INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
Supported by the CGIAR

NSSP Working Paper 21

A Review of Literature on Agricultural Productivity, Social Capital and Food Security in Nigeria

Lenis Saweda Liverpool-Tasie
International Food Policy Research Institute

Oluyemisi Kuku
International Food Policy Research Institute

Akeem Ajibola
International Food Policy Research Institute

Nigeria Strategy Support Program (NSSP)

NSSP Working Paper No. 21

October 2011

IFPRI-ABUJA
International Food Policy Research Institute
c/o International Center for Soil Fertility and Agriculture Development
No.6/ Plot 1413 Ogbagi Street
Off Oro-Ago Crescent
Cadastral Zone 11, Garki, Abuja
Nigeria
E-mail: ifpri-nigeria@cgiar.org
www.ifpri.org

IFPRI HEADQUARTERS
International Food Policy Research Institute
2033 K Street NW
Washington, DC 20006-1002 USA
Tel. +1-202-862-5600
Fax +1-202-467-4439
E-mail ifpri@cgiar.org
www.ifpri.org

THE NIGERIA STRATEGY SUPPORT PROGRAM (NSSP) WORKING PAPERS

ABOUT NSSP

The Nigeria Strategy Support Program (NSSP) of the International Food Policy Research Institute (IFPRI) aims to strengthen evidence-based policymaking in Nigeria in the areas of rural and agricultural development. In collaboration with the Federal Ministry of Agriculture and Rural Development, NSSP supports the implementation of Nigeria's national development plans by strengthening agricultural-sector policies and strategies through:

- Enhanced knowledge, information, data, and tools for the analysis, design, and implementation of pro-poor, gender-sensitive, and environmentally sustainable agricultural and rural development polices and strategies in Nigeria;
- Strengthened capacity for government agencies, research institutions, and other stakeholders to carry out and use applied research that directly informs agricultural and rural polices and strategies; and
- Improved communication linkages and consultations between policymakers, policy analysts, and policy beneficiaries on agricultural and rural development policy issues.

ABOUT THESE WORKING PAPERS

The Nigeria Strategy Support Program (NSSP) Working Papers contain preliminary material and research results from IFPRI and/or its partners in Nigeria. They have not gone through IFPRI's official peer review process but have been reviewed by two internal IFPRI researchers. They are circulated in order to stimulate discussion and critical comment. The opinions are those of the authors and do not necessarily reflect those of their home institutions or supporting organizations.

This paper received support from the U.S. Agency for International Development (USAID)-funded Feed the Future (FTF) initiative.

A review of literature on food security, social capital and agricultural productivity in Nigeria

Lenis Saweda Liverpool-Tasie
International Food Policy Research Institute

Oluyemisi Kuku
International Food Policy Research Institute

Akeem Ajibola
International Food Policy Research Institute

Contents

List of Figures

List of Tables

Acknowledgements

The authors have received support and useful information from various government agencies and educational institutions in the process of compiling this review.
The views expressed in this paper are the personal views of the authors and do not represent the official positions of the International Food Policy Research Institute (IFPRI) or the Government of Nigeria.

Abstract

Despite the rapid pace of urbanization taking place in Nigeria, half of Nigerians (approximately 70 million individuals) still live in rural areas; most of them engaged in smallholder semi-subsistence agriculture. Agriculture remains a crucial sector in the Nigerian economy, being a major source of raw materials, food and foreign exchange; employing over 70 percent of the Nigerian labor force, and serving as a potential vehicle for diversifying the Nigerian economy. However, there are no rigorous studies that explain productivity in this sector vis-à-vis the relationship of the sector to food security and social capital. This review assesses the nature and scope of agricultural productivity, food security, and social capital in Nigeria, while also laying the groundwork for investigating the interrelationships among them. The literature reveals the pervasive inefficiency of Nigerian farmers as most smallholder farmers produce significantly below their production frontiers. As a result, they produce less than optimal levels of output as revealed by studies of productivity (mostly land productivity). Also, while many farming enterprises are profitable, profit margins are generally low. The vast majority of Nigerians are reported to be food insecure as revealed by studies on availability, utilization, and access to food. In terms of social capital, most studies are focused on membership in formal or informal organizations or associations, or by the access of individuals or associations to formal and informal sources of credit. Evidence shows that both measures of social capital improve several aspects of social welfare, particularly poverty reduction, in addition to influencing technology adoption. This review also identifies the potential pathways through which all three concepts are linked.

Keywords: food security, agricultural productivity, social capital

I. Introduction

The absence of food security and associated coping strategies are increasingly being studied in Africa. There has, however, been very little emphasis on the roles that social capital plays within this domain to exacerbate or mitigate extreme poverty and food insecurity. There is limited information about how the various interrelationships between individuals and households affect their food security status. This could be via the roles these relationships play in facilitating household ability to produce food and/or generate income, the role these relationships play when diverse shocks are experienced, as well as the roles various interrelationships play in bridging the gaps caused by input and output market failures. Furthermore, very little is known about how the shifts in family structure within many African countries towards a more western model have affected the agricultural production possibilities and food security status of families across the continent.

Nigeria is the 8th most populous nation in the world, with about 140 million inhabitants (NBS 2009). Poverty is widespread with an estimated 80 percent of Nigerians subsisting on less than $2 a day (UNDP 2009). Despite rapid levels of rural-urban migration, poor rural dwellers still account for about half of Nigeria's population (ESA/UN 2009; Akinbami and Fadare 1997).

With more than half of Nigeria's population currently employed in the agricultural sector (Manyong et al. 2005), and with the vast majority of these individuals living in rural areas, the agricultural sector is key to Nigeria's economic development. Though agriculture accounts for about 40 percent of GDP, the level of growth in that sector has lagged behind other sectors. Real annual GDP growth from 2000 to 2007 in the Nigerian economy averaged 8.8 percent, while the agriculture sector grew at 3.7 percent in 2007 (Phillip et al. 2009). Low agricultural productivity in Nigeria is due to a wide variety of factors including poor soil quality caused by pollution, erosion and leaching, the negative impact of climate change on weather patterns, the scarcity and high cost of inputs, rudimentary implements, and outdated farming practices. Poor agricultural output and widespread poverty has resulted in extensive and persistent food insecurity, with some studies showing that as many as 70 percent of Nigerians are food insecure (Orewa and Iyangbe 2009a; Obayelu 2010).

Social relationships play an instrumental role in the daily lives of all humans, particularly in developing countries where these relationships bridge the gaps caused by numerous market and institutional failures. However, studies on social capital and household welfare or poverty in Nigeria are very few, and are mostly limited to one state (e.g. Yusuf 2008) or one region (e.g. Balogun and Yusuf 2011). No rigorous empirical work investigating the links between social capital and food security exist. Similarly, there are no rigorous research studies that explicitly explore the role that social capital plays in stimulating agricultural productivity in rural Nigeria.

Consequently this literature review examines these three concepts, while identifying potential theoretical linkages among them. This review presents a detailed explanation of constraints mitigating against agricultural productivity, including a regional analysis of levels of farm efficiency and a description of the prevalence of food security, captured in a manner that reflects its multidimensional nature, across space and by farming systems. It also presents a conceptual framework that identifies the mechanisms through which various forms of social capital are expected to affect farmer conditions and behaviors. The conceptual framework provides the basis for various testable hypotheses, which will consequently be tested empirically with primary data collected across Nigeria in a manner that reflects the nation's diversity in terms of agroecology, farming systems, and poverty.

The main objectives of this review are to identify the knowledge gaps assessed from the literature in Nigeria, to develop a conceptual framework that can fill such knowledge gaps if used with empirical data, and to select the key research questions that can be answered through empirical analysis. In addition to providing empirical evidence of the prevalence and trends in the variables of interest, the review also includes detailed definitions and

explanations of core concepts related to food security, agricultural productivity, and social capital.

The rest of the review is organized as follows: agricultural productivity is discussed in section II, food security and social capital are explored in sections III and IV respectively, while section V presents the conceptual framework that addresses the linkages among the different concepts, the estimation model, and relevant variables to capture the concepts.

II. Agricultural Productivity

The purpose of this section is to identify and define core agricultural productivity related concepts, including measures of agricultural productivity, efficiency, and profitability, while also providing contextual information on the trends in agricultural productivity and related concepts in Nigeria.

Definition and measures of agricultural productivity

Agricultural productivity refers to the output produced by a given level of input(s) in the agricultural sector of a given economy (Fulginiti and Perrin 1998). More formally, it can be defined as "the ratio of the value of total farm outputs to the value of total inputs used in farm production" (Olayide and Heady 1982).

Agricultural productivity is measured as the ratio of final output, in appropriate units, to some measure of inputs. However, measures of productivity can be divided into partial or total measures depending on the number of inputs under consideration. Total output as a ratio of some measure of labor quantity, usually man days in developing countries, is called labor productivity (LP) and provides some notion of output per worker; while output per area of land planted is land productivity (Wiebe et al. 2003; Zepeda 2001). The two previously mentioned measures are examples of single factor productivity (SFP), defined as the ratio of a measure of output quantity to the quantity of a single input used (Diewert and Nakamura 2005). Partial measures of productivity can be misleading because they ignore the role of other inputs in any observed output changes (Zepeda 2001). As a result of this shortcoming, a total measure of productivity was developed. Total factor productivity (TFP) is defined as the ratio of a measure of total output quantity to a measure of the quantity of total input (Wiebe et al. 2003; Zepeda 2001).

Agriculture plays a major role in the economy of many developing countries, as it is a significant source of nourishment for citizens and a means of livelihood for the most vulnerable members of these countries. As a consequence, raising agricultural productivity is an important policy goal for concerned governments and development agencies.

Increasing agricultural productivity requires one or more of the following: an increase in output and input with output increasing proportionately more than inputs; an increase in output while inputs remain the same; a decrease in both output and input with input decreasing more; or decreasing input while output remains the same (Adewuyi 2006; Oni et al. 2009).

Increasing inputs in order to expand output involves raising both the quality and quantity of inputs, examples of which would include the mechanization of agricultural processes, use of high yield varieties, use of fertilizers, irrigation in areas where rainfall is inadequate, and the use of agrochemicals such as herbicides and pesticides. Though all of the aforementioned activities have the potential for productivity enhancement, smallholder farmers, who account for the vast majority of farmers in developing countries, often cannot afford these investments due to their limited resources and restricted access to credit.

Efficiency

There is a large literature on the need to increase the quantity and quality of inputs in agriculture in developing countries as well as the need to increase access to resources to

finance these inputs. However, it is also possible to increase output even given current levels and quality of inputs by increasing overall economic efficiency of farmers (Bravo-Ureta and Pinheiro 1997). The concept of efficiency is critical in developing country agriculture. Given the level and quality of inputs available, how well farmers are able to utilize these inputs is an important determinant of the quantity of output they are able to produce. Recent measurement of farmer efficiency has been based on the seminal paper by Farrell (1957), who decomposed economic efficiency into its technical and allocative components.

Technical efficiency refers to the ability of a producing unit to obtain maximum (optimal) output from a given amount of inputs. Formally, the level of technical efficiency is measured by the distance of farm production from the optimal production frontier. A firm that sits on the production frontier is said to be technically efficient (Henderson 2003). Allocative (or price) efficiency refers to the ability of the firm to choose its inputs in a cost-minimizing manner (Murillo-Zamorano 2004; Chavas and Aliber, 1993). For allocative efficiency to hold, farmers must equalize their marginal returns with true factor market prices. Thus, technical inefficiency is related to deviations from the frontier isoquant, while allocative inefficiency reflects deviations from the minimum cost input ratios (Bravo-Ureta and Pinheiro 1997).

In addition to technical and allocative efficiency, Farrell (1957) also defined the concept of overall efficiency (renamed economic efficiency by later literature). Economic efficiency refers to "the capacity of a firm to produce a predetermined quantity of output at minimum cost for a given level of technology" (Farrell 1957) and is derived by multiplying the technical and allocative components of efficiency (Bravo-Ureta and Pinheiro 1997). All three measures are bounded between zero and one (Murillo-Zamorano 2004).

Parametric and non-parametric methods are often utilized to measure economic efficiency. The most common specifications are the stochastic frontier models, which have been extensively specified in Nigeria for a wide variety of crops (Ajibefun 1998; Fasoranti 2006; Amos, Chikwendu, and Nmadu 2004; Adejoh 2009; Ojo et al. 2009). Parametric methods assume that the functional form of the production function is known while non-parametric methods do away with the restrictive functional form assumptions, instead relying on the data to specify the production frontier. Data envelope analysis models are the most commonly used forms of non-parametric models (Ajibefun 1998, 2008). Using either methodology (parametric or non-parametric), it is possible to estimate technical efficiency and allocative efficiency for each observation in the dataset. Most studies report mean levels of technical and allocative efficiency for the sample under observation. Studies that have applied both methodologies report no substantive differences in estimates of efficiency (Ajibefun 1998, 2008).

Trends in agricultural production in Nigeria

Nigeria is the most populous country in Africa with about 140 million citizens. Approximately half of them, or 70 million, are rural dwellers. Most rural residents are engaged in smallholder semi-subsistence agriculture (Oviasogie 2005; Ajibolade 2005). Therefore, agriculture remains a crucial sector in the Nigerian economy, being a major source of raw materials as well as food and foreign exchange, employing over 70 percent of the Nigerian labor force, and serving as a potential vehicle for diversifying the Nigerian economy and enabling economic development.

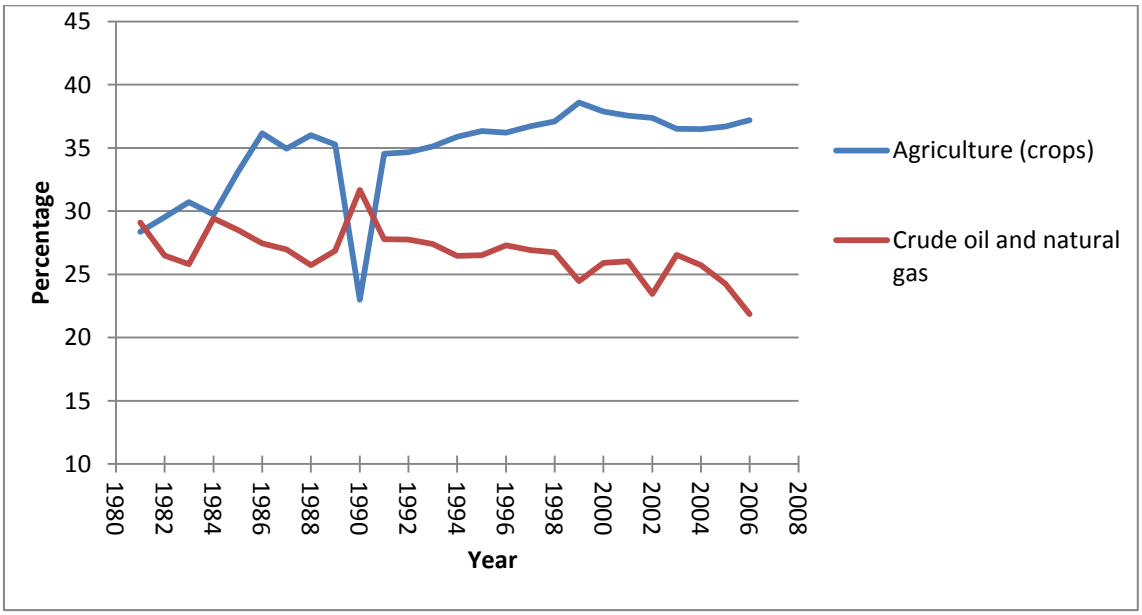
Before the emergence of oil as Nigeria's dominant economic sector, the agricultural sector contributed over 60 percent of Gross Domestic Product (GDP) and 90 percent of exports (UN 2009). The economic relevance of the agricultural sector has since declined, with the share of agriculture in GDP falling to 32.2 percent in the 1975–1979 period (Adewuyi 2002) and averaging 35 percent between 1981 and 2006 (Figure 1). The fall of agriculture in export share has been even more precipitous. From 1960–1970, the export crop subsector contributed 58.4 percent annually on average to the total foreign exchange revenue. This declined to 5.2 percent over the period 1971–85 and then further to 3 percent from 1995–1999 (Adewuyi 2002). Similarly, the growth of output in the agricultural sector declined from

3.8 percent in the 1987–1990 period to 2.2 percent between 1992–1995 (Adewuyi 2002). Within the 23 years from 1981 to 2003, aggregate agricultural production grew by only 5.4% (Muhammad-Lawal and Atte 2006). As a result of this slow growth in output, Nigeria moved from a food sufficient country in the 1960s to a major importer of food in the 1980s (Fasoranti 2006).

The estimated current 3.7 percent food production growth rate cannot keep pace with the 6.5 percent food demand fueled by a high rate of population increase, moderately rapid income growth, and relatively high elasticities of expenditure for food (Egwuda 2001; Oviasogie 2005, Mellor, 1988). For instance, in 2004, local demand of five million tons of rice far outstripped the supply of three million tons, necessitating the importation of rice to meet the shortfall. The value of rice imports has continually increased from $60 million in 1990 to $280 million in 2001, peaking at over $1billion in 2008 (Akintayo 2011). In 2002, Nigeria was one of the six largest rice importers in the world (Yusuf et al. 2009). As with most other crops in Nigeria, rice yields are low, averaging about 1.8 tons of paddy per hectare, compared to national potential average of 3 tons per hectare for upland system and 5 tons per hectare for the lowland system (Akintayo 2011). In general, food crop production in Nigeria is far below potential and demand is greater than locally produced supply.

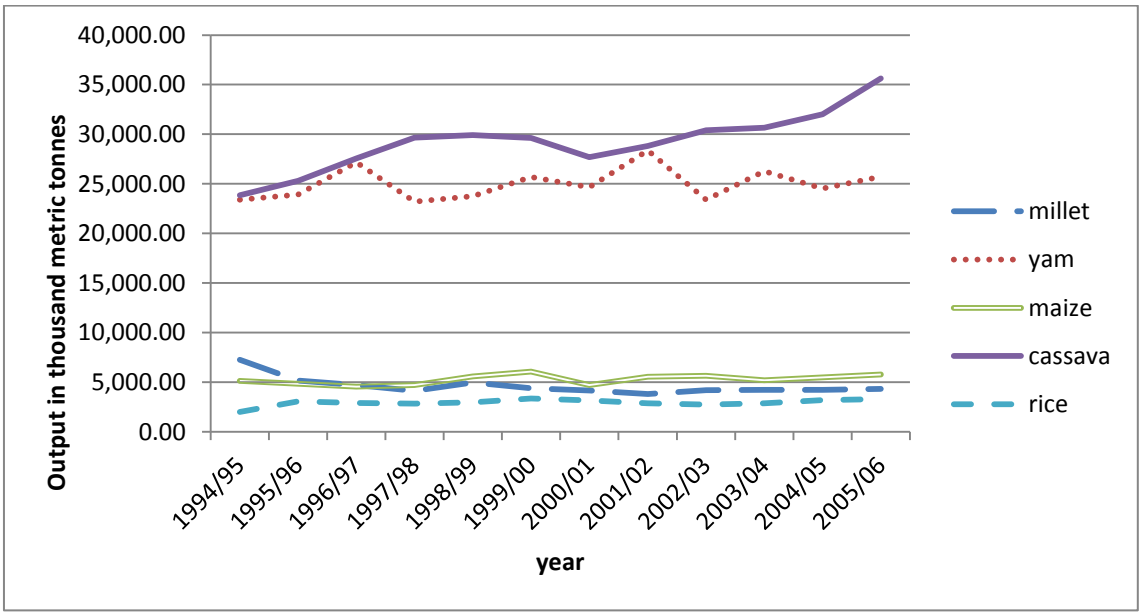
Figure 2 presents the trends in outputs of selected crops (millet, yam, maize, cassava, and rice) for the period (1994/95) - (2005/06). Output produced for most crops was stagnant or declining, with the exception of cassava, which saw modest increases in output. However, land area cultivated for these crops followed a similar trend remaining stagnant or modestly increasing over the period (Figure 3). Similarly, with the exception of cassava, which witnessed modest increases, land productivity was either declining or static (Figure 4).

