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Exploring the potential of cassava for agricultural growth and economic development in Nigeria

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EXPLORING THE POTENTIAL OF CASSAVA FOR AGRICULTURAL GROWTH AND ECONOMIC DEVELOPMENT IN NIGERIA

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At no time during the registration for the research degree- PhD under the Department of Geography, Earth & Environmental Sciences at the University of Plymouth has the author been registered for any other University award without prior agreement of the Graduate Committee. This study was self-financed. Relevant scientific seminars and conferences were regularly attended at which work was presented; external institutions were visited for consultation purposes and several papers prepared for publication.

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ABSTRACT: The decline in agricultural productivity in Nigeria is linked to a host of factors ranging from unsustainable growth policies, inadequate funding and infrastructures, low levels of value added through processing, low commodity prices, unstable markets, poor extension services and low rates of literacy. It is now well recognised that there is a need to diversify Nigerian agriculture as well as improving production performances. This study investigates the potential of cassava root tuber (CRT), as a means to promote agricultural growth. It assesses cassava production, profitability, efficiency, marketing structures and channels, constraints in production, the potential to add value by processing cassava into gari (a fermented, roasted, and dried granule) and its marketing at the farm level. These were supplemented by a critical review of policies and programmes, including trend analysis of cultivated area, production, yield and prices of major crops including cassava at the national level covering the period 1970–2009. The study surveyed 315 cassava producers (including 278 gari processors), 105 marketers involved in cassava marketing and 30 stakeholders from three regions in the Delta State, Nigeria. Descriptive statistics are used to analyse the socio-economic characteristics of the sample. In addition, profitability of CRT and gari and their marketing were assessed by benefit-cost analysis. Furthermore, productivity and efficiency of CRT and gari and their determinants were analysed using non-parametric DEA followed by Tobit regressions. Results indicate that cassava production and processing is profitable in all regions and for all farm size categories. The BCR is estimated at 2.83 and 1.22 for CRT and gari, respectively. However, the yield level of CRT and gari is very low, estimated at 7.7 t/ha and 4.7 t/ha, respectively. Also, efficiency levels are very low and vary by farm size as well as regions, with large scale producers relatively more efficient. Marketing of cassava in any form is profitable and efficient (Marketing Efficiency>1 in all cases) and profitability varies widely across regions. Provision of water was identified as the main constraint in processing, followed by shortage of electricity and poor marketing infrastructure. The review of past policies and trend analysis revealed inconsistent policies and fluctuations in agricultural productivity, but also showed increases in total production mainly driven by expansion of the area cultivated during later years, for cassava in particular. The policy implications include: (a) increased provision of modern technologies, use of improved varieties and modern technology; (b) land reform policies to consolidate farm size; (c) investment in elements of marketing infrastructure; and (d) improvements in extension services. Despite inconsistencies in policies, cassava stood out as a robust and resistant crop which provides confidence that targeted investment in the cassava sector will contribute to development of Nigerian agriculture.

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Signed___________________________

Date ____________________________

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VARIABLE DEFINITIONS AND ACRONYMS

Output	Measured as kilograms of cassava root tuber harvested
Inputs	The input variables are defined as follows
Land	Area (ha) planted to cassava by the farmer
Labour	Amount of both own and hired labour (man-days) used
Fertiliser	Amount of fertiliser (kg)
Seed	Amount of seed (kg) used. (In the case where farmers purchase seedlings for transplantation, the cost of purchase is converted to weight of seed by using standard methods). 1 bundle =11-13kg of cassava cuttings
Land rent	Amount of rent paid (Naira/ha) for the use of land by tenants (imputed for the owner operators)
Wage	Wage (N/day) paid to agricultural labour (imputed for family supplied labour)
Seed price	Price of seed (N/kg) used for rice cultivation (in case of seedlings purchased, it is converted to equivalent seed quantity to determine the imputed seed price)
Fertiliser price	Weighted average of the prices of the three types of fertiliser (N/kg)
Farm-specific Variables:	
Experience	Number of years the farmer has been producing cassava
Family size	Number of people in household
Working adults	Number of working family members in the farm household. This variable, and the one above, are used to pick up possible disguised unemployment
Education	Years of schooling completed by the farmer
Land cultivated	Total area of land cultivated by the farm household
Tenancy	Dummy variable for tenure status. The value is 1 if the farmer is an owner operator and 0 otherwise
Non-agriculture income share	Proportion of total household income obtained from non-agricultural sources
Extension contact	Dummy variable to measure the influence of agricultural extension on efficiency. Value is 1 if the farmer has had contact with an Agricultural Extension Officer in the past year, and 0 otherwise
Training	Dummy variable to measure the influence of agricultural training on efficiency. Value is 1 if the farmer had any training on agriculture in the past seven years, and 0 otherwise
N=Naira	Currency unit in Nigeria (Exchange Rate 1 US Dollar = N116-N120 (£200-218) in 2008)

