long-run linear growth is captured by a linear deterministic trend in levels.

EViews provides facilities for conducting and comparing cointegration tests based on five scenarios that accommodatethe suggestions above. These may be listed, from the most restrictive to the least restrictive options as follows:

Option A: Assumes no deterministic trend in the data, and allows no intercept nor trend in the cointegrating equation (CE) or test VAR;

Option B: Also assumes no deterministic trend in the data, and allows intercept (no trend) in the CE and no intercept in the VAR;

Option C: Allows for linear deterministic trend in the data, with intercept (no trend) in the CE and test VAR;

Option D: Allows for linear deterministic trend in the data, with intercept and trend in the CE but no trend in the VAR;

Option E: Allows for quadratic deterministic trend in the data, with intercept and trend in the CE and linear trend in the VAR.

Because significant trends were not found in series in the model, the final choice among the options was based on application of the Pantula principle (Johansen, 1992), which permits joint test of the rank order of the long-run matrix and the presence of deterministic components. This involved estimating all the possible specifications, and conducting Johansen's likelihood-ratio tests for the rank order of the long-run matrix sequentially from the most restrictive to the least restrictive specification. The first time the null hypothesis is not rejected indicates both the rank order of the long-run matrix and the appropriate specification for the deterministic components (Gujarati and Sangeetha, 2007).

The final stage of the analyses, having established that one cointegrating vector existed in the data, is to estimate the restricted VAR in (39) using VECM facility in EViews.

Model Specification

Following McKay *et al.* (1999) and Muchapondwa (2008), the output function adopted in this study is specified as follows:

$$\Delta R_t = \beta_0 + \sum \beta_{1_i} \Delta p_{t-i} + \sum \beta_{2_i} \Delta R_{t-i} + \beta_{3_i} \Delta Z_t + \beta_4 P + \lambda ECT_t + \varepsilon_t \ldots \ldots \ldots \ldots \ldots \ldots (40)$$

where Rt is the supply in year t

P_{t-i} are the lagged value of producer prices,

R_{t-i} are the lagged value of supply,

Z_t are values of other determinants of rice supply,

P is the policy variable,

ECT is the error correction term

ε_t is the stochastic disturbance.

β's and λ are parameters to be estimated.

Following Mc Kay *et al.* (1999), Nayaran (2005), Akmal (2007), Rahji and Adewumi (2008), Rahji *et al.*, (2008) and Muchapondwa (2008), the variables are defined as follows:

Dependent variable

Rt = Rice Supply in year t, Proxied by Rice Output (tons)

Explanatory Variables

P_{rt} = Price of Rice in year t (₦/tonne)

P_{rt-1} = Lagged value of Price of Rice in year t (₦/tonne)

R_{t-1} = Lagged value of Rice Supply in year t (tons)

Zt's are:

W_t = Amount of Rainfall in year t (mm)

I_t = Rice Import Level in year t (tons)

F_t = Fertilizer consumption in year t (tonne)

A_t = Area of rice cultivated in year t (Ha)

P = Policy Variable (1-Policy intervention era, 0- Non- policy intervention era)

- The period before 1986 has been classified as non-policy (liberal policy) intervention era on rice, while the period from 1986 has been classified as policy intervention era on rice in Nigeria owing to ban on rice and the commencement of trade liberalization in this period. Introduction of SAP and the abolition of Commodity Boards to provide production incentives to farmers through increased producer prices started from 1986 (Ogundele, 2007; Rahji *et al* 2008)

Typically, agricultural economists have modelled expected output as being determined by past prices (cobweb behaviour, distributed lags and adaptive expectation models). Farmers are supposed to react to recent past information and there is no use of current information. In addition to this, a study by Lopez and Ramos (1998) considered the cobweb model appropriate for basic grains and that the price farmers expect is the price they received in the preceeding period.In line with Nerlove (1956), the models portraying the structural relationship in the production of local rice can be postulated as output response. Following the partial adjustment model, the price of substitute is never considered (Gafar, 1997). Similarly, several studies like McKay *et al.* (1999), Rahji *et al.* (2008), Rahji and Adewumi (2008) equally omitted the price of substitute in their analysis owing to the consumption of degree of freedom because of the limited data points. Hence, the non-inclusion of price of substitutes in this study becomes justified.

Table 3: *Apriori* Expectation for Supply Response Variables

Variables	Unit	Expected Signs	Authorities
Area	'000 hectares	+ve	Mc Kay *et al.*(1999);Nayaran(2005), Muchapondwa(2008)
Price	₦ /tonne	+ve(less than unity)	Rahji and Adewumi (2008),Rahji *et al.* (2008),Muchapondwa(2008)
Import	'000 Tons	-ve	Ogundele (2007)
Fertilizer Consm.	'000 Tons	-ve	Muchapondwa(2008)
Rainfall	MM	+ve	Begum *et al.* (2002)
Policy	Dichotomous	+ve/-ve	Rahji *et al.* (1999), Ogundele (2007)

Source: Author's compilation from literature review

3.3.5 Paired sample t-test

The paired sample t-test statistics was used to estimate the direction of preference switch between various pairs of rice commodities. The paired means were checked for statistical significance. The individual means of paired rice commodities were then compared while the one with higher mean was the preferred.Thus, a switch was observed towards it. The sign of the t-statistics further confirms the direction of the switch (Straus, 1982; Nwachukwu *et al.*, 2008 and Agwu *et al.*, 2009).

3.3.6 Generalized Least Square Regression

In estimating the socioeconomic determinants of preference switch from one rice commodity to another, a multiple regression model of three functional forms (Linear, semi-log and double-log) were employed. The fittest of the model, based on economic and statistical criteria was selected as the primary model. Four separate models were estimated. The implicit form of the model is expressed as:

$Y_i = f\ (X_a, X_b, X_c, X_d$ ……………………….Xq)………………………………………..(41)

Following Nwachukwu *et al.*(2008) and Agwu *et al.* (2009), the variables were defined thus:

Dependent variable

Y_i = Switch from one rice commodity to the other

Y_1 = Index of Preference switch from Imported to Agric. rice (Expenditure share of imported rice- Expenditure share of agric. rice)

Y_2 = Index of Preference switch from Imported to local rice (Expenditure share of imported rice- Expenditure share of local rice)

Y_3 = Index of Preference switch from Agric. to Imported rice (Expenditure share of agric. rice – Expenditure share of imported rice)

Y_4 = Index of Preference switch from local to Imported rice (Expenditure share of local rice – Expenditure share of imported rice)

Explanatory variables

X_a- Household Head's Age (years)

X_b-Primary Occupation (D=1 farming, 0 if otherwise)

X_c- Household Size (number- adult equivalent)

X_d- Education (No of years of education)

X_{e-} Marital Status (1-Married, 0 if otherwise)

X_{f-} Membership of Community Organization (1= Member, 0 if otherwise)

X_{g-} Total Asset Value (₦)

X_h- North-East Region (1, 0 otherwise)

X_i- North-West Region (1, 0 otherwise)

X_j- South-East Region (1, 0 otherwise)

X_k- South-South Region (1, 0 otherwise)

X_l- South-West Region (1, 0 otherwise)

X_{m-} Location dummy (D=1 Rural, 0 if otherwise)

X_n Household total expenditure adjusted for regional cost difference (as a proxy for income) (₦/month)

X_0- Price of imported rice (₦/kg)

X_p- Price of agric. rice (₦/kg)

X_q- Price of local rice (₦/kg)

However, following the detection of strong positive spatial autocorrelation with Durbin-Watson values of 0.025, 0.020 0.025 and 0.020 for the estimated equation Y_{1-} Y_4,respectively,in the ordinary least square regression model, the chosen model (semi-log) was modified using General Least Square(GLS) of first difference. We can afford to lose the first data point without necessarily transforming through Cochrane-Orcutt, Prais-Winsten or any other iterative procedures since we are dealing with relatively large samples with high degree of freedom (17, 18844) (Gujarati, 2006; Gujarati and Sangheeta, 2008).

3.4 Limitations of the Study

The major limitations encountered are discussed below:

1. The study was mostly constrained by data availability. The Nigerian Bureau of Statistics (NBS) collects and releases data at distant periodic intervals, a minimum of 5 years. The 2004 NLSS data (which came after the 1999 data set) was the most current national data as at the time of analysis of this work in 2009-2011. The new set of data was released in 2012/2013 after this research work had been completed. However, except for the inclusion of few other variables and the panel nature of the data, the new sets of data were very similar to the 2004 NLSS data. The socioeconomic characteristics which are of interest in our analysis have remained relatively stable over the period of time. Hence, analysis in this study is as relevant as possible in the present time. The results from these studies are comparable with a

similar national study by Nigeria Institute of Social and Economic Research (Adeyeye, 2012) and other localised studies, such as Oyinbo *et al*. (2013). However, analysing with the NLSS data set released in 2013 may improve the relevance of the study in current time.

2. We could not incorporate factors like grain characteristics and processing in the demand and preference switch models owing to the unavailability of such qualitative data in the NLSS, 2004.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents and discusses the results of various analyses. The discussion focuses on descriptive statistics of expenditure patterns and socioeconomic characteristics, inferential statistics of Tobit and Almost Ideal Demand System (AIDS), Vector Error Correction Model (VECM), Generalised Least Square Regression for demand, supply response and preference switch analysis.

4.1 Household expenditure pattern on rice and socioeconomic characteristics of the respondents

In this section, the distribution of households according to their expenditure on total rice consumption as well as individual rice commodities (imported, agric., and local) were fully examined and analysed both at the national and individual geo-political zones. The section further analyses the expenditure share of rice in relation to the total food expenditure and socioeconomic characteristics.

4.1.1 Distribution of expenditure of households on rice

Tables 4 to 7below classify the respondents according to their monthly expenditure on aggregate rice and individual rice commodities (imported, agric. and local rice) for different geopolitical zones and the national aggregate. Table 8compares statistical distribution of expenditure of various rice commodities.

At the national level, Table 4 shows that, over 40 percent of the respondents spent less or equal to ₦2, 000 on rice monthly, a little more of them expended between ₦2, 001 and ₦4,000 on rice while the remaining few spent more than₦4,000 on rice monthly.As seen in Table5, about half of the respondents spent between ₦501 and₦1, 000 on imported rice, while the rest were sparsely distributed across various categories of expenditure. Tables 6 reveal that the majority of the respondents spent between ₦501 and ₦1, 000 on agric. rice.This group was followed by expenditure group of ≤ ₦500 with a marginal number expending above ₦1, 500. The respondents fell into three main categories for local rice expenditure nationally (Table 7).The modal expenditure group was those that spent between ₦501 and ₦1, 000, while the expenditure group of less or equal to ₦500 followed.

Table 4: Distribution of the Respondents by Total Monthly Expenditure on Rice

Zone	Category	Frequency	Percent	Cumulative Percent
South-South	<=2000	2300	80.6	80.6
	2001-4000	554	19.4	100.0
	Total	2854	100.0	
South-East	<=2000	1577	58.8	58.8
	2001-4000	1104	41.2	100.0
	Total	2681	100.0	
South-West	<=2000	2560	85.5	85.5
	2001-4000	433	14.5	100.0
	Total	2993	100.0	
North Central	<=2000	1019	30.6	30.6
	2001-4000	1813	54.4	85.0
	>=8001	499	15.0	100.0
	Total	3331	100.0	
North-East	<=2000	545	17.0	17.0
	2001-4000	2657	83.0	100.0
	Total	3202	100.0	
North-West	2001-4000	2182	57.4	57.4
	4001-6000	1158	30.5	87.9
	6001-8000	460	12.1	100.0
	Total	3800	100.0	
National	<=2000	8001	42.4	42.4
	2001-4000	8743	46.4	88.8
	4001-6000	1158	6.1	94.9
	6001-8000	460	2.4	97.3
	>=8001	499	2.7	100
	Total	18861	100	

Source: Computed from NLSS Data (2004)

The result of the distribution of respondents according to expenditure on aggregate rice invarious geopolitical zones,presented in Table 4 revealed that the South-South zone recorded only two categories of expenditure, wherein the expenditure category of less or equal to ₦2,000 was in the majority over the ₦2001- ₦4000 category. The aforementioned two groups existed in the South-East zone as well; the households in the former category slightly outnumbered those in the latter. A clear tilt was observed towards the expenditure category of less or equal to₦2, 000 against the₦2, 001- ₦4, 000 expenditure category in the South-West. In the North-Central zone, a higher percentage was in favour of respondents that spentbetween₦2, 001- ₦4, 000. The North Eastern region followeda similar trend with that of the North-Central zone. Three groups featured in the North-West geopolitical zone.Respondents that fell within the expenditure bracket of ₦2, 001 and ₦4, 000 recorded the highest frequency.

The zonal report for expenditure on imported rice, in Table 5 revealed that all respondents in the South-South region spent between ₦501 and ₦1, 000 on imported rice. South-Eastern region had three valid groupings with respect to imported rice; close to 60 percent expended between ₦501- ₦1,000, while the remaining were split between the expenditure group of ₦1,501- ₦2,000 and ₦2, 001- ₦2, 500. Unlike the South-East, two valid groups existed in the South-West, with the larger percentage tending towards expenditure bracket of ₦501 and₦1, 000. The North-Central region was well dispersed in consumption of imported rice.The modal group (₦501- ₦1, 000) constituted one–third of the respondents.The majority of the respondent in the North-Eastern zone recordedexpenditure between ₦501 and ₦1000, while two expenditure groups,₦501-₦1, 000 and ₦1, 001-₦1, 500, dominate the North-Western zone.

Considering the zonal distribution of agric. rice expenditure (Table 6), more than half of the respondents expendedbetween ₦501 and ₦1, 000 on agric. rice. All the respondents in the South-Eastern region fell within the Agric. rice expenditure category of ₦501 and ₦1, 000, while South-West had expenditure group of ₦501- ₦1, 000 in the majority. The North-Central zone featured three different expenditure groups for agric. rice;₦1, 001- ₦1, 500 category being the modal group. The same three categories featured in the North-East, with the ₦501- ₦1, 000 group outnumbering the other two groups. The result obtained was quite different in the North-Western region; four different groups were represented. ₦501- ₦1, 000 constituted the largest category of rice consumers in the zone.

Table 5: Distribution of the Respondents by Expenditure on Imported Rice

Zone	Category	Frequency	Percent	Cumulative Percent
South-South	501-1000	2854	100.0	100.0
South-East	501-1000	1577	58.8	58.8
	1501-2000	540	20.1	79.0
	2001-2500	564	21.0	100.0
	Total	2681	100.0	
South-West	501-1000	2560	85.5	85.5
	1501-2000	433	14.5	100.0
	Total	2993	100.0	
North-Central	<=500	470	14.1	14.1
	501-1000	1036	31.1	45.2
	1001-1500	555	16.7	61.9
	1501-2000	254	7.6	69.5
	2001-2500	517	15.5	85.0
	2501-3000	499	15.0	100.0
	Total	3331	100.0	
North-East	<=500	545	17.0	17.0
	501-1000	589	18.4	35.4
	1001-1500	2068	64.6	100.0
	Total	3202	100.0	
North-West	501-1000	1062	27.9	27.9
	1001-1500	1120	29.5	57.4
	2001-2500	575	15.1	72.6
	3001-3500	460	12.1	84.7
	>=3501	583	15.3	100.0
	Total	3800	100.0	
National	<=500	105	5.4	5.4
	501-1000	9678	51.3	56.7
	1001-1500	3743	19.8	76.5
	1501-2000	1227	6.5	83.0
	2001-2500	1656	8.8	91.8
	2501-3000	499	2.6	94.5
	3001-3500	460	2.4	96.9
	>= 3501	583	3.1	100.0
	Total	18861	100.0	

Source: Computed from NLSS Data (2004)

Table 6: Distribution of the Respondents by Expenditure on Improved Domestic (Agric.)Rice

Zone	Category	Frequency	Percent	Cumulative Percent
South-South	<=500	1019	35.7	35.7
	501-1000	1835	64.3	100.0
	Total	2854	100.0	
South-East	501-1000	2681	100.0	100.0
South-West	<=500	1052	35.1	35.1
	501-1000	1941	64.9	100.0
	Total	2993	100.0	
North-Central	<=500	1019	30.6	30.6
	501-1000	741	22.2	52.8
	1001-1500	1571	47.2	100.0
	Total	3331	100.0	
North-East	<=500	545	17.0	17.0
	501-1000	2150	67.1	84.2
	1001-1500	507	15.8	100.0
	Total	3202	100.0	
North-West	501-1000	1663	43.8	43.8
	1001-1500	1149	30.2	74.0
	1501-2000	528	13.9	87.9
	3001-3500	460	12.1	100.0
	Total	3800	100.0	
National	<= 500	3635	19.3	19.3
	501- 1000	11011	58.4	77.7
	1001-1500	3227	17.1	94.8
	1501-2000	528	2.8	97.6
	3001-3500	460	2.4	100
	Total	18861	100	

Source: Computed from NLSS Data (2004)

As presented in Table 7, the gross population of the respondents in the South-South expended less or equal to ₦500 on local rice against the ₦501- ₦1, 000 category. The same pattern was obtained in the South-East and the South-West region. In the North-East and the North-West zones, the higher frequency was in favour of the ₦501- ₦1, 000 local rice expenditure category. The North-Central region added an additional category of expenditure ≥ ₦3,001, yet the ₦501- ₦1, 000 expenditure group for local rice remained the modal group for the region.