Figure 1—Contribution of selected sectors to Nigeria's GDP, 1981 to 2006



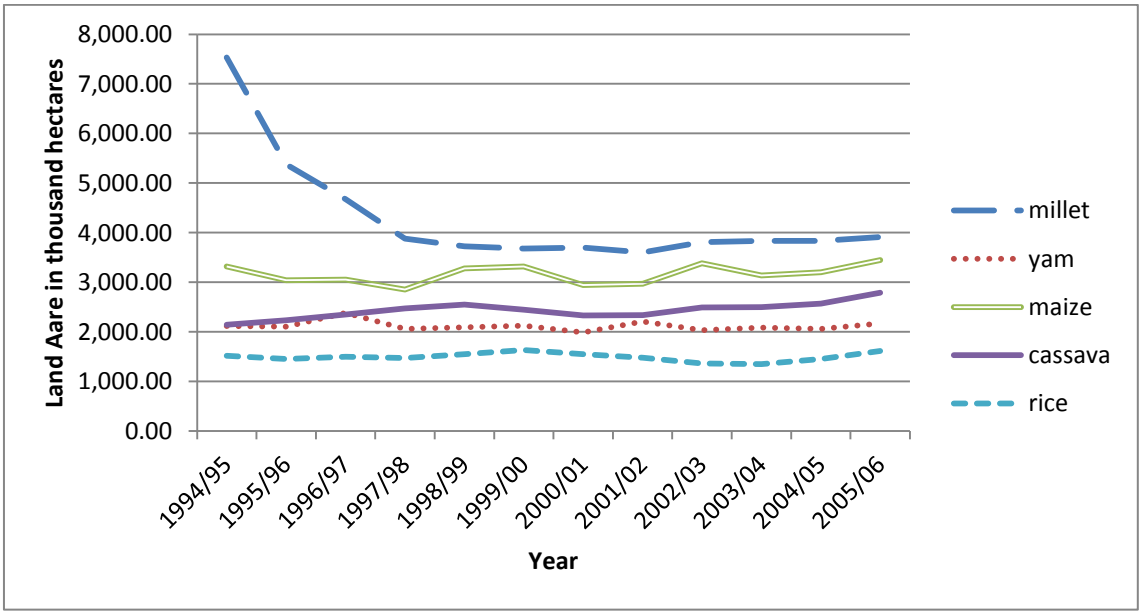
Source: NBS 2009a

Figure 2—Trends in outputs of selected crops, 1994/95 to 2005/06



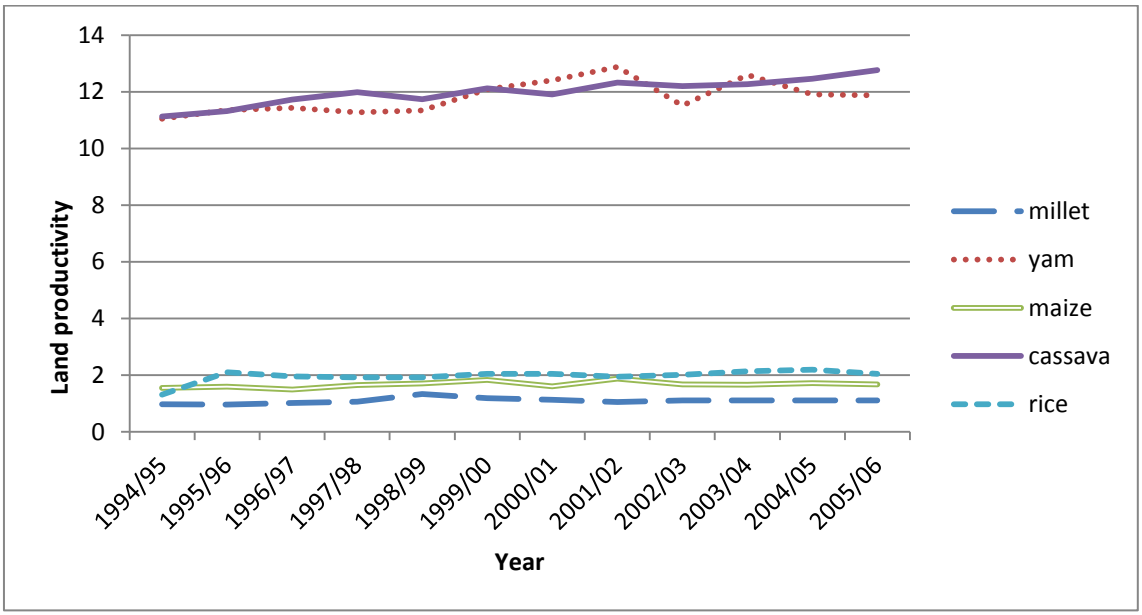
Source: NBS 2009a

Figure 3—Trends in land area planted - selected crops, 1994/95 to 2005/06



Source: NBS 2009a

Figure 4—Trends in land productivity for selected crops, 1994/95 to 2005/06



Source: Output and land area: NBS 2009a.
Land productivity (output per hectare): computed by authors.

Farm households and agricultural productivity

The issues that determine the levels of agricultural productivity attained by farm households in developing countries are multidimensional and complex. Following the categorizations devised by Hussain and Perera, (2004), the constraints and opportunities for agricultural productivity in Nigeria are identified below:

a) Land and water related factors: For many farmers in the South South region of the country, pollution due to petroleum exploration is a major issue that has important implications for the quality of land and water (Idumah 2006). Farmers in this region frequently have to increase their input use, particularly fertilizer, while having to settle for suboptimal output levels and lower revenues despite the higher input costs (Idumah 2006). Idumah's 2006 study of food crop farmers in two states of the South South revealed that soil degradation effects arising from the combined effects of oil pollution and other soil related issues like flooding accounted for about 21 percent of the difference in farm revenue between polluted and non-polluted farms. There are problems with soil quality in other regions of the country as well. Farmers in the Northern states of the country have to contend with the threat of desert encroachment (Akinyosoye 2000), while Southern soils are often low in nutrients arising from long exposure to sunshine and rain, leading to erosion problems (Akinyosoye 2000; Adejoh 2009).

b) Climatic factors: The implications of climate change for agriculture are also a major concern in Nigeria. Desert encroachment due to unpredictable and extreme weather associated with climate change reduces the production possibilities of rural farmers by drastically reducing the available cultivable land. Currently desert encroachment threatens about 35 percent of Nigeria's landmass (NISER 2010). Consequently, farmers in northern Nigeria are facing accelerated desertification due to limited rains and shrinking water sources. For instance, from a peak of 25,000km^2 in the 1960s, Lake Chad has shrunk to approximately 1,000km^2 today, due to drastically reduced precipitation and an increase in irrigation demands by surrounding farmers (Coe and Foley 2001). Similarly, farmers in southern Nigeria face several challenges. While some face the late onset of rains, early cessation of rain, shortened length of the rainy season, and reduced annual amount of rain (Adewuyi 2002), others experience increased flooding due to excessive precipitation (Egwuda 2001).

c) Agronomic factors: A large variety of studies in different regions of the country have identified the scarcity and high cost of inputs (labor, agrochemicals, and fertilizer) as major impediments to raising the productivity of smallholder farmers (Egwuda 2001; Ojo 2005; Adejoh 2009; Peke 2008). Other related problems include the difficulty in maintaining seed quality due to susceptibility to disease, perishability, and the low multiplication rate of seeds (Ojo, 2005; Adejoh 2009). In addition, low skilled and poorly educated family labor is the primary factor of production, often supplemented by hired labor where necessary (Ogunsanya 2009; Ekunwe, Orewa, and Emokaro 2008). Labor is also combined with mostly rudimentary tools such as hoes and cutlasses and ox-drawn ploughs in some parts of Northern Nigeria (Baiyegunhi 2003). Farming methods are also basic (Ogunsanya 2009; Ajani 2000; Akintayo 2011; Oladeebo 2006; Fasoranti 2006; Ajibolade 2005; Peke 2008; Fanegan 2010; Oviasogie 2005), as mechanization of farm processes is rare (Ogunsanya 2009; Adeyemo, Oke and Akinola 2010; Ajani 2000).

d) Farm management factors: In addition to crude farm implements, production technologies in Nigeria are often substandard and farming methods outdated. Also, common practices like bush burning tend to destroy soil and plant quality (Adewuyi 2002; Oseni 2001). Mixed cropping is commonly practiced in many regions of the country (Ajibolade 2005; Ajibefun 1998; Akintayo 2011; Adejoh 2009; Idumah 2006). Adewuyi's 2002 study of food crop farming in Kwara state revealed the dominance of sole cropping (68% of cultivated area) in the region covered by the study. Deriving optimal productivity from a crop often depends on the cropping pattern utilized. For instance, mixed cropping was more productive than sole cropping for maize farmers in Niger State where the Yam/maize mix yielded better returns than sole maize (Amos, Chikwendu, and Nmadu 2004). Similar results were found for yam farmers in Edo State (Oviasogie 2005).

e) Poor supporting infrastructure: These include inadequate storage and marketing facilities, inadequate extension services, poorly organized rural input, output and financial markets, and substandard rural infrastructure. Many farmers report limited contact with extension agents and consequently receive no information on improved production technologies and practices (Adejoh 2009). For instance Egwuda's 2001 study of Lowland rice production in Kogi State revealed the complete absence of extension services in the region. Other challenges include poor feeder roads and limited access to clean potable water, good health services, electricity, telephone and educational facilities. These factors raise transaction costs and with low and unstable agricultural output prices, reduce productivity incentives for farmers (Fasoranti 2006; Okafor 2004; Adewuyi and Okunmadewa 2001; Yusuf et al. 2009; Peke 2008; Adewuyi 2006; Adejoh 2009).

f) Socioeconomic factors: In Nigeria, small scale, resource poor farmers, the majority of whom are engaged in subsistence or near subsistence farming, produce the majority of aggregate agricultural output via rudimentary farming systems (Oviasogie 2005; Ajibolade 2005). Farm holdings across Nigeria are generally small with less than 5 hectares on average and are often inherited rather than purchased (Adeyemo, Oke and Akinola 2010; Akintayo 2011; Oladeebo 2006; Adewuyi 2002; Egwuda 2001; Ojo 2005; Ekunwe, Orewa, and Emokaro 2008; Adejoh 2009; Oviasogie 2005; Haruna et al. 2009; David et al. 2009; Yaro 1999). However, Baiyegunhi (2003) found that Sorghum farmers in Kaduna state resorted to buying or renting more land to augment their farm holdings. Fragmentation of farm holdings is also an issue, as farmers often have more than one location for their farms due to factors like variation in soil fertility and accessibility to land (Abubakar 2006; Adewuyi 2002; Okafor 2004; Akinyosoye 2000). While a study of small scale food crop farmers in the South South (Idumah 2006) also revealed small land holdings with an average of 1.56 hectares), most respondents farmed on communal land and leased land.

Incomes from farming are generally low. Consequently, many farmers engage in other occupations to supplement their incomes such as hunting, trading, crafts, and fishing (Adewuyi 2002; Ogunsanya 2009; Ajani 2000; Ojo 2005; Yaro 1999). Many farmers also face limited access to credit facilities due to high interest rates and lack of collateral and

often have to rely on personal funds or loans from friends and relatives to fund any farm expenses (Oladeebo 2006; Adewuyi 2002; Egwuda 2001; Adejoh 2009).

In terms of demographics, the average farm household head/farmer is middle aged, poorly educated (primary school or less), male, married, and has been farming for both subsistence and commercial purposes for ten years or more (Ogunsanya 2009; Ajani 2000; Akintayo 2011; Oladeebo 2006; Fasoranti 2006; Ajibolade 2005; Peke 2008; Fanegan 2010; Adeyemo, Oke and Akinola 2010; Oluwatayo, Sekumade and Adesoji, 2008; Adewuyi 2002; Olawepo 2010; Egwuda 2001; Ojo ,2005; Ekunwe, Orewa, Emokaro 2008); Adejoh 2009; Oviasogie 2005; David et al. 2009; Abubakar 2006; Abubakar 2010). However, many farmers in the northern part of the country acquire Islamic/Quranic education in lieu of western education (Baiyegunhi 2003; Haruna et al. 2009; Yaro 1999; Abubakar 2006). There are some exceptions. For instance, Idumah's 2006 study of food crop farmers in the South South revealed that over half of the sample acquired post primary education. Average household sizes are large (7–12 persons on average) as households are the primary sources of farm labor (Ogunsanya 2009; Ajani 2000; Akintayo 2011; Olawepo 2010; Egwuda 2001; Ekunwe, Orewa, Emokaro 2008; Adejoh 2009; Oviasogie 2005; Baiyegunhi 2003; David et al. 2009; Idumah 2006).

The previously mentioned factors combine to create a situation of low agricultural productivity. They create a production structure dominated by barely literate subsistence and semi-subsistence smallholders who cultivate no more than 5 hectares, with poor access and limited ability and willingness to adopt production-enhancing inputs such as improved seeds, fertilizer and irrigation. Farmers are dependent on labor-intensive, low input-output technologies and often face high levels of post-harvest losses due to poor handling, inadequate development of agro-processing, as well as poor rural infrastructure, particularly rural roads and storage facilities, and limited access to marketing opportunities (Fasoranti 2006; Okafor 2004; Ekunwe, Orewa and Emokaro 2008; Adejoh 2009).

g) Policy related factors: There have been several attempts by the federal government to create programs to improve agricultural productivity in Nigeria; many of which are developed with the aid and inputs of international organizations. Agriculture specific programs that have been implemented include Agricultural and Coop Bank (1973); National Accelerated Food Production Program (1973); Agricultural Development Projects (1975); River Basin and Rural Development Authorities (1976); Operation Feed the Nation (OFN) (1976); Agricultural Credit and Guarantee Scheme (1977); Land Use Decree (1978); The Green Revolution Program (GRP), (1979/1980); and the Cassava Multiplication Program (1985–1999). Several institutions were also set up in order to facilitate these programs including the Agricultural Credit Guarantee Scheme (ACGS); Rural Banking Scheme (RBS); Nigeria Agricultural Insurance Company (1984); Directorate for Food, Roads and Rural Infrastructure (DFRRI) (1986); Nigerian Agricultural Development Bank (NADB); and the National Agricultural Land Development Authority (NALDA) (1991) (Adewuyi 2002; Okafor 2004).

Many of these initiatives were not successful because they were ad hoc programs that lacked focus. They were poorly conceived and implemented and were duplicates of already existing programs and organizations (Fasoranti 2006). In addition, government policy was inconsistent and projects were improperly monitored and implemented (Okafor 2004; Adewuyi 2002). Also in existence was an unfriendly macroeconomic policy environment characterized by an overvalued exchange rate, a mismanaged subsidy regime and bad export crop pricing schedules (Adewuyi and Okunmadewa 2001). This environment encouraged imports at the expense of local crops, which led to crowding out of local production (Yusuf et al. 2009; Adewuyi 2002; Zakari 1997, Muhammad-Lawal and Atte 2006). Several food crops (particularly tubers) were also neglected in favor of cash crops, while government invested very little funding in support of agricultural related research.

More recent programs created to improve agricultural productivity include several presidential initiatives on selected crops (rice, cassava, vegetable oil); Root and Tuber Expansion Program (RTEP); the National Special Program on food security (NSPFS);

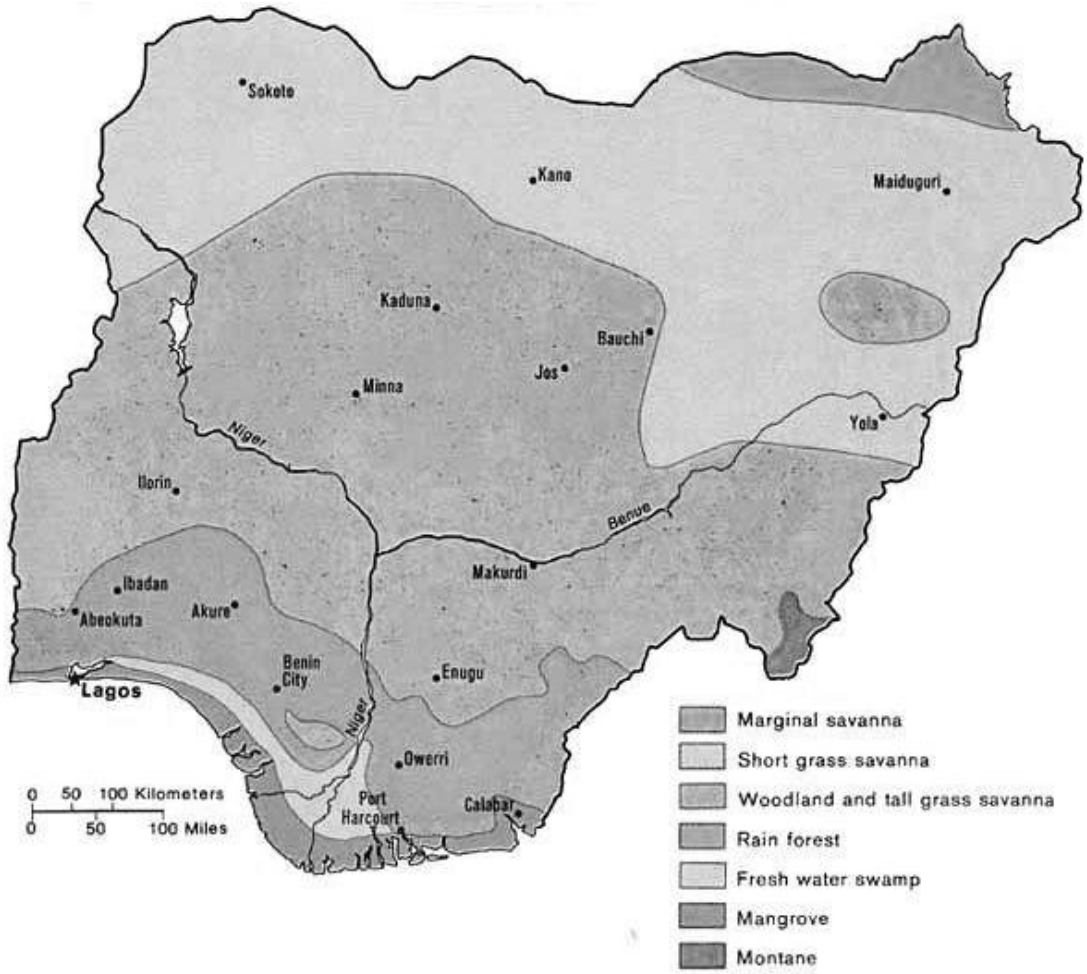
Community Based Agriculture and Rural Development Project (CBARDP); various phases of the National Fadama Development program (NFDP), amongst several other efforts. There is preliminary evidence that some of these programs are improving productivity of farmers by encouraging technology adoption and expanding farmer access to inputs, credit, and extension services (Olawepo 2010; Abubakar 2010). Assessment of the impact of these programs is ongoing (Oruonye 2011; IFAD 2009).