ACGS	Agricultural Credit Guarantee Scheme
ADP	Agricultural Development Project
AE	Allocative efficiency
CAP	Common Agricultural Policy (EU)
CBN	Central Bank of Nigeria
CBO	Congressional Budget Office
CE	Cost efficiency/Economic efficiency
CPI	Consumer Price Index

CRT	Cassava Root Tuber
DC	Delta Central region
DEA	Data Envelopment Analysis
DMUs	Decisions Making Units
DN	Delta North region
DS	Delta South region
EU	European Union
FAO	Food and Agricultural Organization
FAOSTAT	FAO Statistics
GATT	General Agricultural Agreement on Trade and Tariffs
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
IMF	International Monetary Fund
LAC	Latin America and the Caribbean
LGA	Local Government Authority
MANR	Ministry of Agriculture and Natural Resources
MT	Metric Tonnes
N	Naira
NACB	Nigeria Agricultural Cooperative Bank
NACRDB	Nigerian Agricultural Cooperative and Rural Development Bank
NEPAD	New Partnership for Africa Development
NISER	Nigerian Institute of Social and Economic Institute
OECD	Organisation of Economic Co-operation and Development countries
PCU	Projects Coordinating Units
RCMP	Root Crop Monitoring Programme
ReSAKSS	Regional strategic and knowledge support system
RMRDC	Raw Material Research and Development Council
RP	Rupees
RTEP	Root and Tuber Extension Program
SAP	Structural Adjustment Programme
SDR	Standard Drawing Right
SME	Small and Medium-Scale Enterprise
SPFA	Stochastic Production Function Analysis
SSA	Sub-Saharan Africa
TE	Technical efficiency
UK	United Kingdom
UNCTAD	United Nation Conference for Trade and Development
USD	United State Dollar
USDA	United State Department of Agriculture

CHAPTER 1

INTRODUCTION

The forthcoming analysis explores the potential of root tubers (cassava) to generate agricultural growth and economic development in Nigeria. Before outlining the aims, key hypotheses and conceptual framework of this study, this chapter sets the conceptual and theoretical scene for this investigation by considering agricultural production constraints in Africa (Section 1.1), the potential of cassava as a driver of agricultural growth (Section 1.2), key factors affecting agricultural growth in developing economies (Section 1.3), and finally assessing the Nigerian economy, particularly the importance of agriculture (Section 1.4).

1.1 Agricultural Production Constraints in Africa

Agricultural production has been characterized by various constraints in least developed countries (LDCs), especially in sub-Saharan Africa (SSA). These range from lack of adequate research in science and technology, ineffective utilization of soil resources (i.e. low nutrient status and risk of erosion), low commodity prices, and unstable markets for agricultural products (Saingbe, 2010; Awoyinka,2009; Okuneye et al., 2003; Sanginga et al., 2003; 2002a; Wada et al., 2002; Olasantan, 2001; Vanlauwe et al., 2001b; Haque et al., 2000). All these constraints are frequently accentuated by a lack of sustainable resource management strategies critical for agricultural development. According to Brown and Kennedy (2005), lack of capital is an important constraint for agricultural production resulting in the production of staples for household consumption, but with little or nothing left for the wider market. Low commodity prices also discourage farmers from producing surplus which, in turn, discourages new entry into farming (Rosen and Shapouri, 2012; World Bank, 2012; OECD, 2010, 2009).

African economies, particularly in SSA, are adversely affected by several key factors influencing agricultural production. These include lack of improved seed varieties, poor access to markets, poorly developed marketing facilities, deficient credit facilities, inadequate storage facilities, shortage of all-weather roads, and irregular supply of electricity (Taiwo, 2006; Nweke, 2004 Alderman and Shively, 1996). Unstable political and economic business environments, coupled with frequent reforms of agricultural policies, have lead to low levels of agricultural production and a decline in agricultural and economic development often leading to low incomes, poverty, hunger and food insecurity (Azih, 2008; Shadmehri, 2008).