As a whole, the expenditure on imported, agric. and local rice was relatively higher in the northern region than the southern region. This agrees with the findings of Adeyeye(2012). The results discussed so far are a pointer towards sociocultural diversity in rice consumption in Nigeria. Hence, the importance of inclusion of locational factor in rice demand analysis is further buttressed. Also, a comparisonof the results from the rice expenditure tables above, shows that Nigerians spend more on foreign (imported) rice than agric. and local rice (domestically produced rice). This is no doubt a threat to food self - sufficiency if the trend is not reversed.

Table 7: Distribution of the Respondents by Expenditure on Local Rice

Zone	Category	Frequency	Percent	Cumulative Percent
South-South	<=500	2445	85.7	85.7
	501-1000	409	14.3	100.0
	Total	2854	100.0	
South-East	<=500	1610	60.1	60.1
	501-1000	1071	39.9	100.0
	Total	2681	100.0	
South-West	<=500	1992	66.6	66.6
	501-1000	1001	33.4	100.0
	Total	2993	100.0	
North-Central	<=500	517	15.5	15.5
	501-1000	2315	69.5	85.0
	>=3501	499	15.0	100.0
	Total	3331	100.0	
North-East	<=500	999	31.2	31.2
	501-1000	2203	68.8	100.0
	Total	3202	100.0	
North-West	<=500	534	14.1	14.1
	501-1000	3266	85.9	100.0
	Total	3800	100.0	
National	<=500	8097	42.9	42.9
	501-1000	10265	54.4	97.4
	>=3501	499	2.6	100.0
	Total	18861	100.0	

Source: Computed from NLSS Data (2004)

The national statistics of various expenditures and expenditure shares of rice are presented in Table 8. In most cases, the skewness value greater or less than zero as well as kurtosis values greater than 3 indicate that the expenditures of various rice commodities are not normally distributed. The mean expenditure for imported rice (₦1, 256.545) was higher than that of agric. rice (₦797.748) and local rice (₦658.110). Consequently, the share of expenditure of various rice commodities follows the same trend since imported rice is on the top with mean share of total rice expenditure of 0.451. Rice averagely constituted about 25 percent of total food expenditure. The zonal variation is presented in Appendix 7.

Appendix 7further reveals that, on the average, the North-West zone ranked highest in total mean expenditure and expenditure share on almost all rice commodities. This zone was closely followed by the North–Central region. The South-East and North-East region were at close range, while the South-South zone ranked lowest in terms of overall rice consumption expenditure. For imported rice, a comparison of the mean expenditures at various zones showed that it followed the same ranking order as the total rice expenditure. North-West led, followed by North-Central; South-East, North-East, South-West and South-South followed in that sequence. With regard to the mean expenditure of agric. rice, North-East took the usual lead, followed by North-Central; the North-East overtook the South-East for agric. rice expenditure but with minimal difference.

As also presented in Appendix 7, the South-West and the South-South maintained their normal ranking. In terms of expenditure on local rice, the North-Central took an exceptional lead. This is not, in any way, surprising; it could be attributed to the fact that the zone is the Nigerian basket for the production of local rice. The zone was followed by North-West, then North-East. The mean expenditure in the southern zones for local ricewas generally low; South-East followed the northern region, while the South-West and the South–South zones were at close range in the consumption of local rice. In all, it is clear that the northern region consumed more of rice commodities than the southern region simply because of the wide varieties of dishes prepared from rice and relatively higher production in the northern zones.

Table 8: Description of Household Expenditure on Rice Commodities (National)

Expenditure/Share	Mean	S. D	Skewness	Kurtosis
Imported Rice (IR)	1256.545	6.007	1.646	2.120
Agric. Rice (IDR)	797.748	3.611	3.171	13.113
Local Rice (LR)	658.110	4.453	5.226	27.695
Total Rice (TR)	2712.404	11.375	2.225	4.913
Share of IR	0.451	0.001	-0.500	-0.222
Share of IDR	0.301	0.075	-0.232	-0.169
Share of LR	0.248	0.091	1.397	2.522
Share of TR	0.254	0.307	9.486	180.920

Source: Computed from NLSS (2004)

4.1.2 Share of rice in total food expenditure

The national expenditure share on rice is presented in Table 9. The expenditure share of 0-10 and 11-20 percent was at close range and in the majority, followed by 21-30 percent share. Other expenditure share categories were thinly distributed at the national level. The fact that expenditure on rice represents a tangible share of total food consumption expenditure is an exposure of the potential of rice to solve the problem of food self-sufficiency through increased production. Therefore, unavailability of the commodity constitutes a threat to food security and self-sufficiency in Nigeria.

As shown in Appendix 8, almost half of the respondents in the South-South zone expended0-10 percent of their total food expenditure on rice.Another substantial percentage spent up to 30 percent, while the rest were thinly distributed across various expenditure share groups. The situation was a bit different in the South-East, as closer percentages fell within the expenditure share group of 0-10 and 11- 20 percent. Yet, about 16 percent spent between 21 and 30 percent of their monthly food expenditure on rice. A similar trend to that of the South-East zone was obtained in the South-West, North-Central and North-East zones. The expenditure share group of 11-20 percent represented the modal group for North-Central and North-East unlike in the Southern region where 0-10 percent expenditure share were in the majority. The 21-30 percent expenditure share category took an exceptional lead in the North-West, with other expenditure categories closely distributed, save the 60-70 percent expenditure share.

Table 9: Distribution of the Respondents by Share of Rice in Total Food Expenditure (National)

Expenditure	Frequency	Percent	Valid Percent	Cumulative Percent
National				
1-10	3926	20.8	28.3	28.3
11-20	3810	20.2	27.5	55.9
21-30	2458	13.0	17.7	73.6
31-40	1571	8.3	11.3	85.0
41-50	963	5.1	7.0	91.9
51-60	671	3.6	4.8	96.8
61-70	450	2.4	3.2	100.0
Total	13849	73.4	100.0	
Missing value	5012	26.6		
Total	18861	100.0		

Source: Computed from NLSS (2004)

4.1.3 Socioeconomic characteristics of the respondents

Table 10 presents the summary statistics of socioeconomic characteristics of selected respondents in the Nigerian Living Standards Survey. The frequency distribution and percentages by categories are stated, while the mean, mode, median, median, standard deviation, skewness and kurtosis are also presented where applicable.

As captured in Table 10, about one-third of the selected sample had no formal education; even the educated category was heavily skewed to the lower primary and secondary school. It is believed that education has a role to play in consumption pattern of individuals. Most of the respondents had less than 10 household members, averaging about 5 household members. The household size reduces down the category line; larger households are expected to consume more food than the lower household size. A gross number of the sampled respondents were farmers, mostly resident in the rural area. Rural dwellers who are essentially farmers are expected to have more access to domestically produced rice, especially in areas where they are produced. Most of the respondents were married while a little above half of them belonged to one community society or the other. The respondents were mainly middle-aged, with the modal group being the age bracket of 41 and 50. The mean per capita expenditure of household was ₦14, 873.

Table 10: Distribution of the Respondents by Socioeconomic Characteristics

Category	Freq.	Percentage	Mean	Mode	Median	S.D	Skewness	Kurtosis
Per Capita Exp.			14873	5315.190	23345.510	31622	16.740	801.740
≤ 5,000	9027	47.9						
5001- 10000	3957	21.0						
10001-15000	1627	8.6						
15001-20000	934	5.0						
20001-25000	611	3.2						
≥ 25001	2702	14.3						
Total	**18861**	**100.0**						
Education			6.782	0.000	7.000	6.336	0.552	-0.540
No formal	6457	34.2						
Primary	2867	15.7						
Secondary	5581	29.6						
ND/NCE	2889	15.3						
BSc./HND	248	1.3						
Post Grad.	819	4.3						
Total	**18861**	**100.0**						
Household Size			4.847	4.000	4.000	2.905	1.121	2.059
≤5	12316	65.3						
6-10	5683	30.1						
11-15	815	4.3						
16-20	38	0.2						
21-25	8	0.0						
≥25	1	0.0						
Total	**18861**	**100.0**						
Primary Occupation								
Non farming	3267	17.3						
Farming	15594	82.7						
Total	**18861**	**100.0**						
Membership of Society								
Non Member	8640	45.8						
Member	10221	54.2						
Total	**18861**	**100.0**						
Marital Status								
Single	4171	22.1						
Married	14690	77.9						
Total	**18861**	**100.0**						
Location								
Rural	14361	76.1						
Urban	4500	23.9						
Age			47.399	45.000	40.000	14.531	0.510	-0.133
≤ 18	500	2.65						
19-30	2040	10.8						
31-40	4653	24.7						
41-50	4833	25.6						
51-60	3517	18.6						
> =61	3318	17.6						
Total	**18861**	**100.0**						

Source: Computed from NLSS (2004)

4.1.4Distribution of share of rice expenditure and socioeconomic characteristics

Here the total expenditure share on rice is cross tabulated with socioeconomic characteristics of the respondents to give a casual insight into the relationship between expenditure share of rice in total food expenditure and socioeconomic characteristics. The analyses are presented in tables 11–17. As seen in Table 11, the percentage of respondents in ≤ 5 household size increased with increasing share of rice up to a point and then declines. The reverse was the case for all other household size categories except the last two groups that follow irregular pattern. It means that variation seems to exist in rice expenditure among households of varying sizes.

The cross-examination of expenditure share with education in Table 12 presents an irregular pattern. It could be noted that the respondents with higher educational level spent less on rice consumption. Also, for all categories of expenditure share, the majority falls within the 'no formal' education group.

Table 11: Distribution of Share of Rice expenditure by Household size

		Household Size Distribution						
Share of	Rice Expenditure	<=5	6-10	11-15	16-20	21-25	>=25	Total
1-10%	Frequency	2258	1400	246	16	5	1	3926
	% within grouping of percent share of totalrice	57.5%	35.7%	6.3%	0.4%	0.1%	0.0%	100.0%
11-20%	Frequency	2470	1142	185	12	1	0	3810
	% within grouping of percent share of totalrice	64.8%	30.0%	4.9%	0.3%	0.0%	0.0%	100.0%
21-30%	Frequency	1643	700	111	3	1	0	2458
	% within grouping of percent share of totalrice	66.8%	28.5%	4.5%	0.1%	0.0%	0.0%	100.0%
31-40%	Frequency	1094	415	59	3	0	0	1571
	% within grouping of percent share of totalrice	69.6%	26.4%	3.8%	0.2%	0.0%	0.0%	100.0%
41-50%	Frequency	671	267	24	0	1	0	963
	% within grouping of percent share of totalrice	69.7%	27.7%	2.5%	0.0%	0.1%	0.0%	100.0%
51-60%	Frequency	467	186	17	1	0	0	671
	% within grouping of percent share of totalrice	69.6%	27.7%	2.5%	0.1%	0.0%	0.0%	100.0%
61-70%	Frequency	306	131	14	0	0	0	451
	% within grouping of percent share of totalrice	67.8%	29.0%	3.1%	0.0%	0.0%	0.0%	100.0%
Total	Frequency	8909	4241	656	35	8	1	13850
	% within grouping of percent share of totalrice	64.3%	30.6%	4.7%	0.3%	0.1%	0.0%	100.0%

Source: Computed from NLSS Data (2004)

Table 12: Distribution of Share of Rice Expenditure by Education

Share of	Rice Expenditure	Distribution of education						Total
		No formal	Primary	Secondary	ND/NCE	BSc./HND	Post Grad	Total
1-10%	Frequency	1252	619	1204	655	21	175	3926
	% within grouping of percent share of totalrice	31.9%	15.8%	30.7%	16.7%	0.5%	4.5%	100.0%
11-20%	Frequency	1128	602	1244	620	17	199	3810
	% within grouping of percent share of totalrice	29.6%	15.8%	32.7%	16.3%	0.4%	5.2%	100.0%
21-30%	Frequency	839	378	705	389	10	137	2458
	% within grouping of percent share of totalrice	34.1%	15.4%	28.7%	15.8%	0.4%	5.6%	100.0%
31-40%	Frequency	521	216	480	264	5	85	1571
	% within grouping of percent share of totalrice	33.2%	13.7%	30.6%	16.8%	0.3%	5.4%	100.0%
41-50%	Frequency	333	141	282	150	5	52	963
	% within grouping of percent share of totalrice	34.6%	14.6%	29.3%	15.6%	0.5%	5.4%	100.0%
51-60%	Frequency	249	83	203	81	5	50	671
	% within grouping of percent share of totalrice	37.1%	12.4%	30.3%	12.1%	0.7%	7.5%	100.0%
61-70%	Frequency	161	82	127	49	2	30	451
	% within grouping of percent share of totalrice	35.7%	18.2%	28.2%	10.9%	0.4%	6.7%	100.0%
Total	Frequency	4483	2121	4245	2208	65	728	13850
	% within grouping of percent share of totalrice	32.4%	15.3%	30.6%	15.9%	0.5%	5.3%	100.0%

Source: Computed from NLSS Data (2004)

As shown in Table 13, at lower share of rice expenditure (1-40 percent) membership of community society outnumbered non-members, while at higher rice expenditure shares the reverse was the case. Also in Table 14, the result revealed that married people took the larger percentage in all categories of share of expenditure on total rice.In this case, marriage can have some influence on expenditure share of households on rice. Farmers generally expended more on total rice consumption while the rural populace was more in all categories of rice expenditure share (Table 15). Table 17 also shows that there was high level of variation in cross-examining age with expenditure share of rice.In most cases, the age bracket of 31-40 or 41-50 represented the modal group in all categories of expenditure shares.