Agricultural productivity in Nigeria

Nigeria is comprised of 36 states and the federal capital territory (Abuja), which are further categorized into six geopolitical regions namely the South West, South East, South South, North Central, North West, and North East regions (table 2). The North West region, with a population of 36 million, contains the highest proportion of Nigerians with 25 percent, while the South East is the least populated with 9.7 percent. The country also has a very diverse agroecology characterized by numerous farming systems including Pastoral, Agro-Pastoral (millet/sorghum), Irrigated, Cereal-Root Crop Mix, Highland Temperate Mix, Root Crop, Tree Crop, and Coastal Artesian Fishing (FAO 2001). In addition, as many as seven major agroecological zones (figure 5) exist within Nigeria's geographical confines. These zones cut across the six geopolitical regions (as revealed in table 1) and include:

1. The mangrove swamp, which characterizes the coastal areas of the delta region, and is not widely cultivated except for swamp rice and fish.
2. The tropical rain forest made up of the eastern, central, and western rain forest in the states of Ogun, Ondo, Oyo, Edo, Ekiti, Imo, Anambra, and Cross Rivers. Common crops in this zone include cocoa, kolanuts, palm produce, and timber. Root crops such as cassava, yams, and potatoes are also extensively cultivated.
3. The Savannah zone comprising the middle belt region including Kwara, Benue, Niger, Adamawa, and Taraba States. Main crops are cereals, roots, tubers, cotton and groundnuts.
4. The guinea savannah zone comprising the Southern parts of Sokoto, Kaduna, Katsina, Bauchi, and Borno states. Main crops are groundnuts, cotton, sorghum, millet, and rice.
5. The dry savannah which covers the northern parts of Kano, Bauchi and Borno States with the most common crops being groundnuts, sorghum, millet, cowpeas and livestock (Fasoranti 2006; Sowunmi and Akintola 2009).

Figure 5—Nigerian agro-ecological zones



Source: University of Texas

Table 1—Nigerian agroecological zones by region

Region	States	Population (millions)	Agroecological zones	Major crops
North Central	Benue, FCT, Kogi, Kwara, Nasarawa, Niger, Plateau	20.4	Derived savannah, Southern Guinea savannah, woodland and tall grass savannah.	Maize, Rice, Groundnut, Yam, Soya beans, etc.
North East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe	19.0	Northern Guinea savannah, Southern Guinea savannah, Sudan savannah, Sahel savannah, marginal savannah, short grass savannah and montane.	Cowpea, Sorghum, Millet, Groundnut, etc.
North West	Kaduna, Katsina, Kano, Kebbi, Sokoto, Jigawa, Zamfara	35.9	Southern Guinea savannah, Sudan savannah, Sahel savannah and short grass savannah.	Cotton, Sorghum, Millet, Soya beans, Cowpea, etc.
South East	Abia, Anambra, Ebonyi, Enugu, Imo	13.5	High forest, Derived savannah, woodland and tall grass savannah and rainforest.	Cassava, Oil palm, Cocoyam, Melon, Rice, etc.

Region	States	Population (millions)	Agroecological zones	Major crops
South South	Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo, Rivers	21.0	High forest, Derived savannah, Mangrove and fresh water swamp.	Yam, Maize, Cassava, Melon, etc.
South West	Ekiti, Lagos, Osun, Ondo, Ogun, and Oyo	27.7	Derived savannah, Rainforest and Mangrove.	Maize, yam, Cassava, Cocoyam, Melon, etc.
Nigeria	36 states + FCT	140.4		

Sources: NBS 2009b, Onyeka 2004.

Performance indicators on the Nigerian farming sector

Efficiency

Levels of efficiency including Technical Efficiency (TE), Allocative Efficiency (AE) and Economic Efficiency (EE) and productivity differ by crop, location, and cropping system. Table 2 provides available estimates of different measures of efficiency for all six socio-political regions. While there are exceptions, Nigerian farmers across all regions are below their production frontiers and consequently the opportunity exists to increase their productivity above existing levels, even given their current levels of inputs.

South West

Some studies report very high levels of efficiency given the available technology and input quality. For instance, Fasoranti's 2006 TE study of cassava farms in Ondo State revealed mean TE values ranging from 0.85 to 0.98, with the figures implying the superiority of mixed cropping in cassava production. AE values were similarly high, ranging from 0.82 (cassava sole cropping), to 0.93 (cassava plus maize). Oladeebo (2006) also estimated similarly impressive levels of efficiency in the production of rain-fed upland rice in Osun and Oyo states with mean TE and AE estimates of over 0.90 and mean EE levels of over 0.80 in both states. Levels of efficiency of these rice farmers were comparable to those derived in other settings for upland rice production (Oladeebo 2006). Adeyemo, Oke, and Akinola (2010) also reported high levels of technical efficiency by small scale cassava farmers in one local government in Ogun State. TE levels ranged from 0.86 to 1, with a mean of 0.89.

However, there are other crops and settings for which efficiency could be greatly improved. Ajibefun (1998) provided efficiency estimates for small scale food crop farmers in Ondo State for four different agricultural zones in Ondo State. Mean TE in Akure zone was 0.66, mean TE in Ondo zone was 0.56, mean TE in Akoko was 0.57, while mean TE in Owo zone was 0.61. He also provided values for the mean levels of AE, which were 0.71 (Akure zone), 0.60 (Ondo), while Akoko and Owo had 0.66 respectively. Mean values of economic efficiency were Akure (0.5), Ondo (0.35), Akoko (0.44), and Owo (0.42).

The authors also computed values of the different efficiency components using non-parametric methods, specifically data envelope analysis, for comparison and derived similar results. Mean TE in Akure was (0.6), Ondo (0.53), Akoko (0.58), and Owo (0.59). Mean AE was Akure (0.66), Ondo (0.56), Akoko (0.61), and Owo (0.60). Combining the two measures to compute EE, mean EE ranged from 0.33 in Ondo to 0.44 in Akure.

In Ekiti, Oluwatayo, Sekumade, and Adesoji (2008)'s study of maize farmers revealed a mean TE of 0.68. Oluwatosin (2011)'s study of yam farmers in Osun state reported TEs ranging from 0.343–0.962 with mean 0.698, while Ogunniyi (2011)'s study of leafy vegetable farmers in Oyo State produced a mean EE score of only 0.42.

North Central

Available studies in this region also reveal differences in estimated levels of efficiency by crop, cropping system, and location. Amos, Chikwendu, and Nmadu (2004) studied small scale food farmers in Niger State and revealed that the TE of sole maize cropping was 0.53 while the TE for yam/maize cropping was 0.72. Overall TE for all crops was 0.62. Mixed cropping was evidently superior to sole cropping, as over 50% of mixed crop farmers had TE values exceeding 0.70, compared to 100% of sole farmers who had TEs less than 0.60. Adejoh (2009) studied yam farmers in Kogi State and reported a TE of 0.73, while Ekunwe, Orewa and Emokaro (2008) reported a lower TE of 0.65 among yam farmers in Kogi. In this study, TE values ranged from 0.2 to 0.95 and only 23 percent of farmers had TE greater than 0.8. Ojo et al. (2009) also studied yam farmers, this time in Niger state, and reported a TE ranging from 0.3 to 0.95 with a mean of 0.75. According to Shehu et al. (2010), the most technically efficient yam farmers in the North Central region are in Benue State, as estimated TE values ranged from 0.67 to 0.99 with average TE levels of 0.95. Finally, Otitoju and Arene's 2010 study of soybean farmers in Benue State revealed a mean TE of 0.73.

South South

Ebong, Ukoro, and Effiong (2009) in their study of food crop farmers in Akwa Ibom revealed TE values that ranged between 0.1 and 0.95 with mean of 0.81. Ekunwe, Orewa and Emokaro (2008) reported high average levels of TE for yam farmers in Delta State with a mean TE of 0.85 and about 80 percent of farmers with TE exceeding 0.8. Idiong, et al. (2009) also reported high mean levels of TE for rice farmers in Cross River. Mean TE was 0.7 for swamp rice and 0.87 for upland rice. Economic efficiency was, however, much lower, having values of 0.17 (swamp rice) and 0.22 (upland rice). Oviasogie (2005) examined the mean TE for four different cropping patterns of yam in Edo State. Mean TE for sole yam was 0.84, yam/maize mixture was 0.59, yam/groundnut mixture was 0.39, while mean TE for yam/maize/melon/cassava mixture was 0.24. TE reduced with the increase in the number of crops due largely to interaction effects for nutrients, water, and light among competing crops in the yam based cropping pattern. Idumah (2006) examined the impacts of pollution on efficiency of small food crop farmers in two states of the South South and found that pollution reduced TE and overall efficiency. TE with pollution was 0.78 compared to 0.88 in the absence of pollution, while EE with pollution was 0.68 compared to 0.72 for farmers who did not have polluted farmlands.

South East

Raphael's 2008 study of cassava farmers in the two South East states of Abia and Imo revealed a mean TE score of 0.77. A similar study of eggplant farmers in Abia state showed that mean TE was 0.78, while Onyenweaku and Ohajianya's 2009 study of rice farmers in Ebonyi State revealed a mean TE of 0.65.

North East

Available studies in this region reported very high levels of TE for cereals. For instance, Sheu and Msheila's 2007 study of rice farmers in Adamawa state revealed a TE of 0.96. Other studies of rice farmers in the same state revealed TEs of 0.96 (Sheu et al. 2007), and 0.89 (Amaza and Maurice 2005). In addition, Taru et al. (2011) reported a mean TE of 0.95 for cowpea farmers also in Adamawa State. The lowest TE from available studies in the region was for food crops in Borno State, with Amaza and Maurice (2005) reporting a mean TE of 0.68.

North West

Fewer efficiency studies were available for this region. Ojo et al's 2009 study of onion farmers in Sokoto revealed a TE of 0.95, while Usman et al.'s 2010 study of sesame farmers reported a much lower mean TE of 0.57. Finally, Tanko and Jirgi's 2008 study of arable crop farmers in Kebbi State revealed an overall AE of 0.59.

Table 2—Estimates of different measures of efficiency using the stochastic frontier model in regions for which studies are available

Study	Location	Cropping system	Crop	Measure of efficiency (mean)		
				TE	AE	EE
SOUTH WEST						
Fasoranti (2006)	Ondo	Sole	Cassava	0.85	0.82	
	Ondo	Mixed	Cassava, plus maize	0.89	0.93	
	Ondo	Mixed	Cassava and other crops	0.98	0.92	
Oladeebo (2006)	Osun	Sole	Rainfed upland rice	0.90	0.92	0.83
	Oyo	Sole	Rainfed upland rice	0.94	0.90	0.84
Adeyemo, Oke & Akinola (2010)	Ogun		Cassava	0.89		
Ajibefun (1998)			Small scale food crop	0.60	0.66	0.43
Oluwatayo, Sekumade, & Adesoji (2008)	Ekiti		Maize	0.68		
Oluwatosin (2011)	Osun		Yam	0.70		
Ogunniyi (2011)	Oyo		Leafy vegetable			0.42
NORTH CENTRAL						
Amos, Chikwendu, & Nmadu, (2004)	Niger	Sole	Maize	0.53		
		Mixed	Yam, maize	0.72		
Adejoh (2009)	Kogi		Yam	0.73		
Ojo et al. (2009)	Niger		Yam	0.75		
Shehu et al. (2010)	Benue		Yam	0.95		
Otitoju & Arene (2010)	Benue		Soybean	0.73		
SOUTH SOUTH						
Ebong, Ukoro, & Effiong (2009)	Akwa Ibom		Food crop	0.81		
Ekunwe, Orewa, & Emokaro (2008)	Delta		Yam	0.85		
Idiong, et al. (2009)	Cross River	Sole	Swamp rice	0.77		0.17
			Upland rice	0.87		0.22
Oviasogie (2005)	Edo	Sole	Yam	0.84		
		Mixed	Yam, maize	0.59		
			Yam, groundnut	0.39		
			Yam, maize, melon, cassava	0.24		
Idumah (2006)	Delta and Rivers		Food crops (polluted)	0.78	0.88	0.68
			Food crops (unpolluted)	0.88	0.84	0.72

Study	Location	Cropping system	Crop	Measure of efficiency (mean)		
				TE	AE	EE
SOUTH EAST						
Raphael (2008)	Abia, Imo		Cassava	0.77		
Okezie & Okoye (2006)	Abia		Eggplant	0.78		
Onyenweaku & Ohajianya (2009)	Ebonyi		Rice	0.65		
NORTH EAST						
Sheu & Msheila (2007)	Adamawa		Rice	0.96		
Sheu et al. (2007)	Adamawa		Rice	0.93		
Amaza et al. (2005)	Borno		Food crops	0.68		
Amaza & Maurice (2005)	Adamawa		Rice	0.89		
Taru et al. (2011)	Adamawa	Sole	Cowpea	0.95		
NORTH WEST						
Ojo et al. (2009)	Sokoto	Irrigated	Onion	0.95		
Usman et al. (2010)	Jigawa		Sesame	0.57		
Tanko & Jirgi (2008)	Kebbi		Arable crop			0.59

Source: Compiled by authors
Note: EE is defined as the capacity of a farm to produce a predetermined quantity of output at minimum cost for a given level of technology. The higher the value, the closer the farm is to their production frontier, and the less likely it is to increase output without increasing inputs.

In summary, while the studies that have been highlighted do not by any means exhaust the universe of efficiency studies in Nigerian agriculture, they do provide some idea of the crops in which farmers are most efficient. There is no discernible pattern by region, but from these studies, Nigerian farmers are most efficient in the production of tubers (cassava and yam) and rice. This finding was consistent in most regions in which these crops were produced. The only exception from these studies is in the South East where farmers were not as efficient in the production of tubers (cassava) and rice as farmers in other regions.

Factors that affect efficiency

There is a large literature on the factors that affect the levels of efficiency of Nigerian farmers. Variables that have an unambiguous positive impact on efficiency include having a male household head (Otitoju and Arene 2010), educational attainment of farmers (Fasorant 2006; Oladeebo 2006), land ownership and farming systems (Fasoranti 2006), contact with extension agents (Ojo et al. 2009; Ebong, Ukoro, and Effiong 2009), membership of cooperative societies (Shehu et al. 2010; Idiong et al. 2009), and access to credit (Ogundari 2006; Oluwatosin 2011).

Nigerian agriculture is still male dominated, implying that men have more access to the resources and information required to produce crops more efficiently than their female counterparts (Fasoranti, 2006; Otitoju and Arene 2010). More educated farmers are more likely to adopt progressive farming practices and new technologies and thus increase their overall efficiency (Fasorant 2006; Oladeebo 2006; Oluwatosin 2011; Adeyemo, Oke, and Akinola 2010, Adejoh 2009; Shehu et al. 2010; Amos, Chikwendu, and Nmadu 2004). Also, landowners are more efficient than renters because they are more invested in their landholdings (Fasoranti 2006), and farmers who practice mixed cropping often have more profitable and efficient farms. This was found for a wide variety of crops including cassava in Ondo State (Fasoranti 2006) and maize (mixed with yam) (Amos, Chikwendu, and Nmadu

2004). Mixed cropping has the advantage over sole cropping as crop diversification guards against crop failure, leading to higher yield stability and reduced risk (Fasoranti 2006).

However, having more than an optimal number of crops in a mixed cropping system reduces the efficiency of production (Ebong, Okoro, and Effiong 2009).

Contact with extension agents exposes farmers to new technologies and improved varieties of inputs (particularly seed) (Oladeebo 2006; Adejoh 2009; Ojo et al. 2009; Ebong, Ukoro and Effiong 2009), while membership of farmer's association/ cooperative societies creates an avenue for farmers to pool their risks, in addition to providing access to resources and information that will improve their production practices, highlighting the importance of some social capital in improving productivity (Shehu et al. 2010; Idiong et al. 2009; Idumah 2006). Finally, access to credit reduces inefficiency as it enables farmers to adopt high yielding varieties and makes it possible for farmers to access information useful for increasing productivity and efficiency (Ogundari 2006; Oluwatosin 2011). Oftentimes, cooperatives and farmer associations exist to fill the market failure caused by the absence of decent credit markets.

There are other factors that have a more ambiguous impact on efficiency. While some studies find that age and years of farming experience improve efficiency as a result of "practice makes perfect" (Otitoju and Arene 2010; Adeyemo, Oke, and Akinola 2010; Ebong, Okoro, and Effiong 2009; Ekunwe, Orewa, and Emokaro 2008; Idiong et al. 2009), many other studies find that both factors have negative impacts on efficiency as older farmers are less likely to adopt new technologies. Consequently, the aging of the farming population is a source of concern (Ajibefun 1998; Ogundari 2006; Oladeebo 2006; Ogunniyi 2011; Amos, Chikwendu, and Nmadu 2004; Ojo et al. 2009; Ebong, Okoro, and Effiong 2009; Idiong et al. 2009; Oviasogie 2005; Ekunwe, Orewa, and Emokaro 2008).

Finally, high cost of inputs including fertilizers and herbicides negatively affects the efficiency levels of smallholder farmers (Adeyemo, Oke, and Akinola 2010,), as does the pollution of landholdings in the South South (Idumah 2006).

Another important factor is farm size. The inverse relationship between farm size and efficiency is well documented and could be attributed to the higher labor intensities on small farms due to lack of off-farm employment opportunities (Masterson 2007). Labor is the most important factor of production in smallholder Nigerian agriculture (Adewuyi 2002) as it is usually dominated by family labor (Ojo 2005). Labor often accounts for more than half of the costs of production (Oladejo 2005; Oviasogie 2005). There is evidence that farmers are allocatively inefficient in the use of labor, over-utilizing this factor in the production process (Ojo 2005). Household size is an important predictor of efficiency for similar reasons, as it is the source of the most important factor of production on smallholder farms, namely family labor. Some studies find that household size has a negative impact on efficiency, implying that individuals in these households act as a drain on household resources instead of a source of labor supply (Ebong, Ukoro, and Effiong 2009; Idiong et al. 2009).

Productivity

Measuring productivity

Most productivity related studies in Nigeria utilize partial productivity measures, specifically land productivity measured as yield per hectare (Amos, Chikwendu, and Nmadu 2004; Baiyegunhi 2003; Idiong et al. 2009). Many of these studies find that land productivity is below optimal levels. Baiyegunhi's 2003 study of sole sorghum farmers in Kaduna indicated that the land productivity of 750kg and 1400kg on small and large-scale firms respectively was significantly lower than the estimated optimum of 7000–9000kg per hectare. Similarly Idiong et al.'s 2009 study of rice farmers in Cross River estimated the average yield per hectare of lowland rice at 2.65 tons and upland rice at 1.54 tons and both estimates were below national means of 2.75 and 1.70 tons respectively. Much fewer studies of labor productivity exist and they mainly focus on the determinants of labor productivity rather than

analyzing any trends in the measure (Anyaegbunam et al. 2010; Okoye et al. 2008). Existing studies estimate labor productivity as the ratio of total output to labor input (man days).

Fewer studies utilize total factor productivity (TFP) in any analysis of productivity in Nigeria and those that do mostly estimate TFP as the ratio of output to total variable cost or the inverse of average variable cost following Key and McBride (2003). As with labor productivity, most studies on TFP are primarily targeted towards identifying the determinants of TFP in Nigeria (Ukoha et al. 2010; Akintayo 2011; Mbam and Edeh 2011; Fakayode et al. 2008).