Most African agricultural yields are well below the global average, almost one-third of those of Asia and half of those of South America (Muhamma-Lawal and Otte, 2006; FAO, 1997; 1999). Moreover, average cereal productivity in Africa has increased slowly with yield levels of just over 1.2 mt/ha, whereas the world average yield level is 3.5 times higher at 4 mt/ha (FAO, 2012; Langintuyo, 2011; World Bank 2010). African agriculture is also characterized by low levels of input use and modern technologies (e.g. inorganic fertilizers, irrigation, and modern seed varieties). Indeed, since the early 1980s, the rate of application of modern inputs in Africa's cropland has hardly changed (Rosen and Shapouri, 2012; Reardon et al., 2000). This has resulted in low productivity, making it cheaper to bring additional land into cultivation rather than to invest in maintaining long-term productivity of existing land (Asadu et al., 2004).

As a result, many studies suggest that economic and agricultural stagnation have plagued SSA for quite some time (Azih, 2011; Benin et al, 2010; Nweke, 2004; Madhusudan, 2004; Vernier et al.). According to the FAO (2010), in the last three decades agriculture in the region, in addition to losing export markets, has failed to increase the production of food calories per capita above 2100 kcal/day, while all other major regions in the developing world have improved significantly. According to Rosen and Shapouri, (2012) and FAO (2006), per capita food production in Asia has increased by 0.5 percent per year during 1961-1980, whereas in SSA it fell by 1.2 percent over the same period. Even where there is an increase, gains in production are not in proportion with the pace of population growth (World Bank, 2012).

However, in order to feed a likely world population of around 9 billion by 2050, food supply is required to double from existing levels (World Bank, 2012; World Report, 2011; Kruse, 2010), suggesting that SSA will be confronted with an increasing food deficit gap. If average food production per capita in Africa between 1979-81 is set at 100, it amounted to only 94.5 in 1986-1988, and even today the gap is still wide and between 1990 and 2008 decreased by about 16 percent (USDA, 2010; World Bank 2007). Nonetheless, several authors have argued that Nigeria and other African countries have the potential to become major markets for food and fibre, but that this potential has not been fully exploited due to poverty, disease, corruption, civil war, poor infrastructure such inadequate grain storage facilities, transportation and lack of information systems to communicate new research findings and policies (Phillips et al, 2009; Knipscheer et al., 2007; Wiggins, 2000). In addition, per capita income in SSA averages less between $1 and $1.50 per day, which greatly limits the ability of 586 million people living in the region to import products to meet their consumption requirements (World Bank, 2007). This has induced research programmes such as the Collaborative Study of Africa (COSCA) to examine the potential and constraints of particular crops and cropping systems to bridge the food deficit gap (Benin et al., 2010).One of these crops is cassava, whose potential for agricultural growth will be discussed in the next sections.

1.2 Potential of Cassava as a Driver of Agricultural Growth

One method of addressing the food deficit gap for countries in SSA is to introduce agricultural crops that are high yielding and drought resistant. Recent innovations in cassava (*Manihot esculenta crantz*) production show that it is possible to produce up to 22 mt/ha. Given the small size of farms in the sub-Saharan African region, cassava production may have the potential to create the needed production intensification while simultaneously reducing per unit production cost. In addition, recent studies have shown cassava to be of great promise in international trade. Indeed, demand for cassava derivatives such as starch, gari, tapioca, etc have doubled over the last two decades (Nweke 2003). Africa already produces 42 percent of world cassava output with Nigeria and Ghana as leading producers, but who can only process 16 percent of the root tuber for home industrial uses and export (Ayoade and Adeola, 2009; Knipscheer et al., 2007; Nweke, 2004). Cassava processing at household level is an important income generator in poor rural areas, particularly for women, not only in Africa but also in Latin America and Asia. Several studies suggest that cassava has good potential to contribute to economic diversity and could create many opportunities for the development of other processing industries (Kaine, 2011; Sanni et al., 2009; Odebode, 2008; Echebiri and Edaba, 2008; Haggbade, 2007; Olomola, 2007; Ospina and Wheatley, 2007; Nassar and Ortiz, 2006; Nweke, 2003; Camara et al., 2001).