Table 13: Distribution of Share of Rice Expenditure by Membership of Community Society

Share of	Rice expenditure	Distribution by Membership of Community Society: Non Member	Comm. Member	Total
1-10%	Frequency	1654	2272	3926
	% within grouping of percent share of totalrice	42.1%	57.9%	100.0%
11-20%	Frequency	1633	2177	3810
	% within grouping of percent share of totalrice	42.9%	57.1%	100.0%
21-30%	Frequency	1092	1366	2458
	% within grouping of percent share of totalrice	44.4%	55.6%	100.0%
31-40%	Frequency	714	857	1571
	% within grouping of percent share of totalrice	45.4%	54.6%	100.0%
41-50%	Frequency	519	444	963
	% within grouping of percent share of totalrice	53.9%	46.1%	100.0%
51-60%	Frequency	345	326	671
	% within grouping of percent share of totalrice	51.4%	48.6%	100.0%
61-70%	Frequency	248	203	451
	% within grouping of percent share of totalrice	55.0%	45.0%	100.0%
Total	Frequency	6205	7645	13850
	% within grouping of percent share of totalrice	44.8%	55.2%	100.0%

Source: Computed from NLSS Data (2004)

Table 14: Distribution of Share of Rice Expenditure by Marital Status

Share of	Rice Expenditure	Distribution of Respondents by Marital status: Single	Married	Total
1-10%	Frequency	727	3199	3926
	% within grouping of percent share of totalrice	18.5%	81.5%	100.0%
11-20%	Frequency	890	2920	3810
	% within grouping of percent share of totalrice	23.4%	76.6%	100.0%
21-30%	Frequency	584	1874	2458
	% within grouping of percent share of totalrice	23.8%	76.2%	100.0%
31-40%	Frequency	376	1195	1571
	% within grouping of percent share of totalrice	23.9%	76.1%	100.0%
41-50%	Frequency	237	726	963
	% within grouping of percent share of totalrice	24.6%	75.4%	100.0%
51-60%	Frequency	139	532	671
	% within grouping of percent share of totalrice	20.7%	79.3%	100.0%
61-70%	Frequency	74	377	451
	% within grouping of percent share of totalrice	16.4%	83.6%	100.0%
Total	Frequency	3027	10823	13850
	% within grouping of percent share of totalrice	21.9%	78.1%	100.0%

Source: Computed from NLSS Data (2004)

Table 15: Distribution of Share of Rice Expenditure by Primary occupation

Share of	Rice Expenditure	Distribution by Primary Occupation: Non Farming	Farming	Total: Non-Farming
1-10%	Frequency	1111	2815	3926
	% within grouping of percent share of totalrice	28.3%	71.7%	100.0%
11-20%	Frequency	645	3165	3810
	% within grouping of percent share of totalrice	16.9%	83.1%	100.0%
21-30%	Frequency	339	2119	2458
	% within grouping of percent share of totalrice	13.8%	86.2%	100.0%
31-40%	Frequency	165	1406	1571
	% within grouping of percent share of totalrice	10.5%	89.5%	100.0%
41-50%	Frequency	100	863	963
	% within grouping of percent share of totalrice	10.4%	89.6%	100.0%
51-60%	Frequency	59	612	671
	% within grouping of percent share of totalrice	8.8%	91.2%	100.0%
61-70%	Frequency	28	423	451
	% within grouping of percent share of totalrice	6.2%	93.8%	100.0%
Total	Frequency	2447	11403	13850
	% within grouping of percent share of totalrice	17.7%	82.3%	100.0%

Source: Computed from NLSS Data (2004)

Table 16: Distribution of Share of Rice Expenditure by Location

		Distribution by Location		
Share of	Rice Expenditure	Rural	Urban	Total
1-10%	Frequency	2607	1319	3926
	% within grouping of percent share of totalrice	66.4%	33.6%	100.0%
11-20%	Frequency	2785	1025	3810
	% within grouping of percent share of totalrice	73.1%	26.9%	100.0%
21-30%	Frequency	1957	501	2458
	% within grouping of percent share of totalrice	79.6%	20.4%	100.0%
31-40%	Frequency	1328	243	1571
	% within grouping of percent share of totalrice	84.5%	15.5%	100.0%
41-50%	Frequency	834	129	963
	% within grouping of percent share of totalrice	86.6%	13.4%	100.0%
51-60%	Frequency	582	89	671
	% within grouping of percent share of totalrice	86.7%	13.3%	100.0%
61-70%	Frequency	405	46	451
	% within grouping of percent share of totalrice	89.8%	10.2%	100.0%
Total	Frequency	10498	3352	13850
	% within grouping of percent share of totalrice	75.8%	24.2%	100.0%

Source: Computed from NLSS Data (2004)

Table 17: Distribution of Share of Rice Expenditure by Age

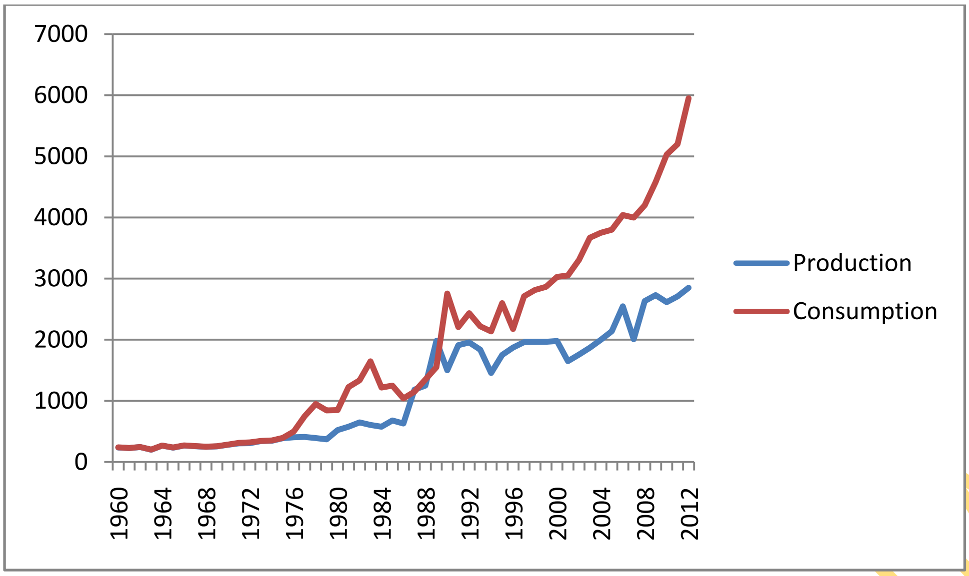
		Distribution of Respondents by Age					
Share of	Rice	<=30	31-40	41-50	51-60	>=61	Total
1-10%	Frequency	351	989	1203	769	614	3926
	% within grouping of percent share of totalrice	8.9%	25.2%	30.6%	19.6%	15.6%	100.0%
11-20%	Frequency	508	890	963	720	729	3810
	% within grouping of percent share of totalrice	13.3%	23.4%	25.3%	18.9%	19.1%	100.0%
21-30%	Frequency	362	588	610	426	472	2458
	% within grouping of percent share of totalrice	14.7%	23.9%	24.8%	17.3%	19.2%	100.0%
31-40%	Frequency	240	411	332	286	302	1571
	% within grouping of percent share of totalrice	15.3%	26.2%	21.1%	18.2%	19.2%	100.0%
41-50%	Frequency	145	221	232	182	183	963
	% within grouping of percent share of totalrice	15.1%	22.9%	24.1%	18.9%	19.0%	100.0%
51-60%	Frequency	103	180	156	115	117	671
	% within grouping of percent share of totalrice	15.4%	26.8%	23.2%	17.1%	17.4%	100.0%
61-70%	Frequency	82	119	106	68	76	451
	% within grouping of percent share of totalrice	18.2%	26.4%	23.5%	15.1%	16.9%	100.0%
Total	Frequency	1791	3398	3602	2566	2493	13850
	% within grouping of percent share of totalrice	12.9%	24.5%	26.0%	18.5%	18.0%	100.0%

Source: Computed from NLSS Data (2004)

4.2 Rice self-sufficiency in Nigeria

As graphically depicted in Figures9 and 10, Nigeria was self-sufficient in rice from 1960 to 1975, as the self- sufficiency ratio was approximately unity during this period. From 1975 the self-sufficiency ratio began to decline up to 1987. Rice farmers responded positively through production increase from 1987 when a ban was placed on importation of rice. The self–sufficiency ratio was around unity in 1987 and was even greater than unity in 1989. Perhaps, owingto lifting of the ban on importation of rice, demand increased astronomically, outstripping supply again from 1990 leaving Nigeria insufficient in rice from that period till 2012. Although there were some fluctuations and improvement in self-sufficiency ratio in some years (such as 1985-1987), the unity status witnessed in the 1960s up to mid-1970s has never been restored. Appendix 9 givesdetails of yearly self-sufficiency ratio of rice in Nigeria between 1960 and 2012.

Even in the face of improved rice self-sufficiency ratio in some years, it is surprising that rice is still massively imported and the importation figure is on the rise with time. The fact is that, not all farm outputs constitute marketed output (real supply), bearing in mind loss in transition owing to poor storage facilities, transportation, intermediate consumption and other constraints that can lead to over-estimation of output and consequently rice self-sufficiency. As a matter of standard, 30 percent reduction in output is usually made for cereals for losses in transition in the Central and Eastern European nations (Hallam, 2000). Sanni (2000) equally reported 20-40 percent losses in cereals output before marketing owing to poor storage in Nigeria. Similarly, IRRI;FAO (2014) rice statistics reported 277, 000 and 263, 000 tons loss in rice output from farm to processing in 2008 and 2009, respectively. If we impose such 30 percent average losses on estimated farm level rice output, the self-sufficiency ratio will definitely decline more for all the years. Besides that, other factors such as preference for imported rice against local rice can also lead to increasing rice importation in the face of increased rice production and improved self-sufficiency ratio. Hence, a dynamic analysis of demand in the light of the preference switchis justified by this study.



NOTE: Points of Intersection between supply and demand represents rice self- sufficient years

Figure 9: Relationship between Rice Supply and Demand (1960-2012)
Source: Computed from IRRI; USDA Rice Statistics (2014)

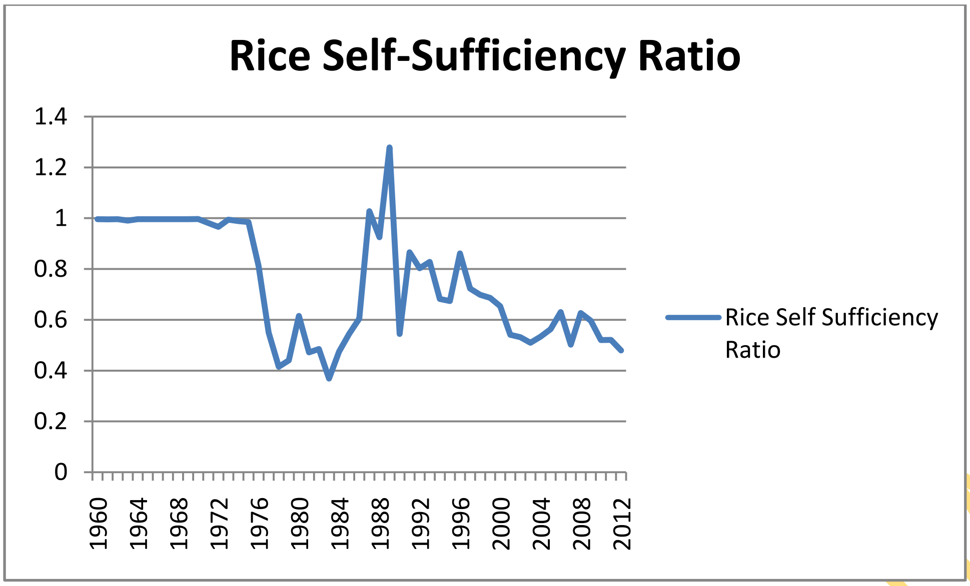


Figure 10: Self-Sufficiency Ratio of Rice in Nigeria (1960-2012)
Source: Computed from IRRI; USDA Rice Statistics (2014)

4.3 Determinants of rice demand in Nigeria

This section discusses the factors that influence rice consumption in Nigeria. It also presents interpretation of relevant elasticity estimates derived from the Tobit and AIDS models.

4.3.1 Tobit model estimate for rice demand

As presented in Table 18, the diagnostic test; Log Likelihood for all the four Tobit regressions indicates the fitness of the model. The F-statistics was significant at 1 percent probability level. The Akaike Information Criterion was equally low enough to confirm the fitness of the model. The relative low R-square value is typical of consumption studies owing to extraneous and qualitative variables not usually totally captured in such studiesand this is in line with the finding of authors of similar studies, such as,Abdulai *et al.* (1999), Akbay and Boz (2001), Okoruwa *et al.*(2008.)and Oyinbo *et al.* (2013). The R-square value of 0.46, 0.47, 0.27 and 0.49 were obtained, respectively for aggregate, imported, agric. and local rice.

Socioeconomics factors

As shown in Table 18, household size was significant in determining aggregate rice demand at 5 percent level ($P \leq 0.05$). Similarly, the demand for imported rice and agric. rice were significantly influenced by household size at 1 percent probability level. An additional membership increase in household size increased the total rice and imported rice consumption by a factor of 3.449×10^{-03} and 1.071×10^{-03},respectively. This exposes the tendencies of populated household to consume generally more of rice and specifically more of imported rice which is readily available, easier to prepare and relatively cheaper. This is consistent with the findings of Abdulai *et al*. (1999), Bamidele *et al.*, (2010) and Oyinbo *et al.*, (2013). However, increase in household size reduced the consumption of agric. rice by 9.232×10^{-04} perhaps because of relatively high price of agric. rice and its availability. Although household food security is guaranteed with increasing demand for imported rice,this constitutes a great threat to food self- sufficiency in Nigeria. The age of the respondents was found to be statistically significant at 1 percent in explaining total rice consumption. An inverse relationship was equally observed, implying that older populace generally consumed less of rice commodity.The same trend was observed for the agric. rice consumption as inverse relationship significant at 1 percent resulted from the Tobit regression estimate.In contrast, an increase in age by a year leads to increasein local rice consumption by a factor of 1.568×10^{-04}.This result is expected as older generations are known for conservativeness in terms of local food consumption. Heilig (1999), Choi and Lee (2000) and

Babatunde *et al.* (2007) equally found age to significantly affect rice consumption. The result also conforms to the findings of Agwu *et al.*(2009) and Adeyeye (2012). A sustained consumption of domestically produced rice not only by older generation, but also by people of all age categories will certainly boost rice self- sufficiency in Nigeria.

As for the influence of educational factor, only imported rice was significantly influenced by education at 5 percent level of probability. An increase in year of educational attainment resulted in an increase in imported rice consumption by 1.557×10^{-04}. This depicts the preference of educated people for imported foods as against local food. This corroborates the findings of Abdulai *et al.* (1999),Jenson(1995),Babatunde *et al.*(2007), Nwachukwu *et al.*(2008), Agwu *et al.*(2009), Bamidele *et al.* (2010) and Adeyeye (2012). If this trend continues, it has a great implication for rice self-sufficiency in Nigeria.

Marital life increased agric. rice consumption by 7.346×10^{-03}, while local rice consumption decreased by 6.832×10^{-03}. The marital status variable was significant at 1 percent probability level. Most often, marriage produces children, which increase the household membership. The relatively higher price of local rice will, no doubt, make it unaffordable for larger families in a poverty-ridden community like Nigeria.Thus, its consumption decreases with marital status. This corroborates the findings of Adeyeye (2012).

Also, taking farming as an occupation reduced consumption of imported rice by a factor of 9.108×10^{-03}; this factor was significant at 1 percent level of probability. A direct relationship was observed between occupational factor and agric. rice consumption (significant at $P \leq 0.01$),implying that agric. rice farmers set aside some proportion of their harvest for home consumption purposes. Most farmers are rural dwellers and hence consume more of domestically produced rice based on availability and/ or conservativeness. This development is a positive step towards increasing rice self-sufficiency in Nigeria.

At 1 percent level, an inverse relationship occurredbetween membership of community society and agric. rice consumption but a positive relationship was obtained with reference to local rice. This is in agreement with the findings of Abdulai *et al.* (1999).This implies that group influence could stimulate the consumption or otherwise of rice commodities.