Factors that affect productivity

Most of the factors earlier identified as determining the level of efficiency of farmers are also identified in the literature as important predictors of productivity, regardless of the measure of productivity in use. Consequently, as with efficiency, productivity is increased by the gender of the farmer (male), educational attainment, contact with extension agents, membership of cooperative societies and access to credit (measures of social capital), all for similar reasons (Ukoha et al. 2010; Fakayode et al. 2008, Akintayo 2011; Adewuyi 2002; Egwuda 2001, Shehu et al. 2010; Otitoju and Arene 2010; Ohajianya, Oguoman, and Onyaegocha 2006).

There is also a very strong emphasis in the literature on the quantity and quality of inputs. The amount of land available (Yaro 1999; Abubakar 2006) planting materials, particularly high quality seeds (Peke 1996; Akintayo 2011; Adewuyi 2002; Egwuda 2001; Shehu et al. 2010), and labor (both family and hired) (Oviasogie 2005; Idumah 2006; Oladeebo 2006; Akintayo 2011; Adewuyi 2002; Egwuda 2001; Shehu et al. ,2010; Otitoju and Arene,2010). The quantity of and the amount spent on fertilizer (Oladeebo 2006; Akintayo 2011), the quantity of and the amount spent on agrochemicals like pesticides and herbicides (Oluwatayo, Sekumade, and Adesoji 2008; Adewuyi 2002; David et al. 2009; Abubakar 2006), and mechanization (the use of a tractor) (Oluwatayo, Sekumade, and Adesoji 2008), are all important predictors of productivity. However, suboptimal utilization of any of these inputs has a negative effect on productivity (Peke 2008; Otitoju and Arene 2010). For instance, in Kaduna, sole sorghum farmers who used agrochemicals reported much better yields than those who did not (Baiyegunhi 2003).

Availability of good quality affordable inputs is clearly a major constraint for smallholder Nigerian farmers (Fasoranti 2006; David et al. 2009; Idiong et al. 2009; Abubakar 2006). Labor is the most easily available input, so farmers tend to overuse it (Ojo 2005,), while fertilizers and agrochemicals, seeds, and high tech implements are often underused because of high costs (Akintayo 2011; Oladeebo 2006). For instance, Akintayo (2011) found that farmers in Niger and Ekiti planted rice below the recommend average quantities of (50–65kg), instead planting 52kg (upland) and 31 kg (lowland), while rice farmers in Cross Rivers applied little or no fertilizer (Idiong et al. 2009). While sorghum farmers in Kaduna underutilized chemical fertilizers because of cost and availability constraints, they supplemented with organic fertilizer from animal sources (Baiyegunhi 2003).

Profitability

Despite the numerous constraints faced by farmers in the production process like the small size of farm holdings and the use of rudimentary inputs, studies of farming establishments across the country show that farming is generally a profitable enterprise for small scale farmers. Profitability measures the ability of farmers to cover their costs and is an important concept, because it provides incentives for entry into and longevity in the farming business. While many studies of Nigerian farms across the country report profitability, profit margins are often very small.

In general, Nigerian farmers can be described as rational profit maximizers who respond to price instruments (Ajani 2000). In the Southwest, several crop production enterprises were found to yield positive returns and they include food crop production in Ekiti State (Peke

2008), rainfed upland rice production in Oyo and Osun states (Oladeebo 2006), as well as cassava production in Ogun (Adeyemo, Oke, and Akinola 2010), Osun (Fanegan 2010) and Ondo (Fasoranti 2006) states, respectively. Several studies from the North Central region also revealed profitable farm enterprises. Egwuda's 2001 study of lowland rice producers in Kogi State revealed a profit of 37 kobo for every one naira invested on average for the 120 farmers surveyed. Yam production in Kogi State was also found to be a profitable venture (Adejoh 2009; Ekunwe and Orewa 2007). Adejoh (2009) reported a profit of 53 kobo for every one naira invested in yam production in the state. Yam farming was also profitable in the South South as Oviasogie (2005) found yam based cropping systems to be profitable in Edo State particularly for farmers who practiced mixed cropping.

Studies of profitability in the North East of Nigeria revealed relatively high profit margins. For instance, Haruna et al.'s 2009 study of cowpea farmers in Gombe state revealed a net return of 2.10 naira for every naira invested. Similarly a study of Fadama food crop farmers in Bauchi revealed a return on naira invested of 3.14 naira (David et al. 2009). Farms in the northwest have been found to be similarly profitable as a number of studies reveal some profitable crops in this region including cowpea and maize in Katsina State (Zakari 1997), cowpea in Kebbi State (Abubakar 2006), and groundnuts in Kano State, with farmers making a profit of 0.47 naira for every naira invested (Yaro 1999). Zakari's 1997 study in Katsina revealed a return of 72k per naira spent for maize, and 38k per naira spent for cowpea. For cowpea production in Kebbi, the three-crop mixture (cowpea/ pearl millet/sorghum) was the most profitable cropping pattern.

In this section, core concepts related to agricultural productivity were defined and related trends analyzed. Agricultural productivity has slowed dramatically since the advent of the oil boom and the Nigerian farming sector can no longer meet the country's food needs. This is due to the fact that Nigerian farming is dominated by barely literate subsistence and semi-subsistence smallholders with poor access and limited ability and willingness to adopt production-enhancing inputs. While there were exceptions, a regional analysis of the efficiency of farmers revealed that most farmers were producing significantly below their production frontiers. In addition, studies of productivity (mostly land productivity) revealed less than optimal levels of production. Finally, many farming enterprises were found to be profitable, even though profit margins were generally low.

III. Food Security

While it is difficult to properly conceptualize the nature of food security in Nigeria, a wide variety of measures have been utilized in an attempt to begin to quantify its scope. In this section, trends in the evolution of definitions of food security are explained, while the state of food security in the country is assessed based on the four broad categories food security measures, namely food availability, food access, stability of access, as well as food utilization.

Food security is a multidimensional concept that has evolved over time and space. Concern about food security originated in the mid-1970s due to the international food problems that emerged as part of a larger global economic crisis. The initial food security focus was macroeconomic in nature and was mainly concerned with assuring the availability and price stability of foodstuffs at the international and national levels. Consequently, food security was traditionally measured through aggregate food supplies, food availability, accessibility, and adequacy (Busch and Lacy 1984; FAO 2003a; FAO 2003b). In addition to economic factors, the preponderance of drought and famine in some developing regions of the world led to further rethinking and refinement of the concept. Amartya Sen (1981), in a seminal publication, helped redefine the food security discussion in the development literature. His contribution extended the concept beyond mere availability of food in the macro sense to considerations of the constraints on individual access to food (Webb et al. 2006).

Definitions of food security have evolved over time. At the 1974 world food summit, food security was defined as, “availability at all times of adequate world food supplies of basic foodstuff to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” (UN 1975). By 2001, the definition of food security evolved to, “a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO 2002). This definition implies that food insecurity reflects uncertain access to enough and appropriate foods (Barrett 2002). However, irrespective of how food security is defined, it is generally agreed that four distinct variables are central to the attainment of food security—namely food availability, access, utilization, and stability of access.

Food availability: Food security research before Sen (1981) focused on food availability in a macro sense. The goal was to ensure that sufficient quantities of appropriate kinds of food were available from domestic sources, imports, or donor sources (FAO 2003b; Webb et al. 2006). The focus of both domestic and international policy was on removing constraints to food availability by concentrating on agricultural policy, trade policy, marketing and transportation systems, the role of natural disasters, and the price effects of economic policies. Eventually, the realization grew that availability was necessary, but not sufficient to promote food security. The concept of food security was expanded to include access.

Food access: The debate on food security shifted from macro supply issues to focus on the ability of households to obtain food in the market place or from other sources (Webb et al. 2006). Having access to food includes having physical access to a place where food is available and economic access, as well as a socially legitimate claim to food (Staatz, Boughton, and Donovan, forthcoming). It is important to note that in many developing countries, the availability and access dimensions of food security are strongly linked. While availability reflects the supply side of food security, access reflects effective demand. The two concepts are linked by food prices (Staatz, Boughton, and Donovan, forthcoming).

Food utilization/consumption: This third aspect of food security speaks to the proper usage of food and includes processing, storage, consumption, and digestion. How the food is prepared (which affects nutritional value) and the health of the individuals consuming the food (which affects the ability to absorb and use nutrients) affects food security (Staatz, Boughton, and Donovan, forthcoming). Providing nutrition education and family management skills is thus another aspect of the process of ensuring food security.

Stability of access: The fourth aspect of food security addresses the stability of household access to nutritious food. Fear of instability in access to nutritious foods in itself can have significant effect on the production and consumption decisions of households which eventually directly affect the food security experience and outcomes (nutritional and health) and is thus an important consideration.

Measures of food security

It is generally accepted that addressing issues of food security in Africa (and the world at large) necessitates a proper identification of the food insecure, the reasons for their insecurity, and the monitoring of changes in food security over time with explanations for the changes. In many developing countries, particularly in Sub-Saharan Africa, food security is commonly measured through consumption and anthropometric measures. Food insecurity is also often used interchangeably with similar concepts such as poverty, malnutrition, and hunger, which can be seen as extreme forms of food insecurity (Coates et al. 2006). However, many of the food security categorizations based on these concepts do not sufficiently capture the multidimensionality of the concept.

Methods for assessing whether families in developing countries are meeting their food needs have evolved over time, but measuring food security has always been difficult due to a lack of sufficient nationally representative data collected at the household or individual level (Smith et al. 2006). As a result, a variety of methods have been utilized to assess food

security including measures based on national food supplies (Naiken 2003) and anthropometric methods (Marcoux 2002; Madise et al. 1999). More recently, attempts have been made to develop measures for developing countries patterned after procedures utilized in the United States (Wunderlich and Norwood 2006; Nord et al. 2002; Melgar-Quinonez et al. 2008). Another method often used to measure food insecurity in the developing world is the coping strategies index. Coping strategies can be defined as a response to adverse events or shocks (Devereux 2001). These activities range in intensity from activities like food rationing or drawing down savings, to more permanent strategies like the sale of assets.

As mentioned above, there is no unified concept of food security in Sub-Saharan Africa and Nigeria, more specifically. Some studies focus on limited access to food measured by income and/or poverty, while others focus on availability of food measured by caloric intake. Some others focus more on the outcome of food insecurity such as low weights and extreme hunger, while some care about dietary diversity, coping mechanisms or strategies with a few more recent studies also considering household perception about their food security (Coates et al. 2006; Meade, Rosen, and Shapouri 2007; Barrett 2002). Thus, as one would expect, this diverse concept of food security is accompanied by similarly diverse food security measures, which do not satisfactorily capture the multiple dimensions of food security.

The US has a widely tested and accepted module for gathering information and measuring and monitoring food security in the nation. While limited, some interesting work has been done on developing food security scale exists across the developing world. Nord et al. (2002) explored the internal validity of certain food security measures in Bangladesh, India, and Uganda. Their results imply that the US modules appropriately contextualized for different African countries could provide a good basis for building an appropriate food security module. Following this work, the USAID, Food and Nutrition technical assistance (FANTA) has developed the Household Food Insecurity Access Scale (HFIAS), which is an adaptation of the approach used to estimate the prevalence of food insecurity in the United States annually. The method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale (Coates et al. 2007).

The major areas explored to capture the experience of food security in the HFIAS are:

1) feelings of uncertainty or anxiety over food (situation, resources, or supply);
2) perceptions that food is of insufficient quantity for adults and children;
3) perceptions that food is of insufficient quality (includes aspects of dietary diversity, nutritional adequacy, and preference);
4) reported reductions of food intake for adults and children;
5) reported consequences of reduced food intake for adults and children; and
6) feelings of shame for resorting to socially unacceptable means to obtain food resources

Food security in Nigeria

The acknowledgement of the importance of food security as a concept has led to the development of a growing robust literature devoted to the topic. Most of the available studies are not nationally representative, but are instead regional in nature. However, they provide an excellent overview of the causes, incidence, and methods of measuring food insecurity in different regions in Nigeria in the recent past.

Determinants of food security

Food security and agricultural productivity are closely related in a country like Nigeria with a very large rural and agrarian population. Therefore, factors that affect the agricultural industry also have direct impacts on food security. In Nigeria, the following factors were identified as inhibiting food security, in seven different categories and include:

1) land and water related factors such as pollution, desertification, and erosion (Akinyosoye 2000; Adejoh 2009; Idumah 2006),
2) climatic factors, particularly climate change leading to adverse and inconsistent weather patterns (Adewuyi 2002; Egwuda 2001),
3) agronomic factors mainly related to the scarcity and high cost of quality inputs (Egwuda 2001; Ojo,2005; Adejoh 2009; Peke 2008),
4) farm management factors which emphasize the production technologies as well as the relevance of cropping patterns used for particular crops (Adewuyi 2002; Oseni 2001),
5) factors related to poor supporting Infrastructure including inadequate storage and marketing facilities, inadequate extension services, poorly organized rural input, output and financial markets, and substandard rural infrastructure including poor feeder roads and limited access to clean potable water, good health services, electricity, telephone and educational facilities (Fasoranti 2006; Okafor 2004, Adewuyi and Okunmadewa 2001; Yusuf et al. 2009; Peke 2008; Adewuyi 2006; Adejoh 2009), and
6) policy related factors where poorly conceived, poorly funded and inconsistent government policy add another layer of constraints to the agricultural industry and reduce the productivity of poor farmers (Adewuyi 2002; Okafor 2004). A related macro factor is trade liberalization because globalization makes it difficult for developing countries to develop an appropriate apparatus for equitable food production and distribution (Usman and Ijaiya 2010).

The socioeconomic factors identified as impacting agricultural productivity in Nigeria are the attributes that make small scale farmers ill-equipped to deal with the demands of modern farming (Ogunsanya 2009; Ajani 2000; Akintayo 2011; Oladeebo 2006; Fasoranti 2006; Ajibolade 2005; Peke 2008; Fanegan 2010; Adeyemo, Oke, and Akinola 2010; Oluwatayo, Sekumade, and Adesoji 2008). There are, however, other socioeconomic attributes identified in the literature that lead to increases in food insecurity. Household size is important because it increases the number of consumers putting pressure on household resources particularly food (Ayantoye 2009; Ibrahim et al. 2009; Agbola 2005), and households with a high dependency ratio are particularly prone to food insecurity (Ayantoye 2009). In addition, households with farming as a primary occupation and with many years of farming experience are also more likely to be food insecure, as most rural farmers are subsistence or semi subsistence farmers with low incomes. Despite being food producers, their productivities are so low that they can barely feed their families (Ayantoye 2009). Other characteristics of households that experience food insecurity include households with older heads, male headed households, as well as farm households that experienced food shortages prior to harvest (Ayantoye 2009; Agbola 2005).

Factors that have been found to provide a buffer against food insecurity include the education level of the household head, the size of the farm (households with larger farms are more food secure) (Ayantoye 2009; Ibrahim et al. 2009), as well as remittances received from relatives working in other towns and cities (Agbola 2005; Ayantoye 2009; Ibrahim et al. 2009).

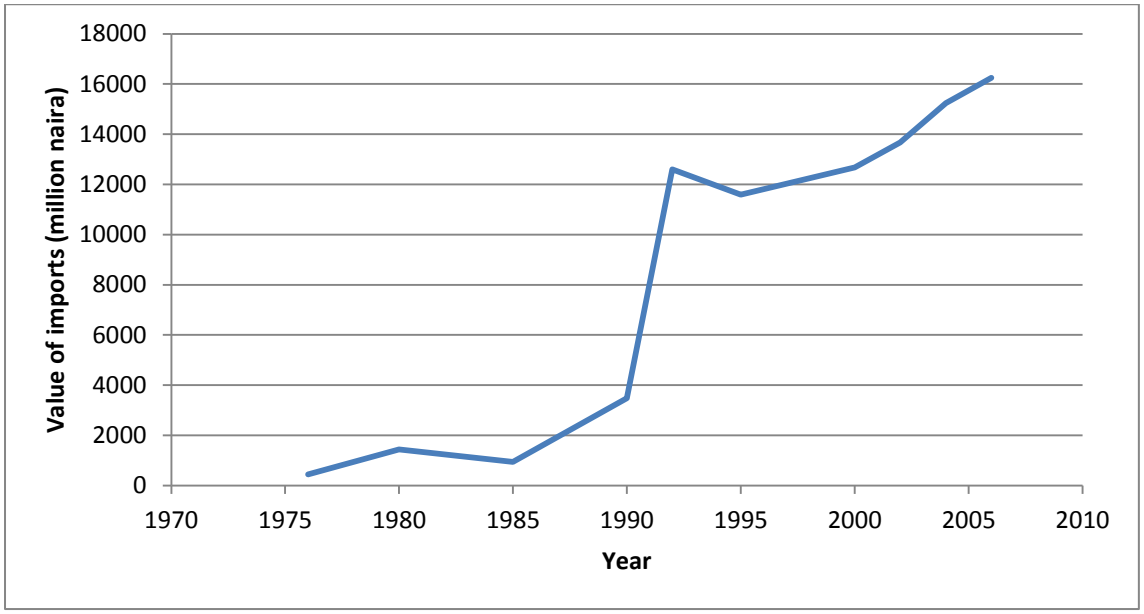
Measures and scope of food security in Nigeria

Food availability

Nigeria does not produce enough food for its large and growing population. The rise of the oil sector to a position of economic preeminence in the early 1970s resulted in the neglect of the agricultural sector. Consequently, Nigeria began to experience a shortfall in domestic production that transformed the country from a food sufficient net exporter of food products to a net importer of many different agricultural products including palm oil, rice, wheat, and maize (Ogen 2007). More specifically, from a low value of N47.8 million in the 1960s, Nigeria's food imports increased to N88.2 million in 1970 and N1,027.0 million in 1988 (Alkali

1997; Ogen 2007). In more recent years, the value of food imports has continued to grow very rapidly (figure 6), reaching a value of N16billion by 2006. Maintaining this level of imports has taken a toll on the country's finances. Between 1990 and 2001, the share of food imports in Nigeria's budget increased from 9 percent to 19 percent, peaking at 55 percent in 1995. Similarly, the share of food imports in total imports also increased from about 8 percent to 22 percent over the same period (Okolo 2004). Currently, food imports are as high as US$3.99 billion a year, which amounts to about 8 per cent of total foreign exchange disbursement (CBN 2009).

Figure 6—Value of food imports in Nigeria, 1976–2006



Source: Akpan 2009.

Utilization: Anthropometric measures and macronutrient deficiencies

When food security is measured by anthropometric measures and macronutrient deficiencies, 42 percent of children were stunted (low height for age), while 25 percent were underweight and 9 percent wasted in 2003 (IITA 2004). For under-five children, 38 percent were reported stunted, 29 percent underweight, and 9 percent wasted (low weight for age) in the same period (IITA 2004). Relative to 1990, by 2008, almost half of all children under 5 were stunted while over a quarter of that population were found to be underweight (See Table 3).

About 30 percent of children under 5 surveyed in 2003 were found to be vitamin A deficient, while about 25 percent of children and 20–40 percent of adult females were reported to suffer from iron deficiency in the same period. In addition, about 25 percent of children were found to suffer from iodine deficiency, while 20 percent of children under 5, 28.1 percent of mothers, and 44 percent of pregnant women were found to be zinc deficient (IITA 2004). In general, several studies of pregnant women in different parts of the country found unacceptably high levels of malnutrition (Idowu et al. 2005; Ekejindu et al. 2006; Maziya-Dixon et al. 2003).