Cassava is a perennial shrub which is cultivated in tropical and sub-tropical climate. It is grown for its tuberous bulky roots which contain about 80 percent carbohydrates (Erhabor et al., 2007). The root takes about 6-18 months to mature and is the world's fourth most important staple crop after rice, wheat and maize and is, therefore, an important component in the diet of over one billion people (Van der land et al., 2007). One important advantage of cassava is that it has a wide range of uses ranging from consumption to industrial use based on the level of processing of the cassava root tuber (CRT). CRT is boiled or steamed before eating, but can also be processed into *gari*, starch, *akpu*, tapioca, and dried chips among others. *Gari* are fine white or yellow granules processed from harvested CRT which is peeled, then grated into pulp, then fermented, dried and roasted into fine granules. *Akpu* is a pasty product of cassava, which is sieved and then fermented, boiled or cooked and pounded to pasty moulded products. Tapioca is produced from peeled CRT, sliced into chips, then soaked, fermented, dried or roasted into dried flakes. Further processing involves grinding and milling into flour. The principal users of cassava products are flour mills, biscuit factories and confectionaries, glue and adhesive producers, ethanol distillers, pharmaceutical industries, livestock and aquaculture farmers, and restaurants, among others (Fasuyi and Aletor, 2005; Obikaonu et al., 2005). The next section will examine main drivers/constraints for cassava production performances in Africa, and more specifically in the Nigerian context.

1.3 Key Factors Affecting Agricultural Growth in Developing Economies

Many studies have argued that efficient land use, value addition through processing, good links between producers and consumers, available market opportunities, good policy frameworks and provision of required infrastructure provisions are key factors influencing Africa's agricultural productivity, as has been the case in other countries like China, Thailand, Brazil and Mexico that resulted in a substantial reduction of rural poverty (Abler, 2010; OECD, 2010; FAO, 1999). Below some of the key drivers of agricultural productivity and efficiency are discussed in more detail.

1.3.1 Farm size and agricultural production efficiency

One main issue that has featured in several studies worldwide is the role of farm size on agricultural productivity which shows mixed results depending on the particular nature of case studies. For example, Wadud and White (2000) suggested that in Bangladesh technical inefficiency decreases with farm size and that farmers with good soils were significantly more efficient. Studies carried out by Gul Unal (2008) and Van Zyl (1995) also supported the view that large-scale farms are generally inefficient when compared to small-scale farms. Adesina and Djato (1996) and Udry et al. (1995) noted that small wheat farmers in the Indian Punjab were more economically efficient than large-scale farmers (also found in in Burkino Faso). The same conclusions were reached in Nigeria by Anyaebunam (2012) and Okoye et al. (2009). Similarly, Taddese and Krishnarmoortly (1997) reported significant differences in technical efficiency across farm size groups of paddy farmers in Pakistan, arguing that small and medium-sized holdings were operating at higher efficiency than large farms. The reason forwarded by them is that since accessibility to institutional finance depends on asset positions, small farms were forced to allocate their meagre resources more efficiently, as they cannot receive finance as easily as large farms.

However, Alvarez and Arias (2004) noted that there are also a number of studies that failed to come up with concrete evidence of differences in relative technical, allocative and economic efficiencies between small and large farm sizes. Thus, Murthy et al. (2009) Al-hassan (2008) and Ghose (1979) all argued that land size does have significant impacts on the level of technical efficiency. Cornia (1985) also asserted that those who find inverse relationships between farm size and efficiency often advocate land redistribution into smaller-units for small farms from land taken from large-scale farms.

On the other hand, Perdomo and Mendiata (2007), Chirwa (2003), Owen (2003) and Rahman (1998), among others, argued that large-scale farms are more efficient than small sized farms – a tendency also supported by Oyewo, (2011), Ogundari and Brummer (2011), Agom et al.

(2011), Ebong et al. (2009), Rahman and Umar (2009), Yusuf and Malomo (2007) for Africa. Overall, therefore, substantial debate continues about farm size as a driver/indicator of efficiency.