Table 18: Tobit Regression Result for Rice Demand in Nigeria (Marginal Values)

Variables	Aggregate Rice	Imported Rice	Agric. Rice	local Rice
HHSIZ	3.449x10^{-03}**	1.071x10^{-03}***	-9.323x10^{-04}***	-1.383e^{-03}
	(1.259x10^{-02})	(3.041x10^{-04})	(2.602x10^{-04})	(2.628x10^{-04})
NFDTOT	-2.794x10^{-7}*	9.912x10^{-09}***	-1.610x10^{-08}***	6.191x10^{-09}**
	(1.454x10^{-7})	(3.563x10^{-09})	(3.048x10^{-09})	(3.079x10^{-09})
AGE	-1.260x10^{-3}***	-2.367x10^{-05}	-1.331x10^{-04}***	1.568x10^{-04}***
	(1.684x10^{-3})	(4.055x10^{-05})	(3.470x10^{-05})	(3.505x10^{-05})
EDUC	3.920x10^{-3}	1.557x10^{-04}**	-1.204x10^{-04}	-3.532x10^{-05}
	(0.3669x10^{-03})	(8.865x10^{-05})	(7.587x10^{-05})	(7.662x10^{-05})
MARST	-3.141x10^{-03}	-5.134x10^{-04}	7.346x10^{-03}***	-6.832x10^{-03}***
	(7.516x10^{-02})	(1.780x10^{-03})	1.540x10^{-03}	(1.556x10^{-03})
PROCC	8.263x10^{-02}	-9.108x10^{-03}***	7.719x10^{-03}***	1.389x10^{-03}
	(6.670x10^{-02})	(1.595x10^{-03})	(1.365x10^{-03})	(1.378x10^{-03})
TASSET	-1.373x10^{-09}	-2.452x10^{-10}	-2.768x10^{-11}	2.728x10^{-10}
	(1.007x10^{-08})	(2.480x10^{-10})	(2.122x$10^{-10)}$	(2.143x10^{-10})
COMEM	4.293x10^{-02}	7.396x10^{-04}	-4.903x10^{-03}***	4.163x10^{-03}***
	(4.681x10^{-02})	(1.129x10^{-03})	(9.658x10^{-04})	(9.754x10^{-4})
LOCAT	-1.976x10^{-01}***	3.693x10^{-03}**	-1.602x10^{-03}	-2.091x10^{-3}
	(6.243x10^{-02})	(1.495x10^{-03})	(1.280x10^{-03})	(1.293x10^{-3})
SS	1.901***	-1.841x10^{-01}***	2.493x10^{-01}***	-6.523x10^{-2}***
	(2.501x10^{-01})	(5.913x10^{-03})	(5.060x10^{-03})	(5.110x10^{-3})
SE	1.533***	1.458x10^{-01}***	-1.791x10^{-02}***	-1.278x10^{-1}***
	(1.433x10^{-01})	(3.377x10^{-03})	(2.890x10^{-03})	(2.921x10^{-3})
SW	1.472***	2.146x10^{-02}***	9.754x10^{-02}***	-1.190x10^{-1}***
	(1.575x10^{-01})	(3.764x10^{-03})	(3.221x10^{-03})	(3.254x10^{-3})
NE	5.049x10^{-01}***	- 3.669x10^{-02}***	1.005x10^{-01}***	-6.381x10^{-1}***
	(1.116x10^{-01})	(2.716x10^{-03})	(2.325x10^{-03})	(2.348x$10^{-3)}$
NW	8.864x10^{-01}***	4.011x10^{-02}***	1.075x10^{-01}***	-1.477x10^{-1}***
	(1.170x10^{-01})	(2.840x10^{-03})	(2.431x10^{-03})	(2.455x10^{-3})
CONST.	-4.245***	-1.538***	5.463x10^{-01}***	6.075x10^{-1}***
	(7.048x10^{-01})	(1.701x10^{-02})	(1.456x10^{-02})	(1.470x10^{-1})
MacFaden R^2	0.461	0.468	0.273	0.489
LogLikelihood	-56804.990	22109.460	25045.040	24858.480
Akaike Info Crt.	13.468	-2.341	-2.652	-2.633
F(30, 18830)	536.220***	552.270***	235.400***	600.49***

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

Source: Computed from NLSS Data (2004)

The non-food total expenditure decreased with increase in total rice expenditure by a factor of 2.794×10^{-07}. The same trend was observed for agric. rice commodities, while a direct relationship ensued for imported and local rice commodities. The beta coefficient of non-food total expenditure was significant at 5 percent level for local rice commodity, while others were significant at 1 percent probability level. Expenditure on rice could generally reduce the amount spent on non-food commodities, especially for people with low income in agreement with Engel's law.This does not hold for expenditure on imported rice and local rice, as obtained in this study.

Locational factors

As for the rural-urban dichotomy, urban livelihood partly explains the variation in the total rice consumption and imported rice at 1 percent and 5 percent probability level, respectively. A positive relationship was observed between urban livelihood and imported rice consumption as *a priori* expected. This is a further confirmation of the fitness of imported rice into urban lifestyle as they often desire easy to prepare food because of their career demand. On the other hand, an inverse relationship holds between urban livelihood and total rice consumption. This effect of urbanisation on rice consumption has been earlier isolated by Bashorun (2013). The estimate of the coefficient was -0.198.

All the geopolitical zone dummies were found to be statistically significant at 1 percent level ($P\leq 0.01$). In relation to the basal North-Central zone, South-South zone increased aggregate rice consumption the more by a factor of 1.901. On the other hand, residing in the South-South zone led to decreased consumption of imported rice relative to the North-Central zone by a factor of 0.184. Furthermore, more agric. rice was consumed in the South-South zone relative to the North-Central. Also, consumption of aggregate and imported rice increased in the South-East zonemore than the North-Central by a factor of 0.143 and 0.146,respectively. In case of agric. and local rice, less was consumed in the South-East relative to the North-Central zone. This is expected because North-Central zone produces more local rice than any other zone in Nigeria. In the South-West zone, more of total, imported and agric. rice was consumed than the North-Central. The cosmopolitan nature of the South-West accounted for wide variety of rice consumption. The high production of rice in the North-Central zone also comes into play here, as the South-West zone consumed less of local rice than the North-Central.

In the North-Eastern zone, at the aggregate level, more rice was consumed than the North-Central zone. On individual rice commodities,more of agric. rice, and less of imported and local rice was consumed in the North-East relative to the North-Central. Lastly, the North-Westzone recorded more consumption of total rice, imported rice and agric. rice relative to the North-Central. As usual, no region, North-West inclusive, superseded the North-Central geopolitical zone in the consumption of local rice. Abdulai *et al.* (1999), Choi and Lee (2000), Adeyeye (2012) and Bashorun (2013) equally found location factors significantly influencing food demand in India, Korea and Nigeria. Therefore, policy on rice production, either through increasing production or stimulation of consumption, should be location based.

Elasticity estimates

The estimated income elasticities from the Tobit model (Table 19) show that imported, agric. and local rice were non-income elastic, as their respective values of elasticities-7.266×10^{-08}, 1.727×10^{-07} and 1.001×10^{-07},were less than unity. In this case, the various commodities of rice could be conveniently classified as 'necessities' and because the elasticity values are greater than zero, they are equally classified as 'normal good'. This result clearly supports the assertion of the Engel's curve, which states that, at higher income, families spend lesser proportion of their income on food. Once the food requirement is satisfied, additional income is rather expended on luxuries (Olayemi, 2004). In all cases, positive relationship existed between income and consumption of various rice commodities, thus confirming the traditional direct relationship between income and demand, a finding consistent with that of Odusola(1997), Miller (2002), Nwachukwu *et al.* (2008), Agwu *et al.* (2009), Bamidele *et al.* (2010) and Oyinbo *et al.* (2013). This implies that, as income increases, the demand for imported, agric. and local rice increases by 7.266×10^{-08}, 1.727×10^{-07} and 1.001×10^{-07},respectively, but in a less than proportionate magnitude to increase in income due to inelasticity.

On the own price elasticities, all the resulting coefficients for imported, agric. and local rice commodities displayed the expected negative signs showing the usual inverse relationship between price and quantity demanded.This confirms the traditional law of demand. More importantly, all the values were less than unity, confirming the inelasticity of rice demand to price,like many other food commodities. This is in line with the findings of Nwachukwu *et al.*(2008), Agwu *et al.*(2009), Rahji *et al.* (2008) and Jimoh *et al.* (2010). Necessities, unlike luxuries, are often associated with lower price elasticities, as further confirmed in this study.

A unit decrease in price leads to increase in the demand for imported, agric. and local rice by a factor of 2.923×10^{-08}, 7.392×10^{-04} and 1.825×10^{-03},respectively. The own price coefficients were statistically significant at 1 percent probability levels. The overall implication of these income and own price elasticities is that a change (increase or decrease) in income and price results in a less than proportionate change in demand for all rice commodities.Hence, price and income instrument have limited effect on demand for various rice commodities.

The results of the cross-price elasticities for imported rice revealed that local rice, white garri, yam and brown beans were substitutes to imported rice, as the coefficients displayed positive signs. Other food commodities, such as agric. rice, yellow garri, white beans, millet, guinea corn, white maize and yellow maize displayed inverse relationship,thus indicating complementarity with imported rice.For the agric. rice commodity, yellow garri, guinea corn, millet, white maize and yellow maize were found to be substitute products, while imported rice, local rice, white garri, yam, brown beans and white beans were found to be complementary to agric. rice.

In the same vein, the competitive products to local rice included agric. rice, yellow garri, yam, millet and guinea corn, while imported rice, white garri, brown beans, white beans, white and yellow maize emerged as complementary products to local rice. All the cross price coefficients were highly significant at 1 percent ($P \leq 0.01$). The significance of all price coefficients in determining the demand for rice is consistent with the findings of earlier researchers, notablyRahji and Adewumi (2008), Nwachukwu *etal.* (2008), Odusina (2008), Agwu *et al.*(2009), Oyinbo *et al.* (2013) and Adeyeye (2012).However, the degree of substitution of a particular rice commodity for other rice or food commodities was minimal because of the cross price inelasticity of demand for various rice commodities.

Table 19: Tobit Elasticity Estimates for Rice Demand in Nigeria

	Imported Rice	**Agric. Rice**	**Local Rice**
Income	$7.266x10^{-08***}$	$1.727x10^{-07***}$	$1.000x10^{-07***}$
Price of Imported Rice	**$-2.923x10^{-03***}$**	$-2.189x10^{-03***}$	$-7.367x10^{-04***}$
Price of Agric. Rice	$-3.296x10^{-03***}$	**$-7.392x10^{-04***}$**	$2.556x10^{-03***}$
Price of Local Rice	$3.928x10^{-03***}$	$-2.102x10^{-03***}$	**$-1.825x10^{-03***}$**
Price of Yellow Garri	$-3.633x10^{-03***}$	$3.131x10^{-03***}$	$5.020\ x10^{-04***}$
Price of white Garri	$8.263x10^{-03***}$	$-6.585x10^{-03***}$	$-1.677x10^{-03***}$
Price of Yam Tuber	$7.005x10^{-04***}$	$-1.330x10^{-03***}$	$6.233x10^{-04***}$
Price of Brown Beans	$4.589x10^{-03***}$	$-3.431x10^{-04***}$	$-4.246x10^{-03***}$
Price of White Beans	$-3.925x10^{-03***}$	$4.700x10^{-03***}$	$-7.749x10^{-04***}$
Price of Millet	$-1.642x10^{-03***}$	$5.168x10^{-04***}$	$1.125x10^{-03***}$
Price of Guinea Corn	$-6.608x10^{-03***}$	$6.070x10^{-04***}$	$6.000x10^{-03***}$
Price of White Maize	$-1.209x10^{-03***}$	$5.190x10^{-03***}$	$-3.981x10^{-03***}$
Price of Yellow Maize	$-1.322x10^{-03***}$	$8.528x10^{-03***}$	$-7.960x10^{-03***}$

Bold Values are own price elasticities; otherprice values are cross price elasticities

*****Values significant at 1%**

****Values significant at 5%**

***Values significant at 10%**

Source: Computed from NLSS data (2004)

4.3.2 Almost Ideal Demand System (AIDS)Estimate for rice demand

The result of the AIDS regression is presented in Table 20, while the elasticity estimates are shown in Table 21. As presented in Table 20, all categories of rice commodities were significantly affected by household size. A direct relationship occured between household size and imported rice ($\beta = 1.350\times10^{-03}$), while an inverse relationship was observed with agric. ($\beta = -0.746\times10^{-03}$) and local rice ($\beta = -5.990\times10^{-04}$). The beta coefficients for imported, agric. and local rice were significant at 1, 5 and 10 percent probability levels respectively. The reason that could be adduced for this fact is the relative cheapness, ease of cooking and availability of imported rice in most part of Nigeria that propel the larger households to demand more of it. In most cases the cost of local rice is unbearable for larger household size and is not readily available as much as imported rice coupled with cooking difficulties.

Non-food total expenditure negatively influenced the consumption of imported, agric. and local rice. A unit rise in non-food expenditure reduces the consumption of imported, agric. and local rice by 1.124×10^{-08}, 1.429×10^{-08} and 2.264×10^{-08},respectively. Age positively affected imported rice demand at 1 percent level by a factor of 4.690×10^{-04} but had an indirect relationship with agric. and local rice at the same level of statistical significance.In agreement with the previous result from the Tobit model, education was a determinant of imported rice as it exerted a positive influence on demand by a factor of 9.430×10^{-04}, while it reduced the consumption of agric. and local rice by a factor 4.157×10^{-04} and 5.278×10^{-03}, respectively. Urban livelihood similarly had a significant positive influence on imported rice consumption. This was significant at 1 percent probability level. The consumption of agric. and local rice was however, favoured by rurality at 5 and 1 percent levels, perhaps because many of the rural people were farmers and were engaged in the production of agric. and local rice.

As seen in Table 20, farmers expectedly demanded more of agric. rice and less of imported rice when compared with people of other primary occupation other than farming.The occupational variable was significant at 1 percent and 5 percent, respectively, for imported and agric. rice. Marital status also showed an inverse relationship with imported and local rice but a direct relationship with agric. rice. Also, demand for local rice significantly appreciated with belongingto a community group but rather depreciated in case of agric. rice.

Table 20: AIDS Regression Result for Rice Demand in Nigeria

Variables	Imported Rice	Agric. Rice	local Rice
HHSIZ	$0.135e^{-02}$***	$-0.746e^{-03}$**	$-0.599e^{-03}$*
	$(0.382e^{-03})$	$(0.291e^{-03})$	$(0342e^{-03})$
NFDTOT	$-0.124e^{-07}$***	$-0.143e^{-07}$***	$0.266e^{-08}$***
	$(0.456e^{-08})$	$(0.348e^{-08})$	$(0.408e^{-08})$
AGE	$-0.470e^{-03}$***	$-0.241e^{-03}$***	$-0.229e^{-03}$***
	$(0.506e^{-04})$	$(0.387e^{-04})$	$(0.453e^{-04})$
EDUC	$0.943e^{-03}$***	$-0.416e^{-03}$***	$-0.528e^{-03}$***
	$(0.111e^{-03})$	$(0.850e^{-04})$	$(0.997e^{-04})$
MARST	$-0.613e^{-02}$***	$\bar{}0.112e^{-01}$***	$-0.502e^{-02}$**
	$(0.231e^{-02})$	$(0.176e^{-02})$	$(0.207e^{-02})$
PROCC	$-0.339e^{-02}$*	$0.346e^{-02}$**	$\bar{}0.708e^{-04}$
	$(0.198e^{-02})$	$(0.151e^{-02})$	$(0.177e^{-02})$
TASSET	$0.190e^{-09}$	$-0.126e^{-09}$	$-0.632e^{-10}$
	$(0.319e^{-09})$	$(0.244e^{-09})$	$(0.286e^{-09})$
COMEM	$\bar{}0.535e^{-03}$	$-0.803e^{-02}$***	$0.857e^{-02}$***
	$(0.113e^{-02})$	$(0.109e^{-02})$	$(0.128e^{-02})$
SECTOR	$0.130e^{-01}$***	$-0.309e^{-02}$**	$-0.161e^{-01}$***
	$(0.176e^{-02})$	$(0.134e^{-02})$	$(0.157e^{-02})$
CONST.	-0.539***	0.272***	0.189***
	$(0.461e^{-02})$	$(0.352e^{-02})$	$(0.413e^{-02})$
R^2	0.119	0.414	0.917
Adj R^2	0.118	0.407	0.906
F(15,18845)	169.200***	54.310***	126.810***
Log Likelihood	304728.140	304728.140	304728.140
Akaike Info Crt.	-2.060	-2.379	-2.060

*****Values significant at 1%**

****Values significant at 5%**

***Values significant at 10%**

Source: Computed from NLSS Data (2004)

Elasticity estimates

For the AIDS model in Table 21, the demand for various rice commodities was found to be income-inelastic. The expected direct relationship was observed in all cases. The coefficients for imported, agric. and local rice were found to be significant at 1 percent probability level. The result is equally in conformity with the Engel's law. Hence, rice is a 'necessity'. The price variable coefficients revealed that all categories of rice,except imported rice, were price inelastic. This is typical of necessities like rice. According to the result of the AIDS model, it also follows that price instrument could be used in manipulating imported rice demand but to a lesser extent for local and agric. rice. The expected demand-price inverse relationship holds in all cases of imported, agric. and local rice, implying that all rice commodities obeyed the traditional law of demand. In addition, all price coefficients were statistically significant at 1 percent ($P \leq 0.01$). The R-square value implies that the factors considered jointly explained about 12 percent variation in the demand for imported rice, 41 percent for agric. rice and 92 percent for local rice consumption. The low R-squared obtained for imported rice is typical of a consumption study, especially the fact that importation is a function of many macroeconomic variables probably unaccounted for in modelling the demand for imported rice in this study.