Food access and stability of access: Caloric sufficiency

Other measures that have been utilized to capture food security include several measures of caloric sufficiency based on a minimum level of nutrition necessary to maintain healthy living. For instance, Omotesho et al. (2006) constructed a food security line based on calorie

consumption of of the members (age and gender specific) of survey households in Kwara State and found that one third of the rural farming households sampled were food insecure. Similar studies were carried out in other states. In Borno State, less than half of survey households (42 percent) were found to be food secure (Amaza et al. 2006), while in Nasarawa State, 58.9 percent of surveyed households were food insecure (Ibrahim et al. 2009). Orewa and Iyangbe's study of 90 households in two Local Government Areas (LGAs) in Edo State of Nigeria involved determining caloric sufficiency via the 24 hour recall method, determining protein and calorific content in each of the food items consumed to estimate the quality of food intake and constructing the incidence, depth, and severity of food insecurity. Food insecurity rates for some demographic groups in this study were as high as 75 percent. Another study in Borno State (Idrisa et al. 2008) also determined food insecurity status by constructing a food security line with minimum caloric requirements determined according to gender and age of household members as recommended by the Food and Agricultural Organization (FAO). The authors also found high levels of food insecurity particularly in households where member incomes and educational attainment were low. Using similar criteria in Ekiti State, and basing the poverty line on the FAO/WHO recommended dietary allocation for calorie intake per average male in 1985, which was 2150.6; Ogunsemi (2006) estimated the incidence of food insecurity at 55 percent.

Similarly, in Oyo State, average calorie intake per day was 13,440 kcal per household, below the threshold of adequacy of 15820 calories per household per day for a seven member household. By this criterion, 45 percent of surveyed households were found to be food insecure (Adio 2000). Oluwafemi (2005) also estimated a food security line in Osun State and found that 61 percent of respondents are food insecure. While also estimating a food insecurity line by applying the method of food energy intake, Ayantoye, (2009)'s study of rural households in Ondo and Ekiti States was more focused on identifying households facing chronic food insecurity. Findings revealed the seasonality of food insecurity, as 42 percent of households were food insecure in the harvesting season, and as much as 78 percent in the planting season. The majority of respondents faced chronic food insecurity as very few were able to transition out of food insecurity even in the harvesting season, significantly increasing the probability of long-term sustained food insecurity.

Adaptation of household food insecurity access scale

Several studies have also utilized some adaptation of the HFIAS to capture food insecurity in Nigeria. For instance, Obayelu (2010) carried out a study in North Central Nigeria (Kwara and Kogi States), using the Rasch model to classify individuals within households into their food security status. Based on their analysis, they found that only 23.7 percent of households in their sample were food secure. Ibrahim et al. (2009) used a 12-item variant of the HFIAS to categorize food insecurity in Nasarawa State, classifying individuals based on the number of affirmative responses. Individuals were classified as food insecure if they answered in the affirmative to five or more food insecurity questions. Based on this classification, 64 percent of the sample was food insecure. However, there is no universal adaptation of a model or scale for capturing food security that permits a comparison of food security over time and across states and/or regions of the country.

Table 3—Malnutrition prevalence in Nigeria: underweight and stunting, percent of children under 5 yrs, selected years

Year	Underweight, (weight for age)	Stunting (height for age)
1990	35.1	50.5
1993	35.1	43.8
1999	27.3	39.7
2003	27.2	43.0
2007	25.7	42.8
2008	26.7	41.0

Source: World Bank World Development Indicators (various years).

This section presented information on the evolution in the definitions of food insecurity over time, in addition to discussing trends in the different measures of food insecurity. In terms of availability, it has been difficult for Nigeria to meet her domestic food needs since oil emerged as a major foreign exchange earner, leading to an increased need for food imports. Trends in anthropometric data indicate that a large percentage of Nigerians suffer from micronutrient deficiencies, while many studies on the caloric adequacy of meals consumed by Nigerians reveal inadequate access to nutritious food. Finally, the few studies that utilize some variant of the HFIAS also show a large incidence of food insecurity.

IV. Social Capital

Social capital refers to the relationship between different family members that determines how individual members can take advantage of whatever financial and human capital other family members possess (Astone and Mclanahan 1991). In times of financial hardship, food shortages, or severe illnesses, various studies in Africa have shown that the social capital that families have access to make a big difference in their abilities to surmount these adverse events (Mtika 2001; Kaschula 2008; Muga and Onyango-Ouma 2009).

The concept of social capital has become one of the most popular exports from sociological theory into everyday language. Though not a new concept, the recent focus on social capital is thought to stem from two sources: interest in the positive consequences of sociability, while putting aside its less attractive features, and the emphasis the current use of the term places on how such nonmonetary forms of capital can be important sources of power and influence, similar to the influence of traditional economic capital such as the size of one's stock holdings or bank account (Portes 1998). Though social capital is viewed and used differently across and within the sociology and economic literature, the consensus moves towards viewing social capital as standing for the ability of actors to secure benefits by virtue of membership in social networks or other social structures.

Like other forms of capital, social capital can be understood as an asset. It has the potential to yield streams of benefit that make future productive processes more efficient, effective, innovative, or simply expanded, just like physical and natural capital. Unlike physical or human capital, however, social capital is not embodied in one person; rather it is in the relations a person has with other individuals and with the socioeconomic institutions within which that individual operates (Coleman 1988).

The first contemporary definition of social capital was provided by Pierre Bourdieu, who defined the concept as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition" (Bourdieu 1985). Bourdieu's definition highlights two key elements: the social relationship which provides people the right to claim access to the

resources of their network and the amount and quality of those resources. One distinction that Bourdieu's take on social capital provides is the fact that while the outcomes of social capital are economic, the process that brings about this economic outcome is not economic, but social. Social processes are complex, possessing their own dynamics and occurring with much less certainty than pure economic exchange. Unlike traditional economic interactions, within the framework of institutionalized social interactions, various actions are driven by unspecified obligation with uncertain time frames and the possible violations of immediate reciprocity.

Other contributors to the modern concept of social capital include Robert Putnam, James Coleman, and the economist Glen Loury. Putnam (2000) in his seminal publication made a difficult sociological concept generally accessible to a non-technical audience. He viewed social capital as a set of horizontal associations between people, which foster cooperation for the mutual benefit of the community. Coleman later expanded this narrow definition to include vertical relationships characterized by a hierarchical structure and unequal power distribution. He also suggested that social capital could even yield useless or harmful effects for society as a whole. Coleman also focused on the role of social capital in the development of human capital. He is considered as starting the proliferation of the use of the term social capital to include "the mechanisms that generated social capital (such as reciprocity expectations and group enforcement of norms); the consequences of possessing social capital (such as privileged access to information); and the appropriable social organization that provided the context for both sources and effects to materialize" (Portes1998). His conceptualization obscured earlier distinctions between the resources themselves and the ability to gain access to those resources by membership in a particular social group. Glen Loury (1977), in his study of racial inequality, focused on the need for a multidimensional consideration of the factors that provided opportunities for escaping poverty. He highlighted that besides merit, the material resources that a child had access to from his family, as well as the kinds of networks whose resources he/she could access were necessary for upward mobility (Loury 1977).

Scholars like Burt (1992) considered social capital as friends, colleagues, and more general contacts through which one receives opportunities to use their financial and human capital. Thus while others before him had considered the density of networks as important for social capital to emerge, Burt was of the different opinion that upward individual mobility is actually facilitated by "the relative absence of ties". This he advocated was because dense networks tend to convey redundant information, while weaker ties can be sources of new knowledge and resources.

Another concept intricately bound up with social capital is the concept of trust. Trust has been identified as both a precondition for and product of social capital (Fu 2004; Cote and Healy 2001). Trustworthy behavior is encouraged because of possible sanctions for actions that flout social norms or failure to meet up to social responsibilities which explains why individuals with more social capital, measured by involvement in community organizations, are often more trustworthy when it comes to paying back microcredit loans (Cassar et al. 2007; Olomola 2002). It is important to note however that this outcome depends on the intimacy of the relationships under consideration. Putnam (2000) distinguishes between the concept of thick and thin trust. Thick trust is a property of intimate social networks and caused by relational social capital in the form of personal trust between individuals and social homogeneity within groups and results in a positive effect on trustworthy behavior for group members (Putnam 2000; Cassar et al. 2007). Conversely however, thin trust can be defined as generalized trust in other community members with whom individuals have more casual relationships. These relationships can be defined either by simple acquaintanceship with other individuals or as an individual's general trust in society and they have less power to influence the individual's behavior. This idea was further expanded by Fukuyama (1995) who identified a "radius of trust," referring to the more intimate relationships where co-operative norms operate. Fukuyama suggests that in societies where there is a narrow radius of trust, a two-tier moral system results, as individuals are likely to act differently

based on the intimacy of their relationships. Trustworthy behavior is thus reserved for close relationships, while there is a lower standard of behavior in the public sphere.

Measurement of social capital

Social capital has a variety of dimensions. While in many developing countries, it is often captured via some measure of membership in community based organizations, as well as engagement in the community (Okunmadewa et al. 2007; Balogun and Yusuf 2011a; Yusuf 2008), there are a number of other aspects of social capital that have been identified as important for a comprehensive understanding of the concept. Some aspects of social capital that have been identified in the literature as very important (Roslan et al. 2010a, 2010b; Balogun and Yusuf 2011) include:

1) Groups and networks, measured by
    a) Membership in formal or informal organization or association.
    b) Ability to get support from those, other than family members and relatives, in case of hardship.
    c) Remittances.
    d) Ability to learn from one's network or group, particularly the impact on technology adoption.
    e) Access to various markets (labor, input, or output) via the group.
2) Trust and solidarity, measured by
    a) Perceptions about whether most people in the community can be trusted.
    b) Perceptions about social support/help provided by group members for each other in times of hardship.
3) Collective action and cooperation, measured by
    a) More than half of the community contributing time or money towards common development goals.
    b) A high likelihood that people, in the community, cooperate to solve common problems.
4) Information and communication, measured by
    a) Frequency of reading or listening to news sources such as radio, newspapers, and television.
5) Social cohesion and inclusion, measured by
    a) Strong feeling of togetherness within the community.
    b) Feeling safe from crime and violence when alone at home.
6) Empowerment and political action, measured by
    a) Having control in making decisions that affect everyday activities
    b) Political participation such as voting and being voted for in local elections

Types of social capital

Intra-family social capital

For the purposes of this study, we differentiate between intra and extra family social capital. Intra-family social capital refers to the relationship between different family members that determines how individual members can take advantage of whatever financial and human capital other family members possess (Astone and Mclanahan 1991). This includes moral

support like childcare or caring for the sick, financial support, labor augmenting, and other forms of support that households enjoy by virtue of their intrahousehold relationships. This type of social capital can be captured via household structure, largely distinguishing between extended versus nuclear households and polygamous versus monogamous households.

Intra-family social capital could have positive and negative effects. One example is the effect of the presence of extended family members on household welfare or productivity. The presence of extended family members may affect agricultural productivity, exacerbate or ameliorate food insecurity or poverty by either creating more mouths to feed, or increasing the resource base of the household.

A similar analysis could be offered for households that are polygamous or monogamous. With regards to polygamy, it can logically be assumed that this family structure creates a larger pool of individuals that can provide support for each other and provide financial, social, and labor support when needed. For farming households, the availability of labor could be crucial for food production and household welfare. On the other hand, there is some evidence of separate spousal budgets in many polygamous homes (Caldwell, Orubuloye, and Caldwell 1992; Desai 1992). In these arrangements, individual wives have primary responsibility for taking care of their children, and there is no resource sharing across co-wives. In the event that the husband is not able to supplement the needs of each co-wife, then individual and household outcomes from such household structures could differ significantly with very different food security implications. This could occur via differential production and consumption decisions.

Another example of intra-family social capital is the differential experience of male and female-headed households. The gender of the household head, and in some cases the gender of different adult household members, also has implications on production decisions and consumption outcomes given their differential access to various resources, such as financial, information, input and output markets, etc., as well as their potentially different preferences. Similarly, female household members are likely to have different types, levels, and intensity of relationships than their male counterparts which might affect their ability to benefit from the potential gains of various relationships or which might render them more vulnerable to the vices of the same.

Extra-family social capital

This refers to the benefits that households have access to by virtue of the relationships of their individual members within the larger community.

Extra-family social capital is complex. Some forms may serve as a transmission mechanism from resources into outcomes through their effects on preferences, constraints and expectations, thereby influencing economic decisions. Social capital can also help to mitigate shocks to income and food supplies in times of crises. Generally, the severity of the shock to income and food supplies and what coping strategies families may choose to utilize to cope with the shock may depend primarily on the strength of the social networks they have access to. In times of financial hardship, food shortages, or severe illnesses, various studies in Africa have shown that the social capital that families have access to makes a big difference in their abilities to surmount these adverse events (Mtika 2001; Kaschula 2008; Muga and Onyango-Ouma 2009). Consequently, social capital has the capacity to impact the consumption possibilities of households.

Generally, as proffered by Uphoff, extra-family social capital can be understood by distinguishing two interrelated categories of phenomena: (a) structural and (b) cognitive. The structural category is associated with various forms of social organization, particularly roles, rules, precedents, and procedures as well as a wide variety of networks that contribute to cooperation and specifically to mutually beneficial collective action (MBCA), which is the stream of benefits that results from social capital. The cognitive category, on the other hand, derives from mental processes and resulting ideas, reinforced by culture and ideology,

specifically norms, values, attitudes, and beliefs that contribute to cooperative behavior and MBCA.

The elements of social organization in the structural form of social capital facilitate MBCA, in particular by lowering transaction costs, having already established patterns of interaction that make productive outcomes from cooperation more predictable and beneficial. This is where the effect of social networks on farmer's probability of adopting productivity enhancing technologies or improved nutrition information lies. Reducing the risks and costs of adopting these technologies or practices through improved access to financial or marketing resources or via social learning and information dissemination are key mechanisms though which structural social capital facilitates increased agricultural productivity and improved nutritional outcomes. Adoption decisions within groups may be correlated when there are shared goals for or constraints to the adoption decision (Besley and Case 1994; Bandiera and Rasul 2006). While homogeneity within a group could also cause members to adopt technology at a similar time, collective action could lower the cost per member and lead to a correlated adoption within the group. This would occur if there were risk sharing in a network or if the technology in question were too expensive for an individual farmer. Group dynamics could also affect the willingness of individuals to engage in new activities, if groups have the power to exert pressure on members and thus affect their behavior (Maertens 2010). Another way that networks might affect technology adoption is via social learning where farmers learn about new technologies through observation of other farmers, imitation of associates, or modeling by peers (Liverpool and Winter-Nelson 2010). In cognitive social capital, individuals are predisposed toward MBCA, in part because of widely shared ideas that make cooperation more likely. Norms, values, attitudes, and beliefs that constitute cognitive social capital are ones that rationalize cooperative behavior and make it respectable. This form of social capital is common within religious and ethnic groups as well as within different associations of like individuals.

While it is possible in the abstract to have structural forms of social capital without cognitive ones, and vice versa, in practice, it is unlikely and difficult for either to persist without the other. These two domains of social capital are intrinsically connected because, although networks together with roles, rules, precedents, and procedures can have observable lives of their own, ultimately they all come from cognitive processes.

Social capital and economic development

Social capital has become a major topic in the development literature with its importance in facilitating the development process being increasingly recognized. The Organization for Economic Co-operation and Development (OECD) defines social capital as "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (Cote and Healy 2001:41). According to the World Bank "Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions…Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together."

In addition to being recognized by the international aid organizations, many studies on social capital are being carried out in developing countries to properly understand and utilize the concept. For instance, Roslan et al. (2010a, 2010b) examined the impact of social capital on poverty reduction and on the quality of life of rural households in Terenggamu, Malaysia. Utilizing a scale that combined several dimensions of social capital, including groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action, the authors found that social capital was able to significantly reduce the incidence of poverty and also significantly increase the quality of life of these households.

Another medium by which social capital can improve living standards is through the spread of new technologies and innovations particularly in agricultural communities. Productivity can be massively increased if individuals are motivated to adopt new technologies that have the

potential to increase their incomes. Social capital has been found to help the process in Uganda (Katungi 2007) and Ethiopia (Liverpool and Winter-Nelson 2010). In Uganda, social capital played a pivotal role in the adoption of new farm management practices in the cultivation of the banana crop. Katungi found that while different aspects of social capital shape the decision to use and extent of use of banana management practices, the nature of effect is specific to the practice and the form of social capital. Findings further revealed that participation in associations and characteristics of the association are important determinants of banana production management decisions and this participation is also influenced by education, wealth, institutional environment, and heterogeneity of the community. In Ethiopia, Liverpool and Winter-Nelson (2010) confirmed evidence of social network effects on adoption of diverse agricultural technologies across households, in a range of poverty situations. However, these effects also varied by technology, poverty status of households, and type of network. Social learning also occurred in the adoption process for new technologies but was absent in the older technologies, with this learning stronger in complex technology adoption particularly among the poor.

Social capital in Nigeria

The literature on social capital in rural Nigeria is dominated by studies that define social capital as membership in formal or informal organizations or associations or by the access of individuals or associations to formal and informal sources of credit.

Studies that focus on membership of associations often examine the impact of these associations on improving some index of social welfare like improved livelihoods, spiritual upliftment, access to technology, or enhanced income (Anisude 2010). For instance, Okunmadewa et al. (2007), in a study that covered 6 Nigerian States namely Abia, Cross River, Ekiti, Kebbi, Kogi, and Yobe, documented the role of social capital in reducing rural poverty in Nigeria. Social capital was specified as indices of membership and participation in community associations and was found to be instrumental in reducing rural poverty. Using similar measures, Balogun and Yusuf (2011a) and Yusuf (2008) also documented the mitigatory impact of social capital on household welfare. Balogun and Yusuf's study was carried out in the two south western states of Ekiti and Osun and membership and participation in community organizations was found to have a positive impact on household welfare, measured as the level of household expenditure. A study carried out in Kwara State (Yusuf 2008), also resulted in similar findings. In Niger state, cooperative societies were found to improve the standard of living by encouraging community projects including the construction of roads, building places of worship, rehabilitation of schools, and other similar activities (Abubakar et al. 2009). Also a women's cooperative society in Enugu, established to tackle the deep rooted cultural and economic gender based constraints faced by these women, reported a steady rise in clients, a steady increase in the amount of funds disbursed, as well as a significant increase in savings, thus leading to economic success for members (Opata 2008).

Membership in community organizations has also been found to impact other economic outcomes that indirectly affect household welfare. For instance, social capital was found to be very important in the performance of microfinance groups in Nigeria by positively affecting repayment performance, perhaps due to the identified importance of trust and homogeneity for social group performance. In addition, a similar measure of social capital (membership and participation in community organizations) was also utilized by Oni et al. (2009) to document the positive impact of social capital on credit access among cocoa farming households in Osun state. Utilizing a Tobit model, the researchers were able to identify the role of social ties as a facilitator in providing access to credit and lowering its costs, while improving welfare by increasing information flows and reducing transaction costs, due to greater trust. These findings were similar to those by Balogun and Yusuf (2011b) who found that social capital variables, including membership density index, meeting attendance index, cash contribution index, and heterogeneity index, had a significant positive influence on the amount of credit available from different sources.