1.3.2 Value addition to cassava through processing

One way to promote agricultural growth is to add value to the raw product through processing. Increasing area under cassava cultivation as well as yield without proper storage facilities and a lack of provisions to link CRT to the market for enhancing local consumption and/or the industries may discourage cassava growth. Many studies (e.g., Folayan and Bifarin, 2011; Wihemina, 2009; Mafimisebi 2007; Abolaji et al., 2007) noted that value addition through processing of CRT improves returns on investment and that processing is profitable. Chukwuji et al. (2007) and Farinde et al. (2007) similarly argued that the problem of spoilage of CRT could be overcome through processing. Abolagi et al. (2007) further argued that the value chain in Nigeria is imperative to the sustainability of the cassava sector, as it will help strengthen links between supply and demand in the most effective way. Furthermore, Kaine (2011), Chukwuji et al. (2007) and Osomtimehin et al. (2006) concluded that processing increases CRT shelf-life in storage, and that value addition leads to an increase in marketing margins of the processors, although realising the full potential was greatly affected by low levels of technical efficiency. On the other hand, Olaleye et al. (2007) argued that gari processing fails to satisfy the profit maximization objective of firms. They concluded that the traditional approach of processing leads to increased expenses and decreased profit. In a similar vein, Ayoade and Adeola (2009), Knipscheer et al. (2007) and Liverpoor et al. (2010), among others, argued that CRT production, processing and marketing were constrained by government agricultural policies and the poor state of infrastructural provisions. Overall, therefore, there is continuing debate about the best ways to add value to cassava production through processing.

1.3.3 Infrastructure and agricultural growth

Studies assessing drivers for increases in agricultural production, particularly CRT, also tend to agree that private and public participation and investment and upgrading of rural infrastructures will not only reduce costs of cassava production but also improve effectiveness and efficiency of cassava production, processing and marketing in Nigeria (e.g., Eze et al. 2010; Walkenhorst, 2007; Adeniji, 2006; Manyong et al. 2005). In particular, Ogunsumi et al. (2010) and Adejoh (2009) noted that having no or limited contact with extension officers results in having no information on improved technologies and practices. Other constraints about infrastructure include poor feeder roads and limited access to clean water, electricity and educational facilities.

These constraints ultimately raise production and marketing costs and lead to unstable output prices, as well as reducing productivity incentives for farmers (Adejoh, 2009; Yusuf et al. 2009; Fasoranti 2006). Highlighting the myriads of infrastructural problems confronting Nigeria, Oladele (2012) particularly suggested that infrastructure development is one of the key factors for national growth and economic development, and listed ways to overcome constraints including involvement of private participation, diversification of sources of power, independence of the judiciary, setting up of infrastructure commissions, and strict adherence to the rule of law to fight corruption. It is evident, therefore, that with good programmes and policies, the performance and income of farmers, especially cassava growers, processors and marketers, could be improved.

1.3.4 Policy reforms and agricultural growth

Implementation of effective policies is a crucial step for improving cassava production and efficiency. Among the range of policies, the Structural Adjustment Programmes (SAP) and trade liberalization were the most influential ones that were designed and imposed by the International Monetary Fund (IMF) and the World Bank. These sought to improve supply response in productive sectors of the economy through correction of policy-induced distortion as well as the management of domestic demand to encourage growth and thus to provide financial resources to alleviate debt and balance of payment problems through reduction of direct government participation in production (Okoye et al. 2008; Sahel and West Africa/OECD, 2005; Garba, 2000; Shadmehri, 2008; Mabogunje 1990; Asiedu-Saforo, 1989).

According to CBO (2005), the total annual economic benefit to the world in 2015 from efficiency gains and investment that will result from full agricultural liberalization from 2005 through to 2010 was estimated to be in the range of approximately $50 - $185 billion or 0.1 percent to 0.4 percent of the value of world output of all goods and services. It was assumed that the effect of liberalization policies on the rate of growth in production could, additionally, raise the estimate between 50-100 percent on the value of outputs (CBO, 2005).

A number of studies on SAP and economic liberalization policy suggest that these policies have led to increased production of food crops and associated reduction of imported food crops by increasing prices of local commodities as well as by making imports more expensive through appropriate tariffs (Azih, 2008; Eboh et al., 2004). However, Azam (1999) argued that SAP was also a source of inflation during 1980-1993 in Nigeria and other LDCs, and most recent studies (Rojas, 2006; Bangoura, 2005; Losch, 2004; Garba, 2001; Reardon et al.,

2000) concluded that SAP policies have led to pauperisation of citizens, decline of the state and increased problems of indebtedness. Many of the countries that were involved with SAP, including Nigeria, Ghana, Kenya, and Mexico are still experiencing such effects on their economy.