Table 21: AIDS Elasticity Estimates for Rice Demand in Nigeria

	Imported	Agric	Local
Price	**-1.804*****	**-0.975*****	**-0.945*****
Income	**0.999****	**0.999****	**0.999****

*****Values significant at 1%**

****Values significant at 5%**

***Values significant at 10%**

Source: Computed from NLSS Data (2004)

4.3.3 The Tobit Model compared with the AIDS Model

The results from the two models showed considerable similarities in the significance of variables as well as the direction of relationship. Even the non-significant variables were similar in the two models. However, the Tobit model had the edge of utilizing all the NLSS data.Also, considering the numbers of variables that were accommodated in the Tobit model as well as the theoretical plausibility of the model results,the Tobit model gave a better estimate of demand for rice commodities in Nigeria. Unlike the AIDS model, the Tobit model in this study permittedthe estimation of various cross-price elasticities as well as showing the effect of variables on demand across various geopolitical zones.

4.4 Supplyresponseanalysis

This section presents and discusses the result on supply response of rice to price and non-price factors applying the Vector Autoregressive Error Correction Model (VECM). As a matter of convention, it begins with the unit root test applying the ADF, and the cointegration test using the Johansen test. The estimation of the long-run and the short-run model was completed in a vector error correction model.

4.4.1 Unit Root Test

The summary of the results of Augmented Dickey Fuller (ADF) unit root analysis is presented in Table 22. The result of the ADF unit root test revealed that output, area, price, import and fertilizer consumption had a unit root. At their various levels, the null hypotheses of the presence of unit root in the variables (ρ=1) were accepted at one percent ($P \leq 0.01$). The variables, however, became stationary at first difference implying that they were all integrated of the order of 1(that is, they were I(1)). This is further confirmation of the fact that most macroeconomic variables are first difference stationary (Tijani and Ajetomobi, 2006; Gujarati and Sangeetha, 2007).The yield and rainfall variables were stationary at their levels, the unit root null hypotheses (ρ=1) was, therefore, rejected at their levels. The unit root hypothesis for rainfall and yield was rejected at one percent and five percent significant levels, respectively. Tijani and Ajetomobi (2006) equally found rainfall to be level stationary in their supply response analysis for cocoa export. In addition, rice price was also found to be trend stationary at five percent probability level. From the result above, it follows that the output of rice can exhibit a long-run relationship with Area Cultivated, Own Price, Fertilizer Consumption and Quantity of Rice Imported. Yield could also co-integrate with rainfall in the long run.

Table 22: Result of ADF Unit Root Test of Variables

Variables	Level		First Difference		Order of
	Untrended	Trended	Untrended	Trended	Integration
Outp	0.672	-2.043	-8.437	8.883*	I(1)
Area	0.742	-2.540	-9.450*	9.649*	I(1)
Yield	-3.059**	3.742**			I(0)
Pric	-2.433	3.865**	-7.947*	7.856*	I(1)
FCon	-1.398	-1.383	-5.997*	-5.968*	1(1)
Impt	-0.790	-2.297	-6.398*	-6.392*	1(1)
Rain	-5.959*	5.943*			I(0)

*****Values significant at 1%**

****Values significant at 5%**

***Values significant at 10%**

Source: Computed from IRRI Rice Statistics (2011)

4.4.2 Pairwise Granger Causality Test

The Granger test of causality to determine the appropriate lag length and see the causal effect andrelative importance of variables is presented in Table 23.

From the result of the pairwise Granger causality test, at the first lag, it was observed that output was Granger-caused by one variable (policy), area was Granger-caused by one variable (Policy), price was Granger-caused by four variables, namely: output,area, fertilizer consumption and policy.Fertilizer consumption and rainfall were not Granger-caused by any variable while policy was Granger-caused by only one variable(price). This suggests that output was most affected byprice, followed by import, area and policy as well as fertilizer consumption and rainfall. However, increasing the lag length up to the fourth lag did not significantly improve the significance of the variable; hence, a one lag model was supportedfrom the result of the Granger causality test.

Table 23: Pairwise Granger Causality Tests

Causal variables	Outp	Area	Pric	Fcon	Impt	Rain	Poly
Output	—	N	Y	N	Y	N	N
Area	N	—	Y	N	Y	N	N
Pric	N	N	—	N	N	N	Y
Fcon	N	N	Y	_	N	N	N
Impt	N	N	N	N	—	N	N
Rain	N	N	N	N	Y	—	N
Poly	Y	Y	Y	N	N	N	—
	1	1	4	0	3	0	1

* Y-Granger-caused *N-Not Granger-caused

Source: Computed from IRRI Rice Statistics (2011)

4.4.3 Tests for Cointegration (Johansen Test)

Table 24 shows the results of the cointegration test for all possible specifications of the vector error correction model using the Johansen test.As for the summary of various cointegration tests, the trace and Maximum Eigen tests reported rank 1 for all possible specification of cointegration except trace test that reported rank 3 for the specification with no intercept and trend in the CE and VAR. The Pantula principle states that the lower the rank of the specification, the better the model. The data for this study supported the use of a vector error correction model (VECM) with all specifications except the one with no intercept or trend in the CE and VAR,since it has a trace value higher than others specifications. We estimated the cointegration specification with intercept and no trend since it has value significant at 5 percent ($P<0.05$) level. The Trace and Maximum- Eigen value presented in Table 24 below indicates the rejection of the null hypothesis of no cointegration equation (CE) at 5% level of significance. The null hypothesis of at most one CE was thus accepted at 5% level of significance. In conformity with the specification stated by the Pantula principle, the Johansen(1992, 1995a) trace and max-Eigen value revealed that one cointegrating equation exists among the variables in the economic model.

Table 24: Cointegration Test for all Specifications

Lags interval: 1 to 1

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
Log Likelihood by Model and Rank					
0	-1455.410	-1455.410	-1449.609	-1449.609	-1444.725
1	-1436.538	-1434.135	-1428.338	-1427.478	-1422.995
2	-1425.719	-1422.769	-1417.023	-1415.610	-1411.437
3	-1416.056	-1412.055	-1410.049	-1405.354	-1402.598
4	-1412.901	-1408.876	-1407.313	-1400.823	-1398.241
5	-1412.901	-1407.163	-1407.163	-1398.089	-1398.089
Akaike Information Criteria by Model and Rank					
0	64.36565	64.36565	64.33083	64.33083	64.33586
1	63.97991	63.91891	63.84077	63.84687	63.82587
2	63.94432	63.90298	63.78361	63.80912	63.75813*
3	63.95897	63.91544	63.91519	63.84150	63.80860
4	64.25656	64.25547	64.23101	64.12274	64.05395
5	64.69134	64.65925	64.65925	64.48213	64.48213
Schwarz Criteria by Model and Rank					
0	65.35947	65.35947	65.52342	65.52342	65.72722
1	65.37127	65.35002*	65.43089	65.47675	65.61476
2	65.73321	65.77138	65.77126	65.87628	65.94455
3	66.14538	66.22112	66.30037	66.34594	66.39255
4	66.84051	66.99843	67.01373	67.06446	67.03543
5	67.67282	67.83949	67.83949	67.86114	67.86114
Trace test	Rank = 3	Rank = 1	Rank = 1	Rank = 1	Rank = 1
Max-Eig	Rank = 1	Rank = 1	Rank = 1	Rank = 1	Rank = 1

Source: Computed from IRRI Rice Statistics (2011)

Table 25: Co-integration Test for Intercept and No deterministic trend in the data

Series: OUTPUT AREA PRIC FCON IMPORT

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.603467	96.49433	76.97277	0.0008
At most 1	0.389936	53.94447**	54.07904	0.0514
At most 2	0.372366	31.21170	35.19275	0.1263
At most 3	0.129109	9.785010	20.26184	0.6609
At most 4	0.071773	3.426018	9.164546	0.5043

Trace test indicates 1 cointegrating equation at the 0.05 level

*** denotes rejection of the hypothesis at the 0.05 level**

**** Value Significant at 5 percent**

Source: Computed from IRRI Rice Statistics (2011)

4.4.4 The Vector Error Correction Model

Following the evidence from the cointegration tests in the previous section, the vector error correction model was estimated using EViews, with one cointegrating restrictions imposed. The normalisation adopted was in respect of the output of rice. This permits assessment of the long-run influence of area cultivated, price of rice, fertilizer consumption and the quantity of import on the output variable. Tables 26 and 27 present the normalised cointegrating vectors in the VECM for the long-run and the short-run equilibrium models, respectively.

1. The Long-Run Model

As shown in Table 26, the estimated coefficients in the long-run equilibrium performance model are quite plausible, as all variables elasticities are consistent with economic theory and previous findings. Lagged values of area cultivated, fertilizer consumption and import quantities significantly influenced the supply of domestic rice in Nigeria at 1, 10 and 5 percent level of probability, respectively. Area cultivated remains the most critical factor that affected rice supply (output) in Nigeria. A one percent change in area cultivated in the previous year caused the output quantity to increase by about 3 percent. This is expected, as farmers cultivate more hectares, the volume of output (supply) increases *ceteris paribus*. Policies that make more farm land available to farmers for rice cultivation will surely go a long way in increasing production to meet up with demand.

Fertilizer consumption improves output by 2.3 percent when increased by 1 percent. Fertilizer consumption was also significant at 5 percent level.By implication availability of improved input,such as fertilizer,could stimulate production and increase the output of domestic rice. A one percent rise in import resulted in a rise in output by 0.3 percent contrary to *apriori* expectation. In the longrun, some level of rice importation could stimulate domestic production through competitiveness.In view of the estimated value of 0.27 for price coefficient, rice output was found to be price-inelastic in the long run. This is consistent with the findings of Rahji (1999), Rahji *et al.* (2008) and Muchapondwa (2008) among others. Therefore, a pricing policy in the long run may not yield any significant result in stimulating production to meet demand.

Table 26: Rice Supply Response Long-Run Model

Variable	Coefficients	Standard Error	t- Statistics
Output (-1)	1.000		
Area (-1)	2.809***	0.109	26.077
Price (-1)	0.273	0.169	1.640
Fertilizer Consumption	2.327*	0.364	6.483
Import (-1)	0.279**	0.279	3.290
Constant	151.405	59.556	
Log-likelihood	-1428.338***		

*****Values significant at 1%**

****Values significant at 5%**

***Values significant at 10%**

Source: Computed from IRRI Rice Statistics (2011)

1. **The Short Run Model**

As reported in Table 27, in the short run, supply of rice responded to one-year lagged value of output, area, fertilizer consumption and import. An increase in output in the preceeding year resulted in decrease in output in the current year by 0.264. Hence, rice output in Nigeria exhibited cobweb behaviour in the short run. Also, an increase in area was also associated with increasing rice output by 0.240. Rice output positively responded to increasing fertilizer consumption as well by a factor of 0.044. An inverse relationship existed between rice supply and import quantity. This implies that a reduction or ban on importation could assist farmers to increase output in the short run. As earlier observed, this assertion does not hold in the long run as farmers are seen to compete favourably by increasing their output with increasing importation of rice.The result of the short-run VECM model indicated an adjustment coefficient of 0.26 for rice output (that is, the error correction term).This implies that the adjustment to any disequilibrium caused by shocks in all factors affecting rice supply will be corrected within 12/0.26 (46) months. The adjustment coefficient of area relative to output was 0.24, thus shocks due to area will be corrected within 12/0.24 (50) months.

Table 27 also reveals the coefficient of adjustment of fertilizer consumption in relation to output as 0.04, implying an adjustment speed of about 4 percent of output to any variation caused by fertilizer consumption. Imported quantity recorded adjustment coefficient of 0.37, thus farmers adjusted to short run fluctuation in import within 12/0.37 (33) months. In all, the speeds of adjustment with respect to all the variables were sluggish, as the highest speed was 37 percent. Yet, rice output was not price-elastic or significant in the short run. Pricing policy in this regard cannot be effective in stimulating rice supply in Nigeria. This corroborates the findings of Rahji *et al.* (2008) and Muchapondwa (2008). The explanatory factors considered jointly accounted for about 25 percent variation in rice output, as seen from the R-squared value. The statistical significance of the Log-likelihood ratio (-1653.236) and the lower value Akaike information and Schwarz criteria confirms the fitness of the vector error correction model.

Table 27: Short-Run Equilibrium Model VECM

Error Correction:	D(OUTPUT)	D(ACREAGE)	D(PRICE)	D(FERT_CONS)	D(IMPORT)	D(POLICY)	D(RAINFAL)
CointEq1	-0.263537	0.239486	0.093049	0.043648	-0.369250	4.13E-06	0.093898
	(0.15731)	(0.05347)	(0.10192)	(0.01900)	(0.08399)	(7.6E-05)	(0.06279)
	[-1.67524]	[4.47912]	[0.91294]	[2.29666]	[-4.39654]	[0.05407]	[1.49538]
D(OUTPUT(-1))	-0.400339	-0.176539	0.114588	0.055390	0.240491	2.77E-05	-0.025409
	(0.21965)	(0.07465)	(0.14231)	(0.02654)	(0.11727)	(0.00011)	(0.08767)
	[-1.82264]	[-2.36479]	[0.80521]	[2.08741]	[2.05082]	[0.25957]	[-0.28982]
D(ACREAGE(-1))	0.553426	0.025678	-0.154127	-0.040300	-0.713216	-4.51E-05	-0.020270
	(0.54011)	(0.18357)	(0.34993)	(0.06525)	(0.28836)	(0.00026)	(0.21559)
	[1.02465]	[0.13988]	[-0.44045]	[-0.61761]	[-2.47339]	[-0.17211]	[-0.09402]
D(PRICE(-1))	0.273709	0.122483	-0.014202	-0.008179	-0.209293	8.35E-05	-0.031028
	(0.25917)	(0.08808)	(0.16791)	(0.03131)	(0.13836)	(0.00013)	(0.10345)
	[1.05612]	[1.39052]	[-0.08458]	[-0.26122]	[-1.51263]	[0.66332]	[-0.29994]
D(FERT_CONS(-1))	-2.176345	-0.653792	-1.755982	-0.168226	2.474122	-0.000651	-0.336631
	(1.43053)	(0.48621)	(0.92683)	(0.17282)	(0.76374)	(0.00069)	(0.57100)
	[-1.52135]	[-1.34468]	[-1.89461]	[-0.97341]	[3.23950]	[-0.93691]	[-0.58955]
D(IMPORT(-1))	0.152642	-0.007875	0.056673	0.026685	-0.077921	-5.69E-05	-0.083339
	(0.24157)	(0.08211)	(0.15651)	(0.02918)	(0.12897)	(0.00012)	(0.09642)
	[0.63186]	[-0.09591]	[0.36210]	[0.91436]	[-0.60417]	[-0.48509]	[-0.86429]
D(POLICY(-1))	571.4313	-180.0903	-45.82642	-64.58049	-91.28526	0.023531	-162.5472
	(367.242)	(124.817)	(237.934)	(44.3663)	(196.064)	(0.17829)	(146.585)
	[1.55601]	[-1.44283]	[-0.19260]	[-1.45562]	[-0.46559]	[0.13198]	[-1.10889]
D(RAINFAL(-1))	0.587497	0.328950	0.614194	0.107130	0.013489	5.96E-05	-0.464862
	(0.39857)	(0.13546)	(0.25823)	(0.04815)	(0.21279)	(0.00019)	(0.15909)
	[1.47402]	[2.42831]	[2.37848]	[2.22488]	[0.06339]	[0.30776]	[-2.92202]
C	110.9417	67.36111	18.59008	2.246679	37.84380	0.023999	6.721778
	(52.4340)	(17.8211)	(33.9716)	(6.33452)	(27.9935)	(0.02546)	(20.9291)
	[2.11584]	[3.77985]	[0.54722]	[0.35467]	[1.35188]	[0.94275]	[0.32117]
R-squared	0.250510	0.502306	0.228687	0.337920	0.453232	0.051964	0.346150
Adj. R-squared	0.088458	0.394697	0.061917	0.194768	0.335012	-0.153017	0.204777
Sum sq. resids	3934757.	454529.0	1651672.	57427.44	1121520.	0.927427	626891.9
S.E. equation	326.1055	110.8358	211.2813	39.39661	174.1016	0.158321	130.1654
F-statistic	1.545863	4.667864	1.371270	2.360560	3.833797	0.253507	2.448491
Log likelihood	-326.4757	-276.8338	-306.5103	-229.2528	-297.6069	24.52044	-284.2286
Akaike AIC	14.58590	12.42756	13.71784	10.35882	13.33074	-0.674802	12.74907
Schwarz SC	14.94368	12.78533	14.07562	10.71660	13.68851	-0.317024	13.10685
Mean dependent	107.8913	46.10870	17.40652	4.956522	34.73913	0.021739	-6.461087
S.D. dependent	341.5622	142.4602	218.1425	43.90341	213.4989	0.147442	145.9658

4.5 Preference Switch Analysis

This section presents and discusses the direction of switch of various commodities of rice when paired. The results of influence of socioeconomic factors on preference switch from one rice commodity to the other are equally presented.