The studies on credit access in rural Nigeria are mostly focused on the relationship between credit access and some indicator of agricultural output such as profitability, productivity, or production. In Zamfara State, formal loan beneficiaries, mostly from the Zamfara Comprehensive Agricultural Revolution Program and commercial banks, recorded higher yields in the major crops and also recorded higher net farm incomes (Musa 2010). Sunusi (2007) similarly found that farmers with access to microcredit in Kano State had more profitable enterprises, enjoying a return of 48kobo per naira invested, compared to 27kobo per naira invested for farmers with no credit access. Basher (2010) similarly found that farmers who were beneficiaries of a microcredit scheme in Sokoto State made more profits than farmers who depended on their own resources. Awe's (2009) study of non-institutional credit sources in Delta State revealed that cassava farmers turned to friends or relatives, the Esusu Rotating Savings and Credit Association, money lenders, or cooperative societies to bridge market failures caused by the absence of formal sources of credit. The increase in funds enabled these farmers to purchase improved inputs and transition from subsistence to commercial farming.

Social capital is a wide and multidimensional concept. However, most studies of social capital in Nigeria are limited to membership of formal or informal organizations or associations or by the access of individuals or associations to formal and informal sources of credit. Membership of these associations or access to credit has been found by a wide variety of studies in different settings to improve household welfare.

V. Conceptual Framework

Food security, agricultural productivity, and social networks are interdependent. We explore the nature of these linkages, which are examined in the context of evidence from the larger literature, in order to identify the patterns of interrelationships among these concepts. Also, the farm household model (Singh, Squire, and Strauss 1986) is outlined as the theoretical framework for this model, and specific empirical questions of interest are identified.

Linkages

Food security and agricultural productivity

The food security status of the household has an impact on the level of agricultural productivity in the farm. When individuals face very severe food insecurity either because of limited access and/or utilization (poor health), this affects their abilities to act as a source of labor supply and reduces their food production possibilities (Asenso-Okyere et al. 2011). The relationship also works in the opposite direction, as agricultural productivity affects food security directly by increasing the available supply of food, particularly for subsistence households, and indirectly by increasing incomes.

Social capital and food security

Household social capital can affect food security indirectly, in two possible ways: by increasing the dependency ratio, which is the number of individuals in the household relying on working household members, or increasing the resource base of the household. A large dependency ratio can exacerbate food insecurity directly by creating more mouths to feed and putting more pressure on available resources. Alternatively, it can ameliorate food insecurity indirectly by increasing the resource base of the household, as family labor is the most common source of labor in many rural farm subsistence, or increasing the number of household members who are earning incomes for households with other resources. Some of these relationships may also differ by the family structure of the household.

There is some empirical evidence of the mitigating impact of social capital on food insecurity. For instance, membership in cooperative societies particularly in rural Nigeria has been found to be an important form of social capital with positive impacts on the food security

status of households in the face of market failures, particularly the absence of access to credit from formal financial institutions which limits activities and consequently incomes of rural farm dwellers (Oluwatayo 2009). Also important is the role of remittances, which have been found to increase total income, household assets, as well as food consumption in households that receive them (Babatunde and Martinetti 2010).

Less clear is the impact of the nuclear and extended family on food security. While possibly useful, social relationships also have the potential to hamper household welfare. Close family or intergroup ties of the kind found in families or high solidarity communities can lead to a free-riding problem, as lazy household members can infringe on the resources of the successful ones backed by the groups shared normative structure (Portes 1998). Within the agricultural context, larger households, with limited non-labor resources or low levels of human capital might serve as a drain on household resources rather than serve as a source of additional revenue generating potential. Several studies do reveal the negative impacts of household size on the food security status of households (Ayantoye 2009; Ibrahim et al. 2009; Agbola 2005).

The aforementioned provide examples of situations where social capital available to household members due to networks of other members could affect the overall welfare outcome of the household. Very little is known about the strength of social capital associated with different family structures and how the shifts in family structure towards a more western model have affected families' food security status. For instance, with regards to polygamy, it might logically be assumed that this family structure creates a larger pool of individuals that can provide support for each other and provide financial, social, and labor support when needed. On the other hand, there is some evidence of separate spousal budgets in many polygamous homes (Caldwell, Orubuloye, and Caldwell 1992; Desai 1992). In these arrangements, individual wives have primary responsibility for taking care of their children, and there is no resource sharing across co-wives. For instance, polygamous women in Udu local government in Nigeria were found to contribute more to the food security status of their dependents than monogamous women whose husbands were more likely to provide for them (Meludu et al. 1999).

Social capital and agricultural productivity

Social networks may indirectly affect agricultural productivity by influencing farming practices and the household' propensity to adopt newer technologies via the supply of information through these networks (Katungi 2007; Liverpool and Winter-Nelson 2010). In addition to the demographic characteristics of the farmer, Akinola and Adeyemo (2008) found that access to extension (a source of information) significantly increased the probability of adopting improved rice varieties by farmers in three rural communities of Osun State.

Social capital may also indirectly impact agricultural productivity by affecting the quantity of labor available either from the immediate and extended family or through the social relationships available to the individual. This is particularly important with the increase in rural-urban migration, which has created restrictions in the supply of rural farm labor.

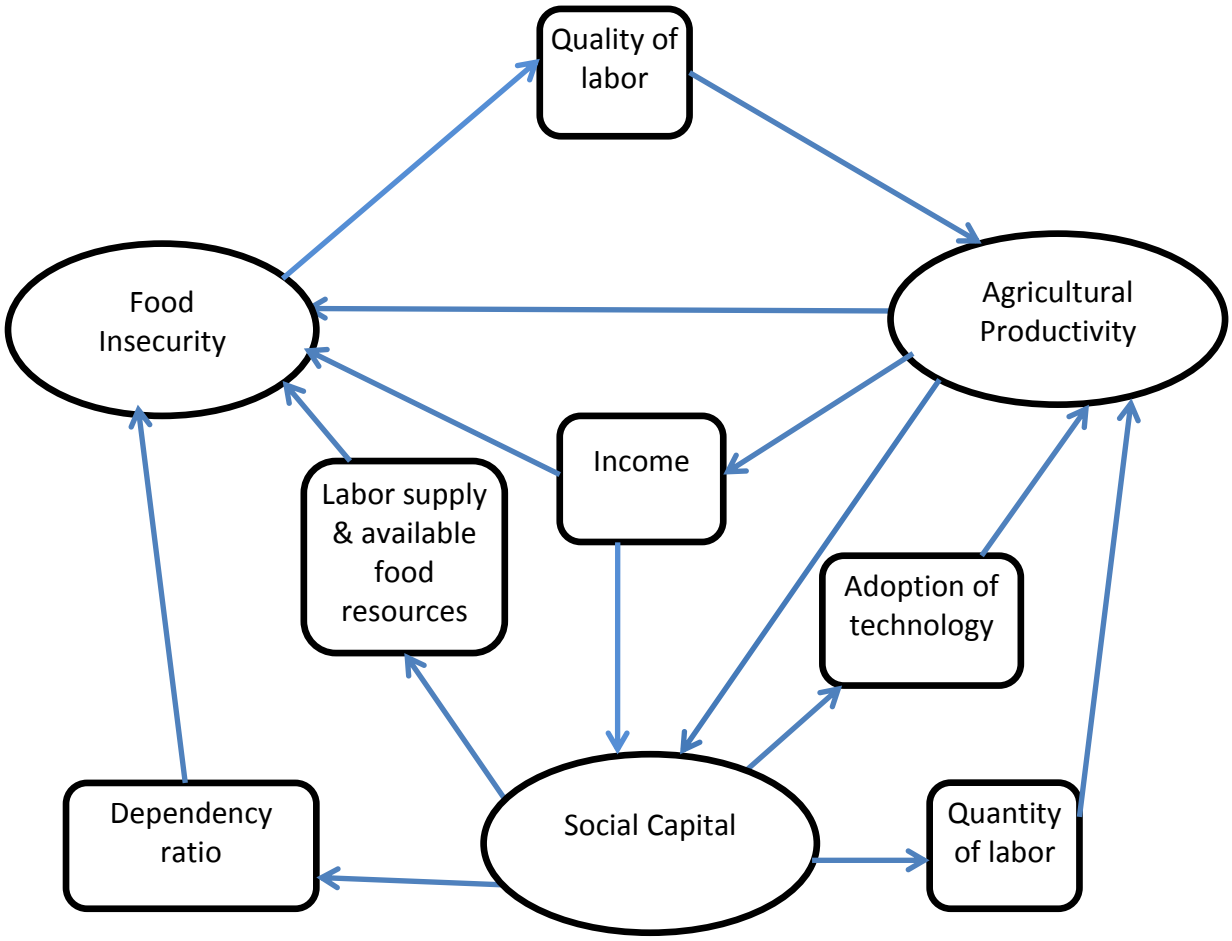
The relationships described above are captured in figure 7, where the hypothesized pattern of relationships among the variables of interest is specified. Agricultural productivity has a direct impact on food security by increasing the quantity of food, but it also has an indirect impact by increasing or decreasing the financial resources available to households, depending on the direction of change in agricultural productivity. Food security, on the other hand, only has an indirect impact on agricultural productivity by affecting the quality of labor mostly through health channels. Food insecure individuals are less likely to be healthy and would subsequently have reduced productivity if they were able to work at all.

The hypothesized relationship between social capital and food security is unidirectional, as social capital impacts food security and not vice versa. Social capital, in the form of household social capital, has indirect impacts on food security by determining the net impact of household structure on the availability of resources. A high dependency ratio would drain

household resources, while more workers in the household would raise available income and subsequently food resources.

The hypothesized relationship between social capital and agricultural productivity is bidirectional. Social capital impacts agricultural productivity indirectly in two ways: by affecting the supply of labor, both household and hired, as well as being a source of information for households. Households process this information to make technology adoption decisions that have direct impacts on their levels of productivity. Similarly more productive/less productive households may be more likely to collude to take advantage of various market or production opportunities. Alternatively, less productive households may be more likely to seek out more productive households to enable them to learn or augment resources to increase productivity. Or, more productive households might work with less productive households to help them improve their productivity.

Figure 7—Interrelationships among agricultural productivity, food security and social capital



Farm household model

The theoretical framework within which the interrelationships among agricultural productivity, food security, and social capital are studied here is the farm household model (Singh, Squire, and Strauss 1986). The primary unit of observation is the rural household in Nigeria where the majority of production and consumption takes place. The framework acknowledges the interdependence of the consumption and production decisions in agricultural households due to various input and output market failures. Consequently, the relationship among the three study concepts, food security, social capital, and agricultural productivity, is captured by adapting the farm household model to allow for missing or

incomplete markets (Sadoulet and De Janvry 1995; De Janvry, Fafchamps, and Sadoulet 1991). The model assumes a single decision maker and specifies the following components:

1) output produced on the farm, including both food and cash crops (q>0),
2) inputs into the production process including labor1 (quality and quantity) and purchased factors (q<0),
3) goods consumed by the household including food, purchased goods, and leisure(c>0),
4) household initial endowment including available time (E),
5) net transfers received including remittances (S)2,
6) access to credit: (K),
7) exogenous effective market prices: ($\bar{p}$), and
8) endogenous decision prices: (p*).

Thus we have a system of *n* products and factors, *m* consumption goods, *t* tradables, and *nt* nontradables.

In addition to recognizing the nonseparability of production and consumption decisions, the model used here also explicitly allows for failed and missing markets due to factors like high transactions costs, shallow local markets, and limited access to credit (Sadoulet and de Janvry 1995). The presence of such market failures, particularly credit constraints, necessitates an important distinction between tradable and nontradable goods and factors, as well as between market and shadow prices. Tradeables are factors or products for which the opportunity cost is the market price, while nontradables have prices no longer determined by the market but which are internal to a household as a shadow price.

The consequent system comprises the following product/factor categories:

a) Tradables, which are not subject to a credit constraint, *TNC*. For these goods, the decision price is the farm-gate price, also referred to as the effective market price.
b) Tradables subject to a credit constraint, *TC*. For these goods, the decision price is the effective market price marked up by the shadow value of credit as determined by the credit constraint.
c) Nontradables, *NT*. For these goods, the decision price is the endogenous shadow price as determined by equilibrium between supply (*qi* + *Ei*) and demand (*ci*) within the household.

Model

While the category to which a particular good belongs is an endogenous choice, the model used here assumes that this classification has already been achieved.

The household's problem amounts to a constrained optimization problem where the household solves the following:

(1a) $\max_{c,q} u(c, z^h)$

Subject to:

---

[1] The concept of labor includes some quality and quantity measures. In agricultural households, the quality of labor depends on household composition and the personal characteristics (age, education, health, and nutrition status) of household members. This impacts their ability to contribute to the production process. Household composition also provides some measure of household social capital.
[2] This is a measure of social capital.

(1b) $\sum_{i\epsilon T}(q_i + E_i - c_i) + S \geq 0$ Cash constraint

(1c) $\sum_{i\epsilon TC}(q_i + E_i - c_i) + K \geq 0$ Credit constraint

(1d) $g(q, z^q) = 0$ Production technology

(1e) $p_i^* = \bar{p}_i$, $i \epsilon T$ Exogenous effective market prices for tradables

$(1f)$ $q_i + E_i = c_i$, $i \epsilon NT$ Equilibrium conditions for nontradables

Note that:

c is consumption and is comprised of a produced food commodity c_a, a purchased food commodity c_m, and leisure c_l. z^h refers to household characteristics, including the composition of the household. z^q refers to fixed factors and firm characteristics (e.g fixed capital and farm size), as well as to social capital in the form of access to information about production technologies.

The Lagrangian associated with the constrained maximization problem is written as:

$$L = u(c, z^h) + \lambda\left[\sum_{i\epsilon T}\bar{p}_i(q_i + E_i - c_i) + S\right] + \eta\left[\sum_{i\epsilon TC}\bar{p}_i(q_i + E_i - c_i) + K\right] + \phi g(q, z^q) + \sum_{i\epsilon NT}\mu_i(q_i + E_i - c_i)$$

The three types of goods can be treated symmetrically in the solution of the model by defining endogenous decision prices *p** as follows:

2a) $p_i^* = \bar{p}_i$, $i \epsilon T$NC

2b) $p_i^* = \bar{p}_i(1 + \lambda_c)$, $\lambda_c = \eta/\lambda$, $i \epsilon T$C

2c) $p_i^* = \mu_i/\lambda$, $i \epsilon NT$

From first order conditions, the following reduced form of the model can be derived:

Production decisions regarding all tradables and nontradables are represented by a system of supply and factor demand functions in the decision prices *p*:*

(3a) $q = q(p^*, z^q)$.

On the production side, the household thus behaves as if it were maximizing profit using the *p** prices. Optimum levels of products and factors yield maximum profit:

(3b) $\pi^* = \sum p_i^* q_i$

On the demand side, decisions are also made in terms of the *p** prices.

The full-income constraint in *p** prices can be written as:

(3c) $\sum p_i^* c_i \leq \pi^* + \sum p_i^* E_i + S + \lambda_c K = y^*$

and the demand system is:

(3d) $c = c(p^*, y^*, z^h)$.

On the consumption side, the household maximizes utility using the *p** prices and y^*.

For tradables, the decision prices are the effective market prices, or farm-gate prices, $\bar{p}_i$ given in equation (1e) while for the nontradables, the decision prices are the shadow prices μ_i/λ, where λ is the marginal utility of cash given by constraint (1b) and μ_i the marginal utility of endowment in nontradable *i* given by equilibrium condition (1f). For the credit-constrained tradables, the decision prices are given by the market prices and the marginal utility of credit λ_c (or η) introduced by the credit constraint (1c). Because the decision prices of nontradables and of credit-constrained tradables are endogenous, this system of equations consequently needs to be solved simultaneously.

Variables and potential estimation methodology

In order to transition from concept to measurement, it is necessary to identify the variables of interest and the expected pattern of relationships between them. The reduced form solutions are utilized to guide the choice of variables for answering research questions of interest. Agricultural productivity is represented in the model via the production function. Social capital is explicitly represented through remittances and access to capital, and implicitly through household characteristics (family structure) and influences on the production technology (information for technology adoption). Food security is measured implicitly as the difference between full income and consumption. However it is important to identify the specific measures that could ultimately be used to represent each of these concepts for estimation purposes. The multidimensional nature of each of the concepts of interest necessitates the use of several measures, each of which are listed below:

Food security

Utilization could potentially be captured through anthropometric measures via measures like Body Mass Index (BMI) (for adults), height for age, and weight for age (for children).

Access: This could be measured via an adaptation of the HFIAS, or a set of questions to capture the dietary diversity of the household diet.

Stability of access: This could potentially be measured by questions that ascertain the seasonality of food insecurity by identifying the periods of the year when households are prone to suffer from lack of food.

Agricultural productivity

Partial measures: These could be captured by land and labor productivity.

Total measures: These will need to take into account the inputs ignored by the partial measures and could be measured by total factor productivity.

Social capital

Household social capital could be measured via household structure, such as monogamous, polygamous, and dependency ratios, among others.

Extra family social capital would potentially include membership in community organizations, access to informal sources of credit and remittances, as well as the nature and density of social networks.

Future research questions and possible estimation methods

There are several apparent research gaps from the foregoing literature that future research could address. They include:

a. specifying the patterns of relationships among agricultural productivity, food security, and social capital,
b. identifying how (if at all) the changing family structure in Nigeria has affected agricultural productivity and food security,
c. understanding what kinds of social networks are most important in rural Nigeria and why, and
d. explaining how agricultural productivity in rural Nigeria contributes to household food security.

One approach to tackling the first question would involve specifying the full model in figure 5, which because of dual causality may not be identified if traditional econometric methods are utilized. In order to specify this model, a method such as structural equation modeling (SEM) would need to be applied. SEM makes it possible to test theoretical propositions regarding

linkages among concepts of interest and also allows for the specification of the directionality of significant relationships (Schreiber et al. 2006).

Question b is important because there is some anecdotal evidence that the structure of the family in Africa is changing to mirror the west, with the family evolving from extended to nuclear family types and also from polygamous to more monogamous family structures (Muga and Onyango-Ouma 2009). In addition there is greater diversity in the different forms of family structures that exist, as there is now a non-trivial growing incidence of divorce, cohabitation, and single parenthood, although most single parents of both sexes in Nigeria are still widows and widowers (Mberu 2007). The purpose of this research question is to test the implication of the resource augmenting or depleting role of household social capital on agricultural productivity and food security. More specifically, interest would be in determining the net impact of each family type on household food resources on both the production and consumption sides. From Figure 5, it is clear that food security and agricultural productivity are both endogenous in this model. This must be taken into account in any proposed process of estimation. Consequently, both the food security and agricultural productivity equations would have to be jointly estimated via seemingly unrelated regression or a similar method and appropriate instruments such as religion for family structure would need to be utilized for identification purposes.

Question c would involve investigating the following specific questions:

i. Are the networks for insurance and risk sharing the same for information dissemination?

ii. What are the roles of various social networks in farmer adoption of new technologies and agricultural practices?

iii. What are the roles of various social networks in disseminating information about health and nutrition?

iv. Do the benefits of social networks cut across gender and socioeconomic levels?

Answering questions i to iii would necessitate an understanding of social networks and the manner in which they work to spread important information and influence actions. Social network analysis, the methodology of choice to achieve this aim, identifies the structure of relationships, which are then mapped for the purposes of identifying important social connections and knowledge flows (Serrat 2009). Understanding the benefits of social networks (question iv) will involve the specification of regression models that allow the exploration of the relationship between social networks and household demographic and socio-economic statistics (e.g. probit and tobit regression models).

Question d is important because it would lead to the identification of the key factors that ensure that increased farmer income or output translates into improved food security and nutrition. Particular interest would be in identifying the mechanisms through which the following factors impact agricultural productivity and in turn food security: gender issues and education, alternative sources of livelihood, remoteness/access to various markets, and institutions and social capital. The endogeneity of both agricultural productivity and food security would necessitate the use of instrumental variable analysis as well as the identification of appropriate instruments to properly analyze this relationship.