As a result, Bangoura (2005), Ugwu and Ukpbi (2000), and Lall (1995) argued that intervention can be distorting and costly if it is not tailored towards particular market failures. As an example, import substitution measures were characterized by inefficiency and waste rather than promotion of dynamic competitiveness. The authors suggest that policy reforms that work are those that address specific market failures that exist, including policies involving selective intervention in export-led marketing initiatives, carried out by well-trained technocrats and backed by human capital investment. A number of good examples of these were seen in the newly industrialized countries of Eastern Asia which adopted such measures and succeeded in creating dynamic competitive industries (World Bank, 2010).

Policy reform is clearly necessary in SSA, since the economic performance of the region has been very poor and the pattern of intervention to support development and industrialization has been haphazard and inefficient. In the present context, there is a particular dispute about the efficiency of factor and product markets, the role of interventions in remedying market failures, and the need to accelerate increases in crop production, harvesting, and processing to add value. The limited absorptive capacity of the world market, and sharp competition between LDCs for the export of tropical crops, means that supplies are increasing more than demand, leading to associated reduction in price. As a result, in the last ten years prices for crops (cereal) have fallen by 20 percent (FAO, 1999), and food prices also eased by 1.2 percent in 2012, although they fluctuated greatly between 2009-2012 (World Bank, 2012;

Gioe, 2006 and Humphrey, 2006). The importance of agriculture for growth and economic development could be expanded only if appropriate policies were set up to support it further, since research shows that agriculture is important to early stages of development (Gollin et al, 2002).

Given these debates, the present study will concentrate on Nigeria, one of the largest economies in Africa, which has lost its past strengths in agriculture due to various reasons. The next section, therefore, takes a closer look at the importance of agriculture for the Nigerian economy, all the while acknowledging that crude oil has been seen as the main engine of economic growth in Nigeria over the past few decades.

1.4. The Nigerian economy and the importance of agriculture

Agriculture was the mainstay of the Nigerian economy before the advent of crude oil. The sector still employs about 70 percent of the country's labour force and is still largely in the hands of peasants and rural smallholders. Large scale farming and plantations are limited, and there is a low level of mechanization (Izuchukwu, 2012; Phillips et al., 2009; Nweke, 2006; Nweke, 2004; Asadu et al. 2004; FAO and IFAD, 2004; Ezeagu, 2002). In the 1960s, the agricultural sector accounted for about 70 percent of Gross Domestic Product (GDP) but then started to decline sharply to 16.6 percent in 2004, although rising slightly to 23.7 percent in 2005 (Eboh et al., 2012; World Bank 2006; Manyong, 2003; Ayoola, 2001, Mbada, 1992). Nigeria was once the largest exporter in the world of cocoa, rubber, cotton, hides and skins, accounting for 30 percent of total export and 70 percent of non-oil export (Okoro and Ujah, 2009; Mogues et al., 2008; Alhassan, 2003). However, production of these cash crops has dropped, as has their importance in terms of international trade, largely due to attention being drawn away from promoting agricultural growth towards mining and exporting of oil. Other food and potentially exportable crops in Nigeria based on its climatic and agro-ecological conditions are sorghum, maize, millet, groundnut, cowpea, soya beans, cotton and onions in the northern belt, and cassava, yam, cocoyam, oil palm, rubber, cocoa, banana, plantain, maize and oranges in the middle and southern belts.

With the emerging body of information and research on agricultural development programmes and agricultural policies, most studies on Nigeria have concentrated on the implications of various agricultural policies and their effects on food production and rural incomes, the sustainability of food production, and the cultivation of crops for export (e.g. Wheatley, 2001; Wiggins, 2000). Other areas of research have focused on the use of modern technology in food production (e.g. Xuedong, 2006). The "baseline" projections (based on future food production using statistictis from 1997 as a basedline to calculate food production up to 2020) indicate that, as world population expands by about 900 million inhabitants in the current decade combined with changing dietary needs, food consumption will increase by almost 50-70 percent worldwide and by 80 percent in developing countries. To match this increase, world output of basic foodstuffs will have to grow by 1.6 percent per year (Kruse, 2010; FAO, 2006). This will place considerable pressure on natural resources of any economy. Farmers have two options: to intensify production in areas already in use, or to expand cultivation into new areas. The commodities likely to grow most rapidly are those responsive to income changes, including oil crops, sugar, tropical beverages, cereals, meat (poultry) and raw material and basic food stuffs (Manyong et al., 2005).