4.5.1 Preference direction

The result in Table 28 shows the preference direction for various commodities of rice both at the national and zonal levels. At the national level, a preference is observed towards imported rice when compared with agric. rice. This is evident fromthe relatively higher mean value recorded for imported rice and a positive t-value. Similarly, when imported rice is paired with local rice, a preference is observed towards imported rice. The pair sample t-statistics also indicates a preference for agric. rice as against the local rice with a higher mean value of 797.75. All the t-values for the three pairs of rice commodities were statistically significant at 1 percent ($P \leq 0.01$). The zonal result for the paired mean sample t-test shows that, in the South-South, the preference was observed towards imported rice when paired with agric. and local rice, while the preference was towards agric. rice when paired with local rice. The t-values for the three rice commodity pairs for the South-South geopolitical zonewere significant at 1 percent level. The result of the South-East and the South-West zones followed the same preference pattern as the South-South. All the t-values were significant at 1 percent probability level.

The result of rice preference in the North-Central geopolitical zone revealed that there was a usual tilt towards imported rice when paired with agric. and local rice. However, in this zone, preferencewas observed towards local rice when paired with agric. rice, as seen from the higher mean value for local rice and a negative t-value. All the coefficients t-values were significant at 1 percent probability levels. Thehigh production of local rice in theNorth-Central region was equally reflected here. In the North-East zone, there was preference for imported rice in relation to agric. and local rice. All t-values for the three pairs were statistically significant at 1 percent probability level. The rice preference results from the North-West Nigeria trended the same pattern as other zones, as preference was observed towards imported rice when compared with agric. and local rice and towards agric.rice in relation to local rice. All the t-values were significant at 1percent ($P \leq 0.01$).

The general preferencetowards imported rice, in Table 28, is in agreement with the studies of Nwachukwu *et al.* (2008) and Agwu *et al.* (2009), Bamba *et al.* (2010) and Oyinbo *et al.* (2013) in separate localised studies of foreign and local rice preference in Nigeria. As mentioned earlier, the high preference for imported rice might be due to its lower price and availability when compared with agric. and local rice. This has a negative implication for rice self-sufficiency in Nigeria. The determinants of preference switch from one commodity to another is fully presented and discussed in the next section.

Table 28: Paired Sample T-test for Preference Switching

	Individual Mean	Paired Mean	95% C. Intv. of Difference Lower Upper	t-stat
National Imported Agric	1256.55 797.75	458.80	449.55 468.04	97.25***
Imported Local	1256.55 658.11	598.44	587.29 609.58	105.25***
Agric Local	797.75 658.11	139.64	130.27 149.01	29.20***
South-South Imported Agric.	700.63 531.98	168.65	163.20 174.10	60.67***
Imported Local	700.63 435.30	265.33	260.23 270.43	102.01***
Agric. Local	531.98 435.30	96.68	93.62 99.75	61.78***
South-East Imported Agric.	1327.74 633.12	694.63	672.01 717.24	60.23***
Imported Local	1327.74 499.62	828.12	807.21 849.04	77.65***
Agric. Local	633.12 499.62	133.50	127.89 139.11	46.66***
South-West Imported Agric.	869.82 580.11	289.71	282.97 296.45	84.31***
Imported Local	869.82 413.25	456.57	445.50 467.64	80.87***
Agric. Local	580.11 413.25	166.86	161.13 172.59	57.10***
North-Central Imported Agric.	1372.26 852.46	168.65	163.20 174.10	48.03***
Imported Local	1372.26 1209.95	265.33	260.23 270.43	10.53***
Agric. Local	852.46 1209.95	96.68	93.62 99.75	-18.19***
North-East Imported Agric.	1044.11 724.03	320.09	304.41 330.76	58.81***
Imported Local	1044.11 549.05	495.06	480.90 509.22	68.55***
Agric. Local	724.03 549.05	174.98	168.93 183.02	42.66***
North-West Imported Agric.	2006.00 1299.09	706.92	672.66 741.18	40.46***
Imported Local	2006.00 738.30	1267.71	1233.931301.50	73.57***
Agric. Local	1299.09 738.30	560.79	537.62 583.97	47.44***

Source: Computed from NLSS Data (2004)

4.5.2 Determinants of preference switch of rice commodities

The result of the determinants of switch from one type of rice commodity to the other is presented in Table 29. As shown in the table**,** preference switch from imported to agric. rice was determined by a number of factors, particularlyhousehold size, per capita expenditure, primary occupation, sector, zonal factors and price of imported and agric. rice. All the aforementioned factors were highly significant at 1 percent probability level.Other factors were marital status and education which were significant at 5 and10 percent, respectively.Household size, age, education, per capita expenditure,primary occupation, price of imported and local rice as well as locational factors significantly influenced switch from imported to local rice. Similarly, switch from agric. to local rice was significantly influenced by household size, age, education, per capita expenditure, marital status, primary occupation, community membership, price of agric. rice and all zonal variables. All these factors were significant at 1 percent probability level. These findings are in tandem with those of Bamidele *et al.* (2010), Adeyeye *et al.* (2012) and Oyinbo *et al.* (2013) in their studies on determinants of preference for foreign and local rice.

An increase in household membership reduced switch from imported to agric. and local rice by 6.585 and 5.161 respectively, and also reduces the switch from agric. to local rice by 11.746. This is because larger households often consume more of imported rice due to availability, ease of cooking and cost saving. Age significantly increased switch from imported to local rice, and also increased switch from agric. to local rice. Older population often has tendencies to consume more of locally produced food than imported foods owing to conservativeness or desire for nutritional value. Education increased switch from imported to agric. rice by a margin of 1.056,and reduced switch from imported to local rice and from agric. to local rice by a factor of -1.623 and -2.678, respectively. Nwachukwu *et al.* (2008) and Agwu *et al.*(2010) found education to influence consumer's switch from foreign to local rice in Abia State. This implies that, through increasing educational awareness of nutritional value of domestically produced rice, educated people could switch from imported to agric. rice. However, this does not hold for imported to local rice or from agric. to local rice perhaps because of the poor quality of processing of local rice that makes it unattractive to educated people. Increasing per capita expenditure was associated with increasing switch from imported to agric. rice by 0.922×10^{-03} and a reduction in switch from imported to local rice and from agric. to local rice. Hence, the consumption of agric. rice is income-driven owing to the higher price of agric. rice.

Being married significantly reduced switch from imported to agric. rice and from imported to local rice. Marriage is usually accompanied with increasing household size and has implication for cost if consumers have to switch to a rice commodity of higher price. Expectedly, taking farming as primary occupation switched consumers from imported to agric. and local rice as well as from agric. to local rice. Farmers often plant agric. and local rice. Even when they do not plant it, they have bias for food produced within their locality because of availability and sustenance of production. Community membership also reduced consumers switch from agric. to local rice.

On the factor of location, rural dwelling positively influenced switch from imported rice to agric. and local rice by 55.128 and 70.194 respectively. Similarly, rural living switched consumers from agric. to local rice. This was because the domestically produced rice commodities were more available in their immediate community and they were equally conservative with respect to consumption of locally produced food. Residing in the South-South influenced switch from imported rice to agric. and local rice less than the North-Central, whereas switch from agric. to local rice increased more than the North-Central. Residence of the South-East geopolitical zone switched more from imported to agric. and local rice and from agric. to local rice relative to the North-Central zone. In the South-West zone, consumers switched less from imported to agric. rice but switched more from imported to local rice in relation to the basal North-Central, perhaps because of the increasing awareness of the nutritional value of local rice. More switches from agric. to local rice were observed in the South-West zone relative to North-Central. Rice consumers in the North-East switched less from imported to agric. rice but switched more from imported to local rice relative to North-Central. They equally switched more from agric. to local rice. The effect of location on rice consumption, as evident in this study, attests to the findings of Adeyeye (2012) and Bashorun (2013).

An increase in the price of imported rice resulted in consumers' drift from imported to agric. and local rice by 30.680 and 1.972. An increase in the price of agric. and local rice reduced switch from imported to agric. and local rice by a factor of 19.385 and 16.309 respectively. Increase in the price of agric. rice switched consumers'preference from agric. to local rice. Nwachukwu *et al.* (2008) and Agwu *et al.*(2010) equally found price of rice to influence consumer's switch from foreign to local rice in Abia State. Hence, pricing policy in terms of price reduction in agric. rice or increasing price of imported rice (for example, through high tariff) could serve as a veritable tool in stimulating demand for agric. rice as against imported rice.

Generally, the result of preference switch from imported to agric. rice, imported to local rice, and agric. to local rice is diametrically opposed to the results of agric. to imported rice, local to imported rice,and local to agric. rice, respectively(Appendix 13). This scenario is true for all socioeconomic factors considered. The coefficients (magnitude) and diagnostic statistics were same for the two pairs except for the difference in the signs. In essence, all factors that influenced switch from imported to agric. rice were the same factors that influenced switch from agric. to imported rice but in a reverse direction. This same holds for imported to local rice as against local to imported rice and similarly for agric. to local rice as against local to agric. rice. For instance, as earlier noted, an increase in price of imported rice leads to a switch from imported to agric. rice. Conversely, an increase in the price of agric. rice (in the agric. to imported rice switch model) resulted in consumers' switch from agric. to imported rice. The same held for all significant socioeconomic variables.

Table 29: Determinants of Preference Switch A

Variables	Imp-Agr	Imp-Loc	Agr-Loc
HHSIZ	-6.585***	-5.161**	-11.746***
	(2.071)	(2.150)	(2.149)
AGE	0.286	0.687**	0.973***
	(0.276)	(0.287)	(0.287)
EDUC	1.056*	-1.623**	-2.678***
	(0.604)	(0.627)	(0.627)
PCEXP	$-0.922e^{-03}$***	$-0.287e^{-03}$**	$0.635e^{-03}$***
	($0.130e^{-03}$)	($0.135e^{-03}$)	($0.135e^{-03}$)
MARST	-30.560**	-14.227	44.787***
	(12.259)	(12.727)	(12.718)
PROCC	130.425***	93.622***	36.802***
	(10.863)	(11.278)	(11.270)
TASSET	$-0.987e^{-06}$	$-0.213e^{-05}$	$-0.114e^{-05}$
	($0.169e^{-05}$)	($0.175e^{-05}$)	($0.175e^{-05}$)
COMEM	35.916	-6.409	-42.325***
	(7.687)	(7.981)	(7.975)
SECTOR	55.128***	70.194***	15.067
	(10.186)	(10.575)	(10.568)
SS	-1605.268***	-612.241***	993.027***
	(40.275)	(41.814)	(41.784)
SE	772.490***	1081.11***	308.624***
	(23.002)	(23.881)	(23.863)
SW	-263.829***	183.316***	447.145***
	(25.642)	(26.623)	(26.603)
NE	-576.549***	314.775***	891.324***
	(18.503)	(19.210)	(19.196)
NW	69.910***	1293.064***	1223.153***
	(19.344)	(20.084)	(20.070)
PRIMP	30.680***	1.972**	
	(0.940)	(0.976)	
PRAGR	-19.385***	-	2.932***
	(0.533)		(0.553)
PRLOC	-	-16.309***	-0.546
		(0.733)	(0.732)
CONST.	3920.572***	-1650.722***	2269.85***
	(115.872)	(120.301)	(120.214)
R^2	0.380	0.540	0.351
Adj R^2	0.379	0.540	0.350
F (17, 18843)	385.32***	737.47***	339.63***

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

Note: Imp-Agr means switch from imported to agric. rice
Imp-Loc means switch from imported to local rice
Agr-Loc means switch from agric to local rice

Source: Computed from NLSS Data (2004)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECCOMMENDATION

This is the concluding chapter of the thesis. It consists of the summary of the research with greater emphasis on the major findings, the conclusion and policy implication of the findings. The contributions of the research to knowledge are documented, appropriate policy recommendations are made from the findings and areas of further research are equally suggested.

5.1 Summary

The inability of domestic supply to match rising demand for rice alongside preference for imported rice resulting in increasing importation of milled rice in Nigeria was the focus of this study. Against this background, the study examined the determinants of demand, supply response and preference switch for rice in Nigeria. Data from the Nigeria Living Standard Survey (NLSS) of 2004 conducted by the National Bureau of Statistics (NBS) and time series data from the official records of International Rice Research Institute (IRRI), 1960-2008 were used in this study. Data were analysed using descriptive statistics, Tobit regression model, AIDS model, vector error correction model and generalised least square regression.

The results of the analysis in this research are summarised thus:

1. Rice averagely constituted about 25 percent of total food expenditure in Nigeria. The mean expenditure for imported rice (₦1, 256.545) was higher than that of improved domestic (agric.) rice (₦797.748) and local rice (₦658.110). Consequently, the share of expenditure of various rice commodities followed the same trend with imported rice on the top with mean share of total rice expenditure of 0.451.
2. At the zonal level, the North-West region ranked highest in total expenditure on all rice commodities. This region was closely followed by the North–Central region. The South East and North-East region were at close range; the South-West followed while the South-South region ranked lowest in terms of overall rice consumption expenditure.North-West zone led in terms of mean expenditure on imported and agric. rice, while North-Central ranked highest in expenditure on local rice.
3. Nigeria was self-sufficient in rice from 1960 to 1975, the self–sufficiency ratio began to decline thereafter. From 1987, there was remarkable increase in self-sufficiency ratio owing to ban on importation but still less than unity till now.

4. Total rice demand was significantly influenced by household size, non-food total expenditure, age, sectoral and zonal factors. All factors were significant at 1 percent probability level, with the exception of non-food total expenditure, that was significant at 10 percent level and household sizethat was significant at 5 percent. Non-food total expenditure and age showed inverse relationship with total rice expenditure, while other significant factors displayed positive signs.
5. The determinants of imported rice demand were: household size, non- food total expenditure, education, primary occupation, sectoral and zonal factors. All the factors were significant at 1 percent probability level, with the exception of educational level, that was significant at 10 percent and the dummy for sectorthat was significant at 5 percent. Non-food total expenditure, primary occupation and two of the zonal dummies were negatively related to imported rice demand, while others were directly related.
6. For improved domestic (agric.) rice demand, the determinants were household size, non-food total expenditure, age, marital status, primary occupation, community membership and all the zonal dummies. A positive relationship existed between agric. rice demand and factors like marital status, primary occupation and all zonal (except South-East) variables. Others were inversely related to agric. rice demand. All the mentioned factors were highly significant at 1 percent probability level.
7. Local rice demand was found to be statistically influenced by the following variables: non-food total expenditure, age, marital status, community membership and all zonal variables. Non-food total expenditure, marital status and all zonal dummies showed negative signs, while other factors were positively related to local rice demand.
8. The estimated elasticities from the Tobit model showed that imported, agric. and local rice were non-income-elastic as their various values of elasticities: 7.266×10^{-08}, $1.727\times10^{-07}$and 1.001×10^{-07},were less than unity but greater than zero. Hence, all rice commodities were classified as 'necessities' and 'normal good'. They were equally non-price-elastic as all price elasticities were less than unity. However, the traditional inverse demand-price and direct demand-income relationship was maintained in all the coefficients.
9. The results of the cross price elasticities for imported rice revealed that local rice, white garri, yam and brown beans were substitute products to imported rice; while agric. rice, yellow garri, white beans, millet, guinea corn, white maize and yellow maize were classified as complements.