Most of the aforementioned areas of research can now be analyzed via available data – in particular the panel General Household Survey (GHS) being developed by the National Bureau of Statistics (NBS) and that World Bank. This is a very rich data set containing information on agricultural inputs and outputs, several measures of food security as well as on networks and social ties of surveyed individuals. The next steps in understanding the relationships among all three variables would be to begin to explore this data set and estimate some of these relationships.

References

Abubakar, A. 2010. “Economic Analysis of Resource-Use Efficiency Of Rice Farmers Under National Fadama Development Project (NFDP-II) In Adamawa State.” Msc Thesis, Department Of Agricultural Economics And Extension, Bayero University, Kano.

Abubakar, B. Z., D. H. Yakubu, J. Y. Fatima, and S. A. Abubakar. 2009. “The Role of Cooperative Societies in Community Development: A Case Study of Agaie LGA, Niger State.” In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

Abubakar, M. I. 2006. “Analysis of Cowpea Production under the National Special Program on Food Security in Argungu LGA of Kebbi State, Nigeria.” Msc Thesis, Department of Agricultural Economics and Extension, Usuman Danfodiyo University, Sokoto.

Adejoh, S. D. 2009. “Analysis of Production Efficiency and Profitability Of Yam-Based Production Systems In Ijunmu LGA Of Kogi State.” Msc thesis Department of Agricultural Economics And Extension, Ahmadu-Bello University, Zaria.

Adewuyi, S. A. 2002. “Resource Use Productivity In Food Crop Production In Kwara State, Nigeria.” Phd Thesis Department of Agricultural Economics University of Ibadan, Ibadan.

———. 2006. “Resource Use Productivity of Rural Farmers In Kwara State, Nigeria.” *International Journal of Agricultural Sciences, Sciences, Environment and Technology* 1(1).

Adewuyi, S. A. and F. Y. Okunmadewa. 2001. “Economic Efficiency of Crop Farmers in Kwara State, Nigeria.” *Nigerian Agric Development Studies* 2(1).

Adeyemo, R., J. T. O. Oke, and A. A. Akinola. 2010. “Economic Efficiency of Small Scale Farmers In Ogun State, Nigeria.” *Tropicultura* 28(2).

Adio, M. A. 2000. Analysis of the food security of farm households in Oyo State. MSc thesis submitted to the Department of Agric-Economics, University of Ibadan, Ibadan, Nigeria.

Agbola, P. O. 2005. “Analysis of Food Insecurity and Coping Strategies among Farming Households In Osun State.” Phd Thesis Department of Agricultural Economics University of Ibadan, Ibadan.

Ajani, O. I. Y. 2000. “Resource Productivity in Food Crop Farming In the Northern Area Of Oyo State, Nigeria.” Phd Thesis, Department of Agricultural Economics University of Ibadan, Ibadan.

Ajibefun, I. A. 1998. “Efficiency of Small Scale Food Crop Farms In Ondo State, Nigeria. An Application of Parametric And Non-Parametric Frontier Production Functions.” Phd Thesis, Department of Agricultural Economics and Extension, FUTA, Akure.

———. 2008. “An Evaluation Of Parametric And Non-Parametric Methods Of Technical Efficiency Measurement: An Application To Small Scale Food Crop Productivity In Nigeria.” *Journal of Agriculture and Social Sciences* 4(3).

Ajibolade, E. O. 2005. “Effects of Land Acquisition for Large Scale Farming On the Productivity Of Small Scale Farming In Okitipupa, LGA, Ondo State.” Master’s Thesis, Department of Agricultural Economics And Extension, FUTA, Akure.

Akinbami, J. and S. Fadare. 1997. Strategies For Sustainable Urban And Transport Development In Nigeria*. Transport Policy* 4: 237–245.

Akinola, A. A. and R. Adeyemo. 2008. “Adoption and Productivity of Improved Rice Varieties In Osun State, Nigeria.” *Ife Journal of Agriculture* 23(1).

Akintayo, O. I. 2011. “Output Differentials, Total Factor Productivity and Factor Use Intensity In Rain-Fed Rice Production Systems In Ekiti And Niger States.” Phd 2nd Seminar

Presentation, Department of Agricultural Economics University of Ibadan, Ibadan. Photocopied.

Akinyosoye, V. O. 2000. “Agricultural Development Projects (ADPs) and Food Crops Production in Nigeria Since 70s.” *Nigeria Agricultural Development Studies* 1(1).

Akpan, E. 2009. “Oil Resource Management and Food Insecurity in Nigeria.” Paper presented at the European Report on Development (ERD) Conference in Accra, Ghana, 21st–23rd May.

Alkali, R.A. 1997. The World Bank and Nigeria: Cornucopia or Pandora Box? Kaduna: Baraka Press.

Amaza, P. S., A. Y. Kamara and Jan Helsen. 2005. “Determinants of food crop production and technical efficiency in Guinea Savannahs of Borno State, Nigeria”. *African crop science proceedings* 7.

Amaza, P. S. and D. C. Maurice. 2005. “Identification of factors that influence technical efficiency in rice based production systems in Nigeria”. Paper presented at workshop on policies and strategies for promoting rice production and food security in Sub-Saharan Africa in Cotonou, Benin.

Amaza, P. S., Y. Bila, and A. C. Iheanacho. 2006. “Identification Of Factors That Influence Technical Efficiency Of Food Crop Production In West-Africa: Empirical Evidence From Borno State, Nigeria.” *Journal of Agric and Rural Development in Tropics and Sub-Tropics* 107.

Amaza, P. S., J. C. Umeh, J. Helsen and A. O. Adejobi. 2006. “Determinants And Measurement Of Food Insecurity In Nigeria: Some Empirical Policy Guide.” Contributed Poster Prepared For Presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia

Amos, T. T., D. O. Chikwendu and J. N. Nmadu. 2004. Productivity, Technical efficiency and cropping patterns in the savanna zone of Nigeria. *J. Food Agric. Environ.* 2: 173-176.

Anisude, G. 2010. “Access And Utilization Of Social Capital In Anaocha LGA Of Anambra State, Nigeria.” Bsc Thesis, Department of Agricultural Economics, EBSU, Abakaliki.

Anyaegbunam, H. N., B. C. Okoye, G. N. Asumugha, M. C. Ogbonna, T. U. Madu, N. Nwakor, and M. E. Ejechi. 2010. “Labor Productivity among Small-Holder Cassava Farmers in South East Agro Ecological Zone, Nigeria.” *African Journal of Agricultural Research* 5(21): 2882–2885.

Asenso-Okyere, K., C. Chiang, P, Thangata, K. Andam, and D. Ayalew Mekonnen. 2011. Understanding the Interaction between Farm Labor Productivity, and Health and Nutrition: A Survey Of The Evidence. *Journal of Development and Agricultural Economics* 3(3): 80–90.

Astone, N. and S. Mclanahan. 1991. “Family Structure, Parental Practices And High School Completion.” *American Sociological Review* 56: 309–320.

Awe, H. V. 2006. “Effect Of Non-Institutional Credit Sources Used On Cassava Output In Ethiope East LGA Of Delta State.” Bsc Thesis, Department of Agricultural Economics, UNICAL.

Ayantoye, K. 2009. “Food Insecurity Status and Transitions among Rural Households in South Western Nigeria.” Phd Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

Babatunde, R. and E. Oyatoye. 2005. *Food Security and Marketing Problems In Nigeria: The Case Of Maize Marketing In Kwara State*. International Conference on Research for Development In Agriculture and Forestry, Food and Natural Resource Management.

Babatunde, R. O. and E. C. Martinetti. 2010. “Impact of Remittances on Food Security And Nutrition In Rural Nigeria.” Unpublished Manuscript, Centre for International Cooperation And Development University of Pavia, Italy.

Baiyeghunhi, L.S. 2003. “Economies of Scale And Resource Use Efficiency In Sole Sorghum Production In Giwa L.G.A Of Kaduna State.” Msc thesis, Department of Agricultural Economics And Extension, Ahmadu-Bello University, Zaria.

Balogun, O. L. and S. A. Yusuf. 2011a. “Effects of Social Capital on Welfare of Rural Households in South-Western States, Nigeria.” *Journal of American Science* 7(3): 506–514.

Balogun, O. L. and S. A. Yusuf. 2011b. “Determinants of Demand for Microcredit Among Rural Households In South Western States, Nigeria.” *Journal of Agriculture and Social Sciences* 7: 41–48.

Bandiera, O. and I. Rasul. 2006. “Social Networks and Technology Adoption in Northern Mozambique” *The Economic Journal* 116: 869–902.

Barrett, C. 2002. “Food Security And Food Assistance Programs.” In *Handbook of Agricultural Economics, Volume 2*. Edited by G. Rausser and B. Gardner. Amsterdam: Elsevier Science.

Basher, M. 2010. “The Effect Of Microcredit Package Of the Nigerian Agricultural Cooperative And Rural Development Bank (NACRDB) on Resources Productivity Of Selected Crops in Selected LGAs Of Sokoto State, Nigeria.” Master’s Thesis, The Department of Agricultural Economics, Usmanu Danfodiyo University, Sokoto, Nigeria.

Besley, T. and A. Case. 1994. "Diffusion as a Learning Process: Evidence From HYV Cotton." Manuscript: Princeton.

Bourdieu, P. 1985. “The Forms of Capital.” In *Handbook of Theory and Research For The Sociology Of Education*, edited by J.G Richardson, 241–58. New York: Greenwood.

Bravo-Ureta, B. and E. Pinheiro. 1997. “Technical, Economic, And Allocative Efficiency In Peasant Farming: Evidence From The Dominican Republic.” *The Developing Economies,* XXXV-1: 48–67.

Burt, R. 1992. *Structural Holes, the Social Structure of Competition.* Cambridge, MA: Harvard University Press.

Busch, L. and W. Lacy. 1984. “What Does Food Security Mean?” In *Food Security In The United States*, edited by L. Buschand & W. Lacy. Boulder: West View Press.

Cassar, A., L. Crowley and B. Wydick. 2007. “The Effect of Social Capital on Group Loan Repayment: Evidence from Field Experiments.” *The Economic Journal* 117: F85–F106.

Caldwell, J., L. Orubuloye, and P. Caldwell. 1992. “Fertility Decline in Africa: A New Type of Transition?” *Population and Development Review,* 18(2): 211–242.

CBN (Central Bank Of Nigeria). 2009. CBN Draft Annual Report For the Year Ended Dec. 31st 2008.

Chavas, J., and M. Aliber. 1993. An analysis of economic efficiency in Agriculture: A non-parametric approach. *Journal of agricultural and resource economics*, 8(1):1-16.

Coates, J., A. Swindale, and P. Bilinsky. 2007. Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. USAID.

Coe, M. and J. Foley. 2001. "Human and natural impacts on the water resources of the Lake Chad basin.” *Journal of Geophysical Research* 106: 3349–3356.

Coleman, J.S. 1988. “Social Capital In The Creation Of Human Capital.” *The American Journal Of Sociology* 94: S95–S120.

Cote S. and T. Healy. 2001. *The Well-Being of Nations. The Role of Human and Social Capital.* Organisation for Economic Co-Operation And Development, Paris: OECD.

David, H.D., S. Abdurrahman, R.M Sani, S. Kushwaha, and M. Nasiru. 2009. “Resource Use Efficiency in Irrigated Crop Production by Fadama Users In Bauchi State, Nigeria: Implication For Food Security And Poverty Alleviation.” In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

De Janvry, Fafchamps, and Sadoulet. 1991. “Peasant Household Behavior with Missing Markets: Some Paradoxes Explained.” *Economic Journal*, 101(409): 1400–1417.

Desai, S. 1992. “Children at Risk: The Role of Family Structure in Latin America And West Africa.” *Population and Development Review*, 18 (4): 689–717.

Devereux, S. 2001. “Livelihood Insecurity and Social Protection: A Re-Emerging Issue In Rural Development.” *Development Policy Review*, 19 (4): 507–519.

Diewert, W. and A. Nakamura. 2005. “Concepts and Measures Of Productivity: An Introduction.” In Services, Industries and the Knowledge Based Economy, edited by Lipsey and Nakamura. University Of Calgary Press.

Ebong, V. O., U. S. Okoro and E. O. Effiong. 2009. “Determinants of Technical Efficiency Of Urban Farming In Uyo Metropolis Of Akwa Ibom State, Nigeria.” *Journal of Agriculture and Social Science* 5: 89–92.

Egwuda, Joseph Ekwute. 2001. Economic Analysis of Lowland Rice Production In Ibaji LGA Of Kogi State. Msc thesis, Department of Agricultural Economics and Extension, Ahmadu-Bello University, Zaria.

Ekejindu, I. M., G.O. Udigwe And I.R.C. Chijioke. 2006. “Malaria and Anemia in Pregnancy In Enugu, Southeast Nigeria.” *African Journal of Medical Science.* 35 (1): 1–3.

Ekunwe, P. A. and S. I. Orewa. 2007. “Technical Efficiency And Productivity Of Yam In Kogi State, Nigeria.” *Journal of Applied Sciences* 7(13).

Ekunwe, P. A., S. I. Orewa, and C. A. Emokaro. 2008. “Resource Use Efficiency In Yam Production In Delta And Kogi States Of Nigeria.” *Asian Journal Of Agricultural Research* 2(2).

ESA/UN (Population Division of the Department Of Economic And Social Affairs Of The United Nations Secretariat). 2009. *World Urbanization Prospects: The 2009 Revision* Http://Esa.Un.Org/Wup2009/Unup/.

Fakayode, S. B., R. O. Babatunde, and Ajao Rasheed. 2008. “Productivity Analysis of Cassava-Based Production Systems In The Guinea Savannah: Case Study Of Kwara State, Nigeria.” *American-Eurasian Journal Of Scientific Research* 3(1): 33–39.

Fanegan, I. A. 2010. “Effects of Farm Size on the Productivity of Cassava In Ife-South And Ayedaade LGAs Of Osun State, Nigeria.” Bsc Thesis, Department of Agricultural Economics, OAU, Ile-Ife.

Farrell, M. 1957. “The Measurement of Productive Efficiency.” Journal Of The Royal Statistical Society, 120(3): 253–290.

Fasoranti, M. M. 2006. “A Stochastic Frontier Analysis of Effectiveness Of Cassava-Based Cropping Systems In Ondo State, Nigeria.” Phd Thesis, Department of Agricultural Economics and Extension, FUTA, Akure.

Food and Agricultural Organization (FAO). 2001. Farming Systems And Poverty: Improving Farmers’ Livelihoods in a Changing World. Rome and Washington D.C.: FAO and World Bank.

———. 2002. *The State Of Food Insecurity In The World 2001*. Rome: FAO.

———. 2003a. The State Of Food Insecurity In The World. Rome.

———. 2003b. Trade Reforms and Food Security: Conceptualizing the Linkages. FAO.

Fu, Q. 2004. Trust, Social Capital And Organizational Effectiveness, Masters Thesis, Department Of Public And International Affairs, Virginia Polytechnic, Blacksburg, VA.

Fukuyama, F. 1995. Trust: The Social Values and the Creation of Prosperity. New York: Free Press.

Fulginiti, L. and R. Perrin. 1998. "Agricultural Productivity In Developing Countries." *Agricultural Economics 19*: 45–51.

Haruna, B., U. B. Kyiogwam, I. D. Senchi, and A. Singh. 2009. "Resource Use Efficiency in Cotton Production in Selected Local Government Areas of Zamfara State." In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

Henderson, D. 2003. *"The Measurement Of Technical Efficiency Using Panel Data."* Mimeo, State University Of New York At Binghamton, New York.

Hussain, I., and I. R. Perera. 2004. Improving agricultural productivity through integrated service provision with public-private partnership. International Water Management Institute working Paper 66, Columbia, Sri-Lanka.

Ibrahim, H., M. Bello, and H. Ibrahim. 2009. "Food Security and Resource Allocation Among Farming Households In North Central Nigeria." *Pakistan Journal Of Nutrition* 8(8): 1235–1239.

Ibrahim, H., N. R. Uba-Eze, S. O. Oyewole, and E. G. Onuk. 2009. "Food Security Among Urban Households: A Case Study Of Gwagwalada Area Council Of The Federal Capital Territory Abuja, Nigeria." *Pakistan Journal of Nutrition* 8(6): 810–813.

Ibrahim, H., M. Bello, and H. Ibrahim. 2009. "Food Security and Resource Allocation Among Farming Households In North Central Nigeria*." Pakistan Journal Of Nutrition* 8(8).

Ibrahim, H., S. O. Oyewole, A. A. Abdulrahman, and I. A. Olanrewaju. 2009. "Analysis of Food Security Of Rural Households In Doma Area Of Nasarawa State, Nigeria." In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

Ibrahim, H., N. R. Uba-Eze, S. O. Oyewole, and E. G. Onuk. 2009. "Food Security Among Urban Households: A Case Study Of Gwagwalada Area Council Of The FCT, Abuja, Nigeria." *Pakistan Journal of Nutrition* 8(6).

Idiong, I. C., D. I. Agom, E. O. Effiong, and S. B. Ohen. 2009. "Analysis of Technical And Economic Efficiencies In Rice Production Systems In The Niger Delta Region Of Nigeria." In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

Idowu O., A, C. F. Mafiana, and S. Dapo. 2005. "Anemia in Pregnancy: A Survey of Pregnant Women In Abeokuta, Nigeria"*. African Health Science* 5(4): 295–299.

Idrisa, Y. L., M. M. Gwary, and H. Shehu. 2008. "Analysis of Food Security Status among Farming Households In Jere Local Government Of Borno State, Nigeria." *Journal Of Tropical Agriculture, Food, Environment And Extension* 7(3).

Idumah, F. O. 2006. "Productivity Differentials among Food Crop Farmers in The Niger Delta." Phd Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

IFAD. 2009. Country Program Evaluation: Federal Republic of Nigeria. Report No. 1959–N. Rome: IFAD.

International Institute for Tropical Agriculture (IITA). 2004. *Summary Report on the Nigeria Food Consumption and Nutrition Survey (NFCNS).* Ibadan: IITA.

Kaschula, S. 2008. "Wild Foods And Household Food Security Responses To AIDS: Evidence From South Africa*." Population and Environment* 29: 162–185.

Katungi, E. M. 2007. “Social Capital and Technology Adoption on Small Farms: The Case of Banana Production Technology in Uganda.” Ph.D Thesis, Department of Agricultural Economics, Extension & Rural Development, University Of Pretoria, South Africa.

Key, N. and W. Mcbride. 2003. Production Contracts and Productivity In The US Hog Sector*”. American Journal of Agricultural Economics* 85 (1): 121–133.

Liverpool, S.L.O. and A. Winter-Nelson. 2010. Poverty status and the impact of social networks on smallholder technology adoption in rural Ethiopia. IFPRI Discussion Paper 970. Washington D.C.: IFPRI.

Loury, G. C. 1977. “A Dynamic Theory of Racial Income Differences.” In *Women, Minorities, and Employment Discrimination,* edited by P.A. Wallace and A.M. La Mond, 153–186. Lexington, MA: Heath.

Madise, N., Z. Matthews, and B. Margetts. 1999. “Heterogeneity Of Child Nutritional Status Between Households: A Comparison Of Six Sub-Saharan African Countries.” *Population Studies* 53(3): 331–343.

Maertens, A. 2010. Who Cares What Others Think (Or Do)? Social Learning, Social Pressures And Imitation In Cotton Farming In India. Unpublished.