The key question is how Nigeria could benefit from this predicted increase in food demand and the potential export growth from Third World countries? Ayoade and Adeola (2009) and Nweke (2004) suggested that there is a need in Nigeria and Ghana to access the potential for the use of cassava as an industrial raw material (e.g. dried cassava roots, cassava starch or derivatives; see above). They found that market and farm level information is vital for research and policy intervention aimed at accelerating cassava transformation in both countries. Carlous and Galvez (1999), in his study to identify and assess market opportunities for rural smallholder producers, concluded that with globalisation and opening of the world economy, it is increasingly necessary to link small producers with markets through producing value added products. The main priority should, according to Carlous and Galvez (1999), be given to what is already produced, rather than proposals for additional alternatives of agricultural production. Moreover, Aluko (2000) emphasized the need to shift Nigeria's source of foreign exchange from oil and gas to untapped agricultural resources like cocoa, palm oil, grains, etc. Although he failed to mention cassava, Aluko (2000) argued that for agriculture to be productive, the presence of peasant and subsistence farming methods must be discarded completely to give way for large scale or commercial farming.

In countries such as Nigeria there is a lack of an active supply chain between producers and the agro-industries. It is known that agricultural development is one of the drivers with which growth in the agricultural sector can be realized through horizontal diversification and/or vertical integration (OECD, 2004; Delgado, 1995). To meet the challenges of Nigeria's rapidly growing needs, one indispensable tool is knowledge of the natural environment and sustainable use of its resources. The characteristics of the environment, its capabilities and limitations determine its potential for agriculture, and this enables farmers to obtain the best from their efforts. Ayoade and Adeola (2009) Ezedinma et al. (2002) and Adeogbo, (1996) also reported that no supply chain structure links with industrialization of secondary cassava products as a primary source for agro-industries. The International Institute for Tropical Agriculture (IITA) (2005) further asserted that the production cost for cassava is relatively high compared to other countries and that production is not oriented towards commercial use. Awerije (2004) conducted a review of Nigerian agricultural policies and found that agricultural policy has impacts on the growth and fiscal macro-economic policies, which in turn have effects on the prices and uses of agricultural inputs. Increases in the prices of produce will lead to an increase in production, and suggestions were advanced that further studies should encourage exploration of the alternative uses and markets for local/staple agricultural produce, particularly cassava - a call directly addressed in this present study. Indeed, research should be conducted on how to improve yield, quality and storage facilities through the application of scientific research and development. Wiggins (2005), in his study of the key elements of agricultural growth success, further concluded that strong demand for export of tropical products was a driver, and was affected when the primary commodity prices fell.

Nonetheless, since the early 1970s episodes of notable growth have been observed for some Nigerian regions, and for some particular crops, although sometimes these have been short-lived. Examples of these are open pollinated varieties of maize in the middle belt of Nigeria (Smith et al. 1993) and peri-urban production of dairy, fruits and vegetable in the city of Kano (Mortimore 1993). Sustaining success has often proved problematic and most studies agreed with Wiggins (2005) that access to markets, high prices and associated demand for agricultural surpluses, and factors that are endogenous (e.g. population) in Boserup's hypothesis, come out strongly as drivers of growth (Boserup, 1969). Given effective demand, the most likely result is agricultural growth that will generate greater output surplus for sale and higher income for farmers, with multiplier effects. Many studies (e.g., Woecles, 2006; Ruben et al. 2006; Losch, 2005; Brown and Kennedy, 2005; Wiggins, 2005; Barbier, 2000;

Adrangi, 1999) have suggested that the effect of prices and margins also affect the levels of production of food for sale.

According to Palmer-Jones and Sen, (2006), economic development can be achieved through agricultural growth and increased prices of crops. Watershed development in rain-fed zones may, therefore, enhance agricultural productivity, but fundamental constraints of unsuitable topography and soils in many areas will limit the potential for agricultural growth. There is, however, another body of critical literature that links failure of agricultural growth to external influences or factors such as colonization. The colonies were forced to produce cash crops to the neglect of staples (Langintuyo, 2011; Nweke, 2006), and Grote (2001) has viewed external demand raised from environmental and food safety as another constraint. Pressures from the International Monetary Fund and World Bank to poor countries have also encouraged production for export (Nweke, 2004).