10. For the agric. rice commodity, yellow garri, guinea corn, millet, white maize and yellow maize were found to be substitute products; while imported rice, local rice, white garri, yam, brown beans and white beans, were found to be complementary to agric. rice.
11. Similarly, the competitive products to local rice includedimported rice,agric. rice, yellow garri, yam, millet and guinea corn; while, white garri, brown beans, white beans, white maize and yellow maize emerged as complementary products to local rice.
12. Area cultivated, fertilizer consumption and import quantities were found to significantly influence the supply of domestic rice in Nigeria in the Vector ECM short-run and long-run model.
13. The result of the short-run VECM model stated that the adjustment to any disequilibrium caused by shocks in output of rice was corrected within 12/0.26 (46) months. Shocks due to area were corrected within 12/0.24 (50) months. The adjustment speed of fertilizer consumption was 0.04. Farmers adjusted to short-run fluctuation in import within 12/0.37 (33) months.
14. Local rice output was not price elastic in the long run and short run in the error correction model.
15. Household size, per capita expenditure, education, marital status, primary occupation, prices of imported and agric. rice and all locational factors exercised significant influence on switch from imported to agric. rice. All the factors were significant at 1 percent probability level with due exception to education and marital status, which were significant at 10 and 5 percent, respectively. Per capita expenditure, marital status, and price of agric. and two zonal dummies showed inverse relationship, while other factors were directly related. All the factors that were significant above equally influenced switch from agric. to imported rice but in reverse direction.
16. Preference switch from imported to agric. rice was determined by a number of factors, particularly household size, per capita expenditure, primary occupation, sector, zonal factors and price of imported and agric. rice. All the aforementioned factors were highly significant at 1 percent probability level. Other factors were marital status and education, which were significant at 5 and10 percent, respectively.
17. Household size, age, education, per capita expenditure,primary occupation, price of imported and local rice as well as locational factors significantly influenced switch from imported to local rice at various probability levels.

18. Similarly, switch from agric. to local rice was significantly influenced by household size, age, education, per capita expenditure, marital status, primary occupation, community membership, price of agric. rice and all zonal variables. All these factors were significant at 1 percent probability level.

5.2 Policy implications of the findings

1. Rice is consumed in all geopolitical zones of Nigeria and constitutes a significant share of total food expenditure, hence, attention on increasing local supply and stimulation of consumption of local rice will certainly contribute to the attainment of overall food self-sufficiency and food security in Nigeria.
2. Although price and income significantly influenced the demand for various rice commodities, the inelasticity of price and income make them influence demand in a less than proportionate trend. It also follows that there is limit to the use of pricing and income policy in stimulating rice demand. Similarly, the degree of substitution of one rice commodities type for another and other food commodities is largely limited.
3. Variation exists among different sectors and geopolitical zones in terms of rice demand. Urbanization and cosmopolitan nature of zones seem to favour the consumption of imported rice as against local rice probably owing to availability, acceptability (resulting from quality processing and good packaging) and ease of cooking. Therefore, improvement in availability and processing of local rice has become necessary to stimulate its consumption
4. Pricing policy is rather a blunt instrument in motivating farmers for rice supply, as supply is price-inelastic in Nigeria.
5. Increase in area cultivated and fertilizer consumption could increase productivity and boost domestic rice supply in the short run and long run in Nigeria.
6. Import restriction could also stimulate domestic rice production in the short run but importation allowance will ensure competitiveness and stimulate local rice production in the long run.
7. Since price is inversely related to switch from imported to domestically produced rice, a switch of such could be driven by price reduction in domestically produced rice (cost reduction production technologies are essential to farmers in this regard).
8. Switch from imported to agric. rice consumption has equally been found to be income driven, hence policies that increase the income of the populaceare of relevance in increasing agric. rice demand

9. Education has also been observed to positively influence switch from imported to agric. rice, therefore, educational awareness on nutritional value of agric. rice will be of great importance.

5.3 Conclusion

Against the background of rising importation bills and consequent drains on foreign exchange earnings necessitated by the ever increasing demand, shortage in supply of domestically produced rice and preference switch towards imported rice, this study examined the determinants of demand for rice, estimated a supply response model for rice alongside analysing the determinants of preference switch from one rice commodity to the other. The analysis isolated the determinants of demand for various rice commodities, estimated the supply response of rice and examined the determinants of preference switch from one rice commodity to another in Nigeria. Demand for rice was largely influenced by household characteristics, which included: non-food total expenditure, age, education, price and location among other factors. The price and income elasticities show that demand for rice is price and income-inelastic. In addition, complements and substitutes of various rice commodities were identified, although with limited degree of substitution owing to inelasticity. On the other hand, supply of rice responded to area cultivated, fertilizer consumption and quantity of imports but was non-price or climate responsive. In addition to income, education and few other socioeconomic variables, the price of rice commodities could switch consumers from imported to domestically produced rice. To this end, the following recommendations are made:

5.4 Policy Recommendations

(a) Enhancing demand/consumption of domestically produced rice

1. Since education largely favours the consumption of imported rice as against local rice, re-educating literates and students on the nutritional value of domestically produced rice as well as local rice baiting (feeding students with local rice in schools) will assist in stimulating local rice demand.

2. Residing in the North-Central zone relatively stimulated local rice consumption more than other zones,therefore,efforts at stimulation of consumption of local rice should be more intensified in other geopolitical zones than the North-central zone.

3. Imported rice was found to increase with urban livelihood (as a result of availability, improved processing, packaging and ease of cooking). This calls for making domestically produced rice available in urban centres. Improved processing and packaging of domestically produced rice will also increase acceptance and consumption by urban dwellers.This can be achieved through the followings of which most are components of the Agricultural Transformation Agenda:

a. Public and private sector investment in rice mill;
b. Training on improved parboiling and drying methods;
c. Dissemination of improved small-scale milling technology;
d. Dissemination of destoners and their use, and
e. Establishment of rice development fund within existing financial system establish fund to facilitate investments in new rice processing technology/ equipment.

(b) Increasing output/supply of domestically produced rice

1. In view of the responsiveness of rice supply to area cultivated and fertilizer use, increasing farmers' holdings and encouraging land transfer to rice farmers will be effective in boosting domestic rice supply. Also, increased use of improved input, especially fertilizer (through effective extension delivery, subsidy programme, private participation to increase avialability) is a veritable means of increasing domestic rice productivity and supply.

One of the key elements of the transformation agenda is the sanitisation of the government subsidy programme and subsequent liberalisation of the fertilizer industry. This is expected to improve the availability of fertilizers to farmers and consequently boost productivity if properly implemented.

2. Quantity imported has been found to vary negatively and positively with rice supply in the short run and long run, respectively.It follows that policy on importation control could confer a short-run advantage on domestic rice producer. Allowance of some level of importation to ensure competitiveness may also be beneficial in boosting rice supply in the long run. Hence, government should not close its gate totally to rice importation in the long run as planned in the transformation agenda

(c) Switching Consumers' Preference from Imported to domestically produced rice

1. Since consumers are seen to switch from imported to local rice upon price reduction, cost reducing measures (such as development and adoption of improved varieties and technologies) are essential in reducing domestic rice price and increasing switch towards domestically produced rice.

2. Similarly, income-increasing policies could drive consumers' towards agric. rice consumption because switch from imported to agric. rice was found to increase with increasing income.

3. Education has been associated with increasing switch from imported to agric. rice, hence education and reorientation on the nutritional value of domestically produced rice has the potential to switch consumer from imported to agric. rice consumption.

5.5 Contributions to knowledge

This study has contributed to knowledge in the following ways:

1. Through disaggregation of determinants of rice demand, the study empirically showed that household size, non-food total expenditure, education and urban livelihood increased imported rice demand; marital status and farming occupation increased agric. rice demand, while non-food total expenditure, age and membership of community organization favour local rice consumption among other socioeconomic characteristics.Factors that reduced demand for various rice commodities were equally isolated. Hitherto, determinants of demand for domestically produced rice have never been disaggregated into agric. and local rice components.
2. By factoring in the effect of geopolitical zone into demand analysis, the study revealed that the residents of North-Central relatively consumed more of domestically produced rice than virtually all other zones while residing in the South-East and South-West stimulated the consumption of imported rice relative to North-Central.
3. The study showed that consumers' preference could be switched from imported to domestically produced rice through education, income and price reduction in domestically produced rice among other factors.

4. Finally, it was revealed that import restriction could stimulate domestic production of rice in the short run while some allowance of importation could assist farmers in competing favourably through production cost reduction in the long run.

5.6 Suggestions for further research

1. Due to data limitation, this study could not incorporate organoleptic characteristics of rice (size, colour, texture, taste, aroma, rising capacity and so on) as well as value addition characteristics (processing and packaging) in the demand and preference switch models. Future research could incorporate thesequalitative variables to capture better the determinants of demand and preference switch of various rice commodities.
2. Rice marketed output rather than the farm level output data will be better in analysing rice self-sufficiency and supply response. Such data should be sourced to provide a better estimate of rice self-sufficiency and supply response in future research.
3. Studies on determinants of demand, supply response and preference switch should be extended to other important staple foods in Nigeria.
4. There is a need for further research on the determinant of more consumption of local rice in the North central relative to other zones
5. Further researchers should update their data for both demand and supply response analysis to elicit more current results on demand and supply of rice in Nigeria.

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Appendix 1: Nigerian Rice Production Systems

Production System	Major States Covered	Estimated share of national rice area	Ave. Yield (ton/ha)
Rainfed Upland	Ogun, Ondo, Osun, Ekiti, Oyo, Edo, Delta, Niger, Kwara, Kogi, Sokoto, Kebbi, Kaduna and Benue states	30%	1.7
Rainfed Lowland	Ondo, Ekiti, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom, Lagos, all major river valleys, e.g., shallow swamps of Niger basin, Kaduna basin and inland swamps of Abakaliki and Ogoja areas	47%	2.2
Irrigated	Niger, Sokoto, Kebbi, Borno, Benue, Kogi, Anambra, Enugu, Ebonyi and Cross River states	16%	3.5
Deep water /Floating	Flooded areas of Rima valley-Kebbi state and deep flood areas of Ilushi, Delta state	5%	1.3
Mangrove Swamp	Ondo, Ekiti, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom Lagos	1%	2.0

Source: Akpokodje *et al.* (2001)

Appendix 2: Analysis of Objectives

OBJECTIVE	FOCUS	DATA REQUIREMENTS	ANALYTICAL TOOLS
1. To describe the expenditure pattern of rice in Nigeria	This objective described the Expenditure on various types of rice and also related it to other food commodities and socioeconomic characteristics	Data on consumption expenditures on rice, other food commodities and socioeconomic characteristics	Descriptive Statistics: frequency tables, mean median, mode, standard deviation, percentages, skewness and kurtosis.
2. To examine the self-sufficiency ratio of rice in Nigeria	In this objective we examine the ratio of domestic rice supply to demand in Nigeria in relation to the quantity imported annually	Data on production, consumption and import quantities of rice in Nigeria	Descriptive Statistics: frequency tables, mean, median, mode, standard deviation, percentages.
3. To estimate a demand model for rice in Nigeria	Here, the determinants of rice demand, their signs, magnitude and corresponding elasticities were estimated	Data on household expenditure on various rice commodities, Price, income and other socioeconomic variables, such as age, household size, education, etc.	Tobit Regression Model, Almost Ideal Demand System (AIDS)
4. To analyse the supply response of rice in Nigeria	Here, the response of rice output to price and non-price factors were tested,the elasticities and coefficientof adjustment determined in the short run and long run.	Data on rice output, area and prices, weather variable, fertilizer consumption etc.	Cointegration and Error Correction Model (Vector autoregressive procedure)
5. To isolate the determinants of preference switch from foreign to local rice or vice versa	This objective analysed the direction and determinants of preference switch between various pairs of rice commodities.	Data on expenditure share on local, agric. and imported rice; socioeconomic variables: age, income, education, price etc.	Paired sample t-test and Generalized least square (GLS) multiple regression

Source: Author's Compilation

Appendix 3: Taxonomy of Trade Policy on Rice in Nigeria

PERIOD	POLICY MEASURES
Before april 1974	60% tariff
April 1974-April 1975	20%
April 1975- April 1978	10%
April1978 – June 1978	20%
June 1978 –October 1978	19%
October 1978 – April 1979	Import in container under 50kg were banned
April 1979	Import under restricted license only Government agencies
September 1979	6 months ban on all rice imports
January 1980	Import license issued for 200,000 tonnes of rice
October 1980	Rice under general import license with no quantitative restrictions
December 1980	Presidential task force (PTF) on rice was created and it used the Nigeria National Supply Company to issue allocations to customers and traders
May 1982	PTF commenced issuing of allocations directly to customers and traders in addition to those issued by NNSC
January 1984	PTF disbanded, rice importation placed under general license restriction
October 1985	Importation of rice banned.
July 1986	Introduction of SAP and the abolition of Commodity Boards to provide production incentives to farmers through increased producer prices
1995	100%
1996	50%
1998	50%
1999	50%
2000	50%
2001	85%

Source: Akpokodje *et al.* (2001); Akande *et al.*(2007)

Appendix 4: NBS Rice Production Statistics

a. **Rice Area, Output and Yield (2002-2007)**

	2002/03	2003/04	2004/05	2005/06	2006/07
AREA('000Ha)	1,361.17	1,389.13	1,454.57	1,590.37	1,526.00
OUTPUT('000MT)	2,737.61	2,980.57	3,183.39	3,247.52	3,333.00
YIELD (Kg / ha)	2,011.2	2,145.7	2,188.5	2,042.0	2,184.0

Source: National Bureau of Statistics (NBS) (2010)

b. **Rice Output (2006-2010)**

	2006	2007	2008	2009	2010
OUTPUT('000MT)	3333.00	3561.55	3369.70	3402.59	4468.04

Source: National Bureau of Statistics (2012b)

Appendix 5: Trend in Rice Production, Consumption and Import in Nigeria (1995 - 2011)

Year	Productn ('000)	Area ('000ha)	Yield (tonne/ha)	Consumption	Import
1995	2920	1796	1.63	2249	300
1996	3122	1784	1.75	2429	346
1997	3268	2048	1.60	2880	679
1998	3275	2044	1.60	2781	594
1999	3277	2191	1.50	3000	813
2000	3298	2199	1.50	2994	786
2001	2752	2117	1.30	3402	1710
2002	2928	2185	1.34	3146	1236
2003	3116	2210	1.41	3284	1601
2004	3334	2348	1.42	3251	1398
2005	3567	2494	1.46	3182	1188
2006	4042	2725	1.65	3372	976
2007	3186	3000	1.30	3601	1217
2008	4179	2382	1.75	3324	972
2009	3403	1837	1.93	3545	1164
2010	3219	2433	1.84	NA	1885
2011	3045	2580	1.77	NA	NA

Source: IRRI; FAOSTAT World Rice Statistics (2014)
Available at: http://www.beta.irri.org/statistics

Appendix 6: Estimates of Aggregate Agricultural Supply Response

Studies	*Country*	*Supply Response*	
		Short-run	*Long-run*
Griliches (1959) N	US	0.28 - 0.30	1.20 - 1.32
Griliches (1960)G	US	0.10 - 0.20	0.15
Tweeten and Quance (1968)G	US	0.25	1.79
Rayner (1970)G	UK	0.34	0.42
Pandey *et al* (1982)N, G	Australia	0.30	0.6 - 1.00
Reca (1980)N	Argentina	0.21 - 0.35	0.42 - 0.78
Bapna (1980)N	India (Ajmer)	0.24	na
Krishna (1982)N	India	0.20 - 0.30	na
Chhibber (1989) N	India	0.20 - 0.30	0.40 - 0.50
Bond (1983)N:	Ghana	0.20	0.34
	Kenya	0.10	0.16
	Côte d'Ivoire	0.13	0.13
	Liberia	0.10	0.11
	Madagascar	0.10	0.14
	Senegal	0.54	0.54
	Tanzania	0.15	0.15
	Uganda	0.05	0.07
	Burkina Faso	0.22	0.24
	SSA (ave.)	0.18	0.21

Those studies indicated by N use the Nerlove Model, those indicated by G use the Griliches approach.