Manyong, V.M., A. Ikpi, J.K. Olayemi, S.A. Yusuf, B.T. Omonona, V. Okoruwa, and F.S. Idachaba. 2005. *Agriculture in Nigeria: identifying opportunities for increased commercialization and investment*. IITA, Ibadan: IITA.

Marcoux, A., 2002. “Sex Differentials In Undernutrition: A Look At Survey Evidence*.” Population And Development Review* 28: 275–284.

Masterson, T. 2007. Productivity, Technical Efficiency and Farm Size in Paraguayan Agriculture. The Levy Economics Institute Working Paper No. 490.

Maziya-Dixon, B., I. O. Akinyele, E. B. Oguntona, S. Nokoe, R.A. Sanusi, and E. Harris. 2004. *Nigeria Food Consumption And Nutrition Survey 2001–2003.* Ibadan: International Institute for Tropical Agriculture.

Mbam, B. N. and H. O. Edeh. 2011. “Determinants Of Farm Productivity Among Smallholder Rice Farmers In Anambra State, Nigeria*.” Journal of Animal and Plant Sciences* 9(3): 1187–1191.

Mberu, B. 2007. “Household Structure and Living Conditions in Nigeria*.” Journal of Marriage and Family* 69.

Meade, B., S. Rosen, and S. Shapouri. 2007. *Food Security Assessment, 2006.* USDA. Http://Www.Ers.Usda.Gov/Publications/Gfa18/Gfa18.Pdf

Melgar-Quinonez, H., M. Nord, R. Perez-Escamilla, and A. Segall-Correa. 2008. “Psychometric Properties Of A Modified US-Household Food Security Survey Module In Campinas, Brazil.” *European Journal of Clinical Nutrition.* 62: 665–673.

Mellor, J.W., 1988. Food demand in developing countries and the transition of world agriculture. *European Review of Agricultural Economics*, 15(4), p.419-436.

Meludu, N., P. Ifie, L. Akinbile, and E. Adekoya. 1999. The Role of Women in Sustainable Food Security In Nigeria: A Case Of Udu Local Government Area Of Delta State. *Journal of Sustainable Agriculture* 15(1): 87–97.

Muga, G. and W. Onyango-Ouma. 2009. “Changing Household Composition And Food Security Among The Elderly Caretakers In Rural Western Kenya*.” Journal Of Cross Cultural Gerontology* 24: 259–272.

Muhammad-Lawal, A. and O. A. Atte. 2006. “An Analysis Of Agricultural Production In Nigeria*.” African Journal of General Agriculture* 2(1).

Mtika, M. 2001. The AIDS Epidemic in Malawi and Its Threat to Household Food Security. *Human Organization* 60:178–188.

Murillo-Zamorano, L. 2004. "Economic Efficiency and Frontier Techniques." *Journal of Economic Surveys* 18(1): 33–77.

Musa, I.B. 2010. "The Effects Of Formal And Informal Sources Of Agricultural Credit On Yield And Income Of Crop Farmers In Zamfara State, Nigeria." Masters Thesis, Department of Agricultural Economics, Usmanu Danfodiyo Unversity, Sokoto, Nigeria.

Naiken, L., 2003. "FAO Methodology for Estimating the Prevalence of Undernourishment." Proceedings of International Scientific Symposium on Measurement And Assessment Of Food Deprivation and Undernutrition, 26–28 June 2002, 7–47. Rome: Food and Agriculture Organization of the United Nations.

Nigerian Bureau of Statistics (NBS). 2009a. Filling Data Gap 2. NBS.

NBS. 2009b. Annual Abstract of Statistics, 2009.

NISER (Nigeria Institute Of Socio-Economic Research). 2010. "An Analysis of the Socio-Economic Impacts of Climate Change on Nigerian Agriculture." In *NISER Review Of Nigerian Development. 2009/2010, Socio-Economic Impact Of Climate Change In Nigeria.* Ibadan: NISER.

Nord, M., A. Satpathy, N. Raj, P. Webb, and R. Houser. 2002. *Comparing Household Survey-Based Measures of Food Insecurity across Countries: Case Studies in India, Uganda and Bangladesh.* The Gerald J. and Dorothy R. Friedman School Of Nutrition Science and Policy. Food Policy And Applied Nutrition Program Discussion Paper No. 7.

Obayelu, A. E. 2010a. "Classifications of Households into Food Security Status In The North-Central Nigeria: An Application Of Rasch Measurement Model." *Journal Of Agricultural and Biological Sciences* 5(3).

———. 2010b. "Global Food Price Increases And Nutritional Status Of Nigerians: The Determinants, Coping Strategies, Policy Responses And Implications." *Journal Of Agricultural and Biological Sciences* 5(2).

———. 2010c. "Classification Of Households Into Food Security Status In The North-

Central Nigeria: An Application Of Rasch Measurement Model". *Journal of Agricultural And Biological Science* 5(3).

Ogen, O. 2007. The Agricultural Sector and Nigeria's Development: Comparative Perspectives from the Brazilian Agro-Industrial Economy, 1960–1995. *Nebula* 4(1): 184–194.

Ogundari, Kolawole. 2006. "Economic Efficiency of Food Crop Production in Ondo State of Nigeria." Msc Thesis, Department of Agricultural Economics And Extension, FUTA, Akure.

Ogunniyi, L. T. 2011. "Economic Efficiency of Leafy Vegetable Production in Oyo State Nigeria." *Report and Opinion* 3(1). Http://Www.Sciencepub.Net/Report.

Ogunsanya, S. B. 2009. "Effects of Rural Non-Farm Income on Agricultural Productivity in Lagelu LGA, Oyo State." Bsc Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

Ogunsemi, C. F. 2006. "Nutritional Poverty Analysis of Households in Ekiti State." Msc Thesis, Department of Agricultural Economics and Extension, FUTA, Akure.

Ohajianya, D.O., Oguoma, N.N and S.U. Onyeagocha. 2006. "Stochastic translog profit frontier approach to measurement of profit inefficiency in Yam production in Imo State, Nigeria". *J. of Agric. & Soc, Research (JASR),* Vol.6, No.1.

Ojo, A. 2005. “Economic Analysis Of Irish Potatoe Production Innovations Among Contact Farmers In Plateau State.” Msc Thesis, Department of Agricultural Economics and Extension, Ahmadu-Bello University, Zaria.

Ojo, M. A., U. S. Mohamed, A. O. Ojo, and R. S. Olaleye. 2009. “Return To Scale And Determinants Of Farm Level Technical Inefficiency Among Small Scale Yam Based Farmers In Niger State Nigeria: Implications For Food Security.” *International Journal of Agricultural Economics and Rural Development*.

Ojo, M. A., U. S. Mohammed, B. Adeniji, and A. O. Ojo. 2009. “Profitability and technical efficiency in irrigated onion production under middle Rima valley irrigation project in Goronyo, Sokoto State, Nigeria”. *Continental Journal of Agricultural Science* 3: 7–14.

Okafor, F. 2004. “Analysis Of Trends In Production, Area Harvested, Yield Per Hectare Of Major Root And Tuber Crops In Nigeria (1961–2003).” Msc Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

Okezie, C.A. and B.C. Okoye, 2006. “Determination of Technical Efficiency among Eggplant *(Solanum* sp.) Farmers Using The Stochastic Frontier Model in Isialangwa Area of Abia State, Nigeria.” *Agricultural Journal* 1: 119–122.

Okolo, D. 2004. *Regional Study on Agricultural Support, Nigeria’s Case*. FAO. Http://Www.Fao.Org/Tc/Tca/Work05/Nigeria.Pdf

Okoye, B. C., C. E. Onyenweaku, O. O. Ukoha, G. N. Asumugha, and O. C. Aniedu. 2008. “Determinants of Labour Productivity on Small-Holder Cocoyam Farms In Anambra State, Nigeria*.” Scientific Research and Essay* 3(11): 559–561.

Okunmadewa, F. Y., S. A. Yusuf, and B. T. Omonona, 2007. “Effects of Social Capital on Rural Poverty In Nigeria*.” Journal Of Social Science* 4(3): 331–339.

Olayide, S.O. and E. O. Heady. 1982. *Introduction to Agricultural Production Economics.* First Edition. Ibadan: Ibadan University Press.

Oladeebo, J. O. 2006. “Economic Efficiency of Rain-Fed Upland Rice Production in Osun and Oyo States Of Nigeria.” Phd Thesis Department of Agricultural Economics and Extension, FUTA, Akure.

Oladejo, Oyelami-Benjamin. 2005. “Food crop production in selected local government areas of kwara state”. BSc project submitted to the department of Agricultural economics, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Olawepo, V.O. 2010. “Analysis of Productivity and Poverty Status Of Root And Tuber Crop Expansion Programme Farmers In Kwara State.” Msc Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

Olomola, A. S. 2002. *Social Capital, Micro-Finance Group Performance and Poverty Implications In Nigeria.* Paper presented at the Center for the Study of African Economies (CSAE), March 18–19.

Oluwafemi, O. S. 2005. “Economic Analysis of Household food security in South-western Nigeria”. PhD thesis submitted to the department of Agricultural Economics and Extension, Federal university of Technology, Akure, Ondo State, Nigeria.

Oluwatayo I. B. 2009. “Towards Assuring Households’ Food Security In Rural Nigeria: Have Cooperatives Got Any Place?” *International Journal Of Agricultural Economics And Rural Development* 2(1): 52–60.

Oluwatayo, I. B., A. B. Sekumade, and S. A. Adesoji. 2008.” Resource Use Efficiency Of Maize Farmers In Rural Nigeria: Evidence From Ekiti State*.” World Journal of Agriculture Sciences* 4(1).

Oluwatosin, F. M. 2011. “Measuring Technical Efficiency Of Yam Farmers In Nigeria: A Stochastic Parametric Approach.” *Agricultural Journals* 6(2).

Omotesho, O. A., M. O. Adewumi, A. Muhammad-Lawal, and O. E. Ayinde. 2006. "Determinants of Food Security among The Rural Farming Households In Kwara State, Nigeria." *African Journal of General Agriculture* 2(1).

Oni, O., J. Pender, D. Phillips, and E. Kato. 2009. *Trends and Drivers Of Agricultural Productivity In Nigeria*. Nigeria Strategy Support Program (NSSP) Report 001: IFPRI.

Oni, A. O., O. I. Y. Ajani, B. T. Omonona, and J. O. Lawal. 2009. "Effects of Social Capital on Credit Access among Cocoa Farming Households In Osun State, Nigeria." *Agricultural Journal* 494.

Onyeka, T. J., A. G. O. Dixon, R. Bandyopadhy, R. U. Okechukwu, and B. Bamkefa. 2004. *Distribution and current status of bacterial blight and fungal diseases of cassava in Nigeria*. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

Onyenweaku, C.E. and D.O. Ohajianya. 2009. *"*Technical Efficiency of Rice Farmers In Ebonyi State, Nigeria." *Journal of Agriculture and Food Sciences* 3 (2): 175–184.

Opata, P.I. 2008. "Analysis of Informal Women's Cooperative Micro Finance Societies in Enugu State, Nigeria." Msc Thesis, Department of Agricultural Economics, UNN, Nsukka.

Orewa, S. I. and C. O. Iyangbe. 2009. "Household Food Insecurity In Nigeria: An Assessment Of The Present Status Of Protein – Energy Malnutrition Among Rural And Low-Income Urban Households*." Journal of Applied Sciences Research* 5(10): 1615–1621.

Oruonye, E. 2011. "An Assessment of Fadama Dry Season Farming through Small Scale Irrigation System in Jalingo LGA, Taraba State" *International Research Journal of Agricultural Science and Soil Science* 1(1): 014–019.

Oseni, S. O. 2001. "Econometric Analysis of Productivity Of Tuber Crops In Nigeria (1966–1998)." Msc Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.

Otitoju, M. and C. J. Arene. 2010. "Constraints and Determinants of Technical Efficiency in Medium-Scale Soybean Production in Benue State, Nigeria*." African Journal of Agricultural Research* 5(17): 2276–2280.

Oviasogie, D. I. 2005. "Productivity Of Yam-Based Farming System In Edo State, Nigeria." Msc Thesis, Department of Agricultural Economics, FUTA, Akure.

Peke, O. R. 2008. "Economic Analysis of Food Crop Farming Under Ekiti State ADP." Msc Thesis, Department of Agricultural Economics And Extension, FUTA, Akure.

Phillip, D., E. Nkonya, J. Pender, and O. A. Oni. 2009. *Constraints to Increasing Agric Productivity in Nigeria:* A Review. IFPRI-NSSP Background Paper 6.

Portes, A. 1998. "Social Capital: Its Origins and Applications in Modern Sociology." *Annual Review of Sociology* 24: 1–24.

Putnam, R. 2000. Bowling Alone: The Collapse and Revival of American Community. New York: Simon and Schuster.

Raphael, I. 2008. "Technical Efficiency of Cassava Farmers in South Eastern Nigeria: Stochastic Frontier Approach." *Agricultural Journal* 3: 152–156.

Roslan, A. H., R. Ismail, and N. A. Abdul-Razaq. 2010. "The Relationship between Social Capital and Quality Of Life among Rural Households In Terengganu, Malaysia." *International Journal Of Sustainable Development* 1(5).

Roslan, A, A. Nor Azam, and R. Ismail. 2010. "Does Social Capital Reduce Poverty? A Case Study Of Rural Households In Terenggamu, Malaysia*." European Journal of Social Science* 14:4.

Sadoulet, E. and A. De Janvry. 1995. *Quantitative Development Policy Analysis*. Baltimore: The Johns Hopkins University Press.

Schreiber, J., F. K. Stage, J. King, A. Nora, and E. A. Barlow. 2006. “Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review.” *The Journal of Educational Research* 99(6): 323–337.

Sen, A. 1981. Poverty And Famines: An Essay On Entitlement And Deprivation. Oxford, Clarendon Press.

Serrat, 0. 2009. *Social Network Analysis. Knowledge Solutions.* African Development Bank.Http://Www.Adb.Org/Documents/Information/Knowledge-Solutions/Social-Network-Analysis.Pdf

Shehu, J. F., J. T. Iyortyer, S. I. Mshelia, and A. A. U. Jongur. 2010. ”Determinants of Yam Productivity And Technical Efficiency Among Yam Farmers In Benue State Nigeria.” *Journal of Social Science* 24(2).

Shehu, J. F. and S. I. Mshelia. 2007. “Productivity and technical efficiency of small scale rice farmers in Adamawa state, Nigeria. *Journal of agricultural and social sciences 3(4).*

Shehu, J. F., S. I. Mshelia, and A. K. Tashikalma. 2007. “Analysis of technical efficiency of small scale rain-fed upland rice farmers in north-west agricultural zone of Adamawa state, Nigeria.” *Journal of agriculture and social sciences 3(4).*

Singh, I., L. Squire and J. Strauss (eds.). 1986. *Agricultural Household Models—Extensions, Applications and Policy.* Baltimore: The Johns Hopkins University Press.

Smith, L., H. Alderman, and D. Aduayom. 2006. *Food Insecurity in Sub-Saharan Africa.* Research Report No. 146: IFPRI.

Sowunmi, F. A. and J. O. Akintola. 2010. “Effect Of Climatic Variability On Maize Production in Nigeria.” *Research Journal of Environmental And Earth Sciences* 2(1): 19–30.

Staatz, J., M., Boughton, H, Duncan, and C. Donovan. 2009. Food Security in Developing Countries. In *Critical Food Issues: Problems and State-Of-The-Art Solutions Worldwide*, edited by Laurel Phoenix and Lynn Walter. Westport, CT: Praeger Publishers.

Sunusi, Abdu Yusuf. 2007. “Economic Analysis Of The Use Of Micro-Credits In Rice Production Among Small Scale Farmers In Dambatta LGA Of Kano State.” Bsc Thesis, Department of Agricultural Economics and Extension, Bayero University, Kano.

Tanko, L. and A. J. Jirgi. 2008. “Economic efficiency among small holder arable crop farmers in Kebbi State, Nigeria.” *Continental Journal of Agricultural Economics 2.*

Taru, V. B., H. Lawal, and I. Tizhe. 2011. “Technical efficiency of sole cowpea production in adamawa State, Nigeria: A Cobb-Douglas stochastic frontier function”. *Journal of economics and international finance 3(8).*

Ukoha, O. O, B. C. Okoye, and J. Emetu. 2010. *Analysis Of The Determinants Of Total Factor Productivity among Small-Holder Cassava Farmers In Oha a L.G.A Of* Abia State.

MPRA Paper No. 26125. Http://Mpra.Ub.Uni-Muenchen.De/26125/

United Nations. 1975. Report of the World Food Conference, Rome 5-16 November 1974. New York: United Nations.

United Nations Development Program. 2009. *Human Development Report, 2009.* New York: United Nations Development Programme.

University of Texas. Maps. http://www.lib.utexas.edu/maps/nigeria.html

Usman, Abdullateef and Abdulgafar T. Ijaiya. 2010. ”Agricultural Trade Liberalization And Food Security In Nigeria.” *Journal of Economics and International Finance* 2(12): 299–307.

Usman, S., B. Ahmed, and R. A. Omolehin. 2010. “Analysis of technical efficiency of Sesame production system in Jigawa State, Nigeria.” *Savannah journal of Agriculture 5.*

Webb, P., J. Coates, E. A. Frongillo, B. Rogers, A. Swindale, and P. Bilinsky. 2006. "Measuring Household Food Insecurity: Why It's So Important And Yet So Difficult To Do*." Journal of Nutrition 136:* 1404S–1408S.

Wiebe, K., M. J. Soule, C. Narrod and V. E. Brenneman. 2003. "Resource quality and agricultural productivity: A multi-country comparison" in *land quality, agricultural productivity and food security: Biophysical processes and economic choices at local, regional and global levels.* Edward Elgar publishing, 2003.

Wunderlich, G. and J. Norwood. 2006. "Food insecurity and hunger in the United States: An assessment of the measure", National Academic press, Washington, D.C.

Yaro, Muhammed Abdu. 1999. "Economic analysis of groundnut production in Dambatta LGA of Kano State". MSc project at Agricultural-Economics and Extension Department, Ahmadu-Bello University, Zaria.

Yusuf, S.A. 2008. "Social capital and household welfare in Kwara State", *Nigeria. J. hum.ecol., 23(3).*

Yusuf, B.I., K.M. Baba, Mohammed, I. and S.D. Dogondaji. 2009. "Determinants of rice production: A guide for food security policy in Nigeria", In *"Sustaining Agricultural growth to meet national economic development goal".* Proceedings of the 23rd Annual conference of the farm management association of Nigeria, FAMAN. (Muhammed I.; Kyiogwom, U.B.; Hassan, W.A.; Ala, A.L.; Singh, A. and Dogondaji, S.D**.** , eds) .

Yusuf, M., Kyiogwom, U.B., Olukosi, J.O. and B.I. Yusuf. 2009. "Factors affecting supply of locally produced rice", In *"Sustaining Agricultural growth to meet national economic development goal".* Proceedings of the 23rd Annual conference of the farm management association of Nigeria, FAMAN. (Muhammed I.; Kyiogwom, U.B.; Hassan, W.A.; Ala, A.L.; Singh, A. and Dogondaji, S.D**.** , eds) .

Zakari, Abdu Salaam. 1997. "Socio-economic analysis of the production of selected main crops involved in cross-border trade in Katsina State of Nigeria". MSc project at the Agric-Econs and Extension Department, Ahmadu-Bello University, Zaria.

Zepeda, L. 2001. "Agricultural Investment, Production Capacity and Productivity" in *Agricultural Investment and Productivity in Developing Countries,* L. Zepeda, editor. Rome: FAO, 2001.