Another body of literature particularly links low agricultural productivity and low incomes in developing countries in the South to lack of information and infrastructures development (Saingbe and Ibrahim, 2010; Knipscheer et al., 2007; Rahman, 2003; Rahman, 2002). Studies also show that positive agricultural development, with effective policy formulation and implementation, in places where the agricultural sector is integrated with the industrial sector, has resulted in added value both in the domestic market as well as for export.

1.4.1 Potential of cassava in Nigeria

With these issues in mind, what is the potential for cassava in Nigeria? Africa produces 42 percent of the world cassava output. Nigeria and Ghana are the leading producers for cassava but can only process 16 percent of the root tuber for home industrial uses and for export (Ayoade and Adeola, 2009; Knipscheer et al., 2007; Nweke, 2004). Cassava processing at the household level is an important income generator in poor rural areas, particularly for women, not only in Africa but also in Latin America and Asia. Cassava has good potential to contribute to economic diversity and could create many opportunities for the development of other processing industries (Kaine, 2011; Sanni et al., 2009; Odebode, 2008; Echebiri and Edaba, 2008; Haggbade, 2007; Olomola, 2007; Ospina and Wheatley, 2007; Nassar and Ortiz, 2006; Nweke, 2003; Camara et al., 2001; Scott et al., 1992). Recent studies have particularly focused on technical, allocative, economic and environmental efficiency (Sekhon et al, 2010; Shamsudeen et al, 2011; Ogundari and Brummer, 2011; Rahman, 2002) as means of improving agriculture performance and outputs.

Yet, while the countries in some SSA countries are experiencing slow increases in levels of food production and export (Rosen and Sapouri, 2012), the yield gap between SSA and countries like China, Thailand, Brazil and Mexico is increasing. These economies, by boosting their agricultural output and export, have reduced the level of rural poverty significantly (Rosen and Sapouri, 2012; Abler, 2010).

However, no single study has so far closely looked at how to improve productivity and efficiency of CRT, especially with regard to its processed products such as gari. As discussed earlier, there are also controversies regarding farm size and productivity in agricultural crops in general. Therefore, it is important to understand the relationship between farm size and productivity performance of cassava, as well as gari, in a Nigerian context. Furthermore, the discussion above has highlighted that other socio-economic factors may affect performance of producing CRT as well as gari. In addition, little is known about market performance, marketing margins, market structure and marketing constraints of cassava and its processed products in Nigeria.

While cassava does well even in drought regions of Nigeria, Nigeria's Delta State is ranked among the upper 10 percent of the country's producers, and well over 80 percent of the farmers are engaged in its production here. This prominence in cassava production is one of the reasons that the Delta State is known as the 'food basket' of Nigeria. The present research study on cassava as the potential sources of growth in agriculture and economic development will, therefore, be conducted in the Delta State of Nigeria.

1.5. Study Objectives

This study is based on the assumption that opportunities exist in the Delta State of Nigeria to achieve agricultural growth from the production, processing and adding value to cassava through processing. This study, therefore, aims to investigate the potential of the staple tuber crop of Nigeria, i.e. cassava, as a means to promote agricultural growth. This will be done by assessing cassava production profitability, production performance in terms of productivity and efficiency, marketing practices and structure, level of marketing margins and efficiency, constraints in marketing, and the potential to add value by processing cassava into gari, and, finally, to discuss policy implications based on the findings. For this purpose, the Delta State in Nigeria has been selected as the case study area.

The specific inter-related objectives are as follows:

(1) To assess the production of cassava at farm-level in the Delta State, Nigeria,

(2) To assess the profitability of cassava production at farm-level,

(3) To estimate the level of productivity and efficiency of cassava at farm-level,

(4) To estimate the level of productivity and efficiency of gari (processed cassava) at farm-level,

(5) To examine marketing structures, conduct and performance of cassava marketing,

(6) To assess the market for cassava substitutes in Nigeria and the scope to generate value added from cassava,

(7) To identify constraints in cassava production at farm-level, and

(8) To review changes in Nigerian agricultural policy (1970–2009) and examine its effects on cassava production.

1.6 Research hypothesis

Based on above discussion, a number of research hypotheses underpin this research:

(1) There is a positive relationship between farm (firm) size and productivity, efficiency as well as profitability of cassava production,

(2) There is a positive relationship between value addition through processing of CRT (i.e. gari) and productivity, efficiency