Source: McKay *et al.* (1999)

Appendix 7: Description of Household Expenditure on Rice Commodities

Zone/ Rice type	Mean	S. D	Skewness	Kurtosis
North Central				

Imported Rice (IR)	1372.255	869.648	0.621	-0.887
Agric. Rice (IDR)	852.455	408.138	-0.553	-1.243
Local Rice (LR)	1209.948	1273.898	1.913	1.752
Total Rice (TR)	3434.657	2273.684	1.454	0.860
Share of IR	0.4000	0.122	40.149	-0.985
Share of IDR	0.264	0.093	40.272	-1.463
Share of LR	0.336	0.143	0.157	-1.179
Share of TR	0.253	0.168	0.888	0.241
North East				
Imported Rice (IR)	1044.116	358.860	-0.654	-1.279
Agric. Rice (IDR)	724.029	204.561	0.855	-0.109
Local Rice (LR)	549.054	63.118	0.767	-0.621
Total Rice (TR)	2317.199	456.163	-0.453	-0.377
Share of IR	0.437	0.095	-0.404	-1.520
Share of IDR	0.312	0.048	-0.188	-1.244
Share of LR	0.251	0.076	0.602	-1.055
Share of TR	0.249	0.167	0.917	0.409
North West				
Imported Rice (IR)	2006.004	1132.540	0.597	-1.296
Agric. Rice (IDR)	1299.087	805.944	1.670	1.755
Local Rice (LR)	738.293	135.475	-0.772	-0.556
Total Rice (TR)	4043.383	1740.027	0.889	-0.506
Share of IR	0.478	0.124	0.076	-1.254
Share of IDR	0.321	0.107	-0.008	-1.660
Share of LR	0.202	0.048	-0.811	-1.084
Share of TR	0.440	0.575	6.211	63.223
South-South				
Imported Rice (IR)	700.629	150.365	0.976	-0.606
Agric. Rice (IDR)	531.982	123.980	-0.003	-1.062
Local Rice (LR)	435.299	58.271	-0.020	-1.614
Total Rice (TR)	1667.909	275.274	-0.720	-1.357
Share of IR	0.420	0.047	-0.466	-1.166
Share of IDR	0.317	0.039	0.831	-0.182
Share of LR	0.264	0.025	-0.102	-1.212
Share of TR	0.146	0.123	1.799	4.088
South East				
Imported Rice (IR)	1327.744	631.793	0.621	-1.320
Agric. Rice (IDR)	633.117	80.114	-0.213	-1.675
Local Rice (LR)	499.620	133.781	0.635	-1.164
Total Rice (TR)	2460.480	771.019	0.721	-1.099
Share of IR	0.515	0.090	0.124	-1.698
Share of IDR	0.275	0.063	-0.018	-1.058
Share of LR	0.211	0.050	1.051	-0.120
Share of TR	0.208	0.161	1.273	1.229
South-West				
Imported Rice (IR)	860.821	274.675	1.621	1.329
Agric. Rice (IDR)	580.111	97.519	1.157	0.137
Local Rice (LR)	413.253	119.192	0.541	-1.453
Total Rice (TR)	1863.185	375.772	1.091	0.376
Share of IR	0.460	0.054	0.798	-0.635
Share of IDR	0.314	0.028	-0.432	-0.861
Share of LR	0.226	0.061	0.101	-1.254
Share of TR	0.194	0.140	1.258	1.631

Source: Computed from NLSS (2004)

Appendix 8: Distribution of Respondents by Share of Rice in Total Food Expenditure (Zones)

Expenditure	Frequency	Percent	Valid Percent
North Central			

1-10	359	10.8	20.6
11-20	494	14.8	28.3
21-30	342	10.3	19.6
31-40	236	7.1	13.5
41-50	140	4.2	8.0
51-60	109	3.3	6.3
61-70	64	1.9	3.7
Total	1744	52.4	100.0
Missing value	1587	47.6	
Total	3331	100.0	
North East			
1-10	548	17.1	21.5
11-20	689	21.5	27.0
21-30	505	15.8	19.8
31-40	368	11.5	14.4
41-50	216	6.7	8.5
51-60	117	3.7	4.6
61-70	106	3.3	4.2
Total	2549	79.6	100.0
Missing value	653	20.4	
Total	3202	100.0	
North West			
1-10	338	8.9	13.3
11-20	489	12.9	19.3
21-30	552	14.5	21.7
31-40	404	10.6	15.9
41-50	311	8.2	12.2
51-60	267	7.0	10.5
61-70	179	4.7	7.0
Total	2540	66.8	100.0
Missing value	1260	33.2	
Total	3800	100.0	
South-South			
1-10	1246	43.7	48.9
11-20	752	26.3	29.5
21-30	293	10.3	11.5
31-40	136	4.8	5.3
41-50	68	2.4	2.7
51-60	37	1.3	1.5
61-70	16	0.6	0.6
Total	2548	89.3	100.0
Missing value	306	10.7	
Total	2854	100.0	
South-East			
1-10	704	26.3	32.4
11-20	660	24.6	30.4
21-30	338	12.6	15.6
31-40	194	7.2	8.9
41-50	135	5.0	6.2
51-60	82	3.1	3.8
61-70	58	2.2	2.7
Total	2171	81.0	100.0
Missing value	510	19.0	
Total	2681	100.0	
South-West			
1-10	731	24.4	31.8
11-20	726	24.3	31.6
21-30	428	14.3	18.6
31-40	233	7.8	10.1
41-50	93	3.1	4.0
51-60	59	2.0	2.6
61-70	27	0.9	1.2
Total	2297	76.7	100.0
Missing value	696	23.3	
Total	2993	100.0	

Source: Computed from NLSS (2004)

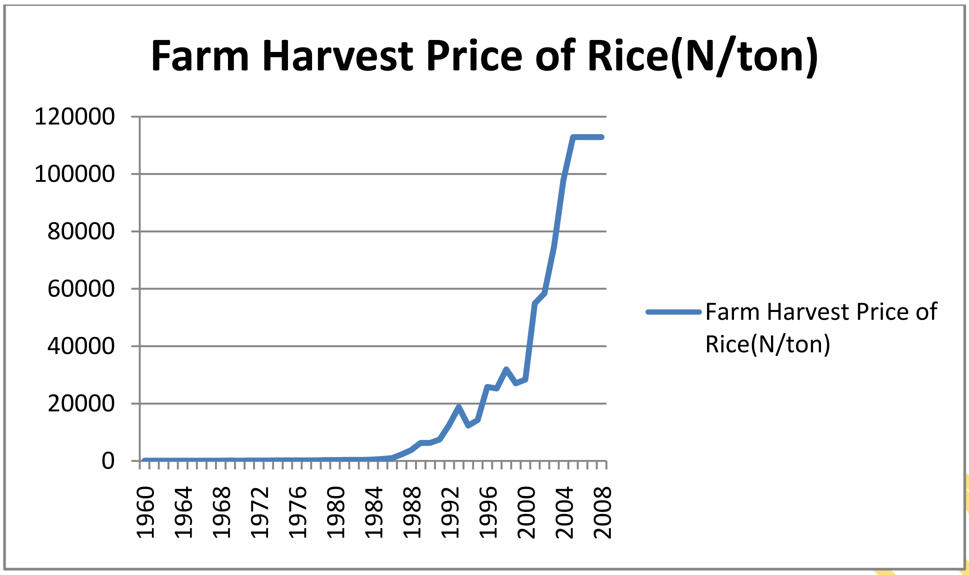
Appendix 9:Nigeria Rice Self- Sufficiency Ratio

Year	Consumption	Production	Import	Self-sufficiency Ratio
1960	239	240	1	0.996

1961	229	230	1	0.996
1962	246	247	2	0.996
1963	202	204	1	0.990
1964	269	270	1	0.996
1965	236	232	1	0.996
1966	270	271	1	0.996
1967	260	261	1	0.996
1968	249	250	1	0.996
1969	257	258	1	0.996
1970	284	285	6	0.997
1971	307	313	11	0.981
1972	310	321	2	0.966
1973	342	344	4	0.994
1974	348	352	6	0.989
1975	390	396	94	0.985
1976	406	500	446	0.812
1977	412	750	789	0.549
1978	394	950	242	0.415
1979	372	854	394	0.440
1980	523	850	686	0.615
1981	579	1227	666	0.472
1982	648	1337	903	0.485
1983	607	1648	629	0.368
1984	579	1220	569	0.474
1985	680	1249	462	0.544
1986	630	1042	642	0.605
1987	1184	1152	344	1.028
1988	1249	1350	164	0.925
1989	1982	1550	224	1.279
1990	1500	2757	290	0.544
1991	1911	2207	440	0.866
1992	1956	2436	382	0.803
1993	1839	2221	300	0.828
1994	1456	2136	300	0.682
1995	1752	2200	350	0.674
1996	1873	2175	731	0.861
1997	1961	2712	900	0.723
1998	1965	2815	850	0.698
1999	1966	2866	1250	0.686
2000	1979	3029	1906	0.653
2001	1651	3051	1897	0.541
2002	1757	3307	1448	0.531
2003	1870	3670	1369	0.510
2004	2000	3750	1777	0.533
2005	2140	3800	1600	0.563
2006	2546	4040	1600	0.630
2007	2008	4000	1550	0.502
2008	2632	4200	1800	0.627
2009	2730	4580	2000	0.596
2010	2615	5030	2000	0.520
2011	2709	5200	2550	0.521
2012	2850	5950	2700	0.479

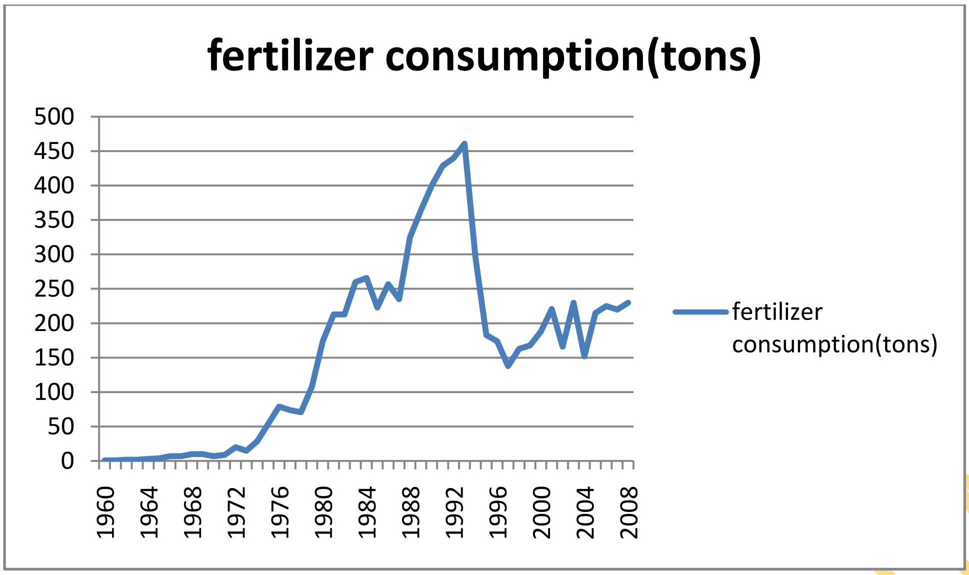
Computed from IRRI (2014); USDA Rice Statistics Data
Available at: http://www.beta.irri.org/statistics

Appendix 10: Farm Harvest Price of Rice in Nigeria (1960-2008)



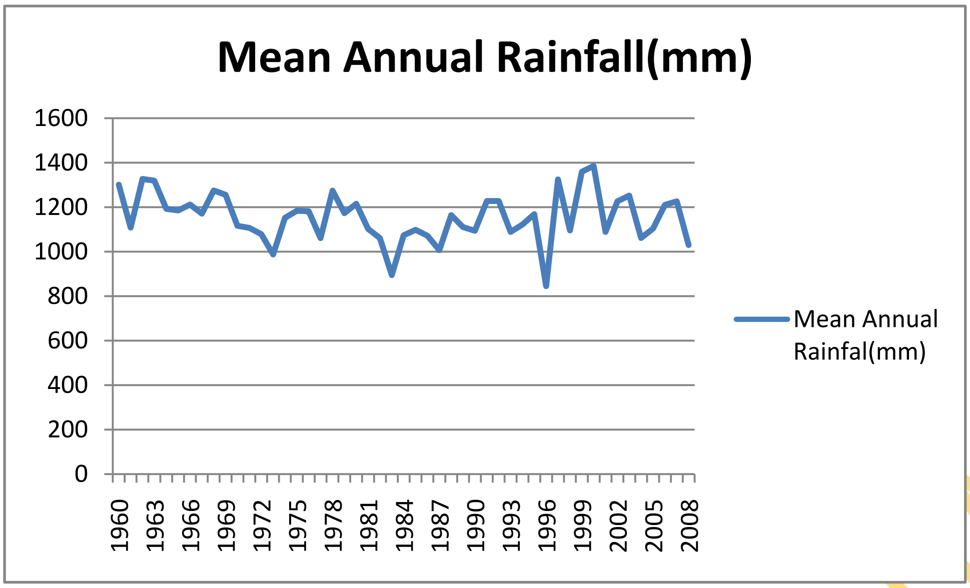
Source: Computed from IRRI Statistics (2011)

Appendix 11: Fertilizer Consumption in Nigeria (1960-2008)



Source: Computed from IRRI; FAO Rice Statistics (2011)

Appendix 12: Mean Annual Rainfall in Nigeria (1960-2008)



Source: Computed from IITA Rainfall Data (2010)

Appendix 13: Determinants of Preference Switch B

Variables	Agr-Imp	Loc-Imp	Loc-Agr
HHSIZ	6.585***	5.161**	11.746***
	(2.071)	(2.150)	(2.149)
AGE	-0.286	-0.687**	-0.973***
	(0.276)	(0.287)	(0.287)
EDUC	-1.056*	1.623**	2.678***
	(0.604)	(0.627)	(0.6267)
PCEXP	$0.922e^{-03}$***	$0.287e^{-03}$**	$-0.635e^{-03}$***
	$(0.130e^{-03})$	$(0.135e^{-03})$	$(0.135e^{-03})$
MARST	30.560**	14.227	-44.787***
	(12.259)	(12.727)	(12.718)
PROCC	-130.425***	93.622***	-36.802***
	(10.863)	(11.278)	(11.270)
TASSET	$0.987e^{-06}$	$0.213e^{-05}$	$0.114e^{-05}$
	$(0.169e^{-05})$	$(0.175e^{-05})$	$(0.175e^{-05})$
COMEM	-35.916	6.409	42.325
	(7.687)	(7.981)	(7.975)
SECTOR	-55.128***	-70.194***	-15.067
	(10.186)	(10.575)	(10.568)
SS	1605.268***	612.241***	-993.027***
	(40.275)	(41.814)	(41.784)
SE	-772.490***	-1081.11***	-308.624***
	(23.002)	(23.881)	(23.863)
SW	263.829***	-183.316***	-447.145***
	(25.642)	(26.623)	(26.603)
NE	576.549***	-314.775***	-891.324
	(18.503)	(19.210)	(19.196)
NW	-69.910***	-1293.064***	-1223.153
	(19.344)	(20.084)	(20.069)
PRIMP	-30.680***	-1.972**	
	(0.940)	(0.976)	
PRAGR	19.385**	-2.932	
	(0.533)		(0.553)
PRLOC	-16.309***	0.546	
		(0.733)	(0.732)
CONST.	-3920.572***	1650.722***	-2269.85
	(115.872)	(120.301)	120.214
R^2	0.380	0.540	
Adj R^2	0.379	0.540	
F (30, 18830)	385.32***	737.47***	

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

Note: Agr-Imp means switch from agric. to imported rice
Loc-Imp means switch from local to imported rice
Loc-Agr means switch from local to agric. rice

Source: Computed from NLSS Data (2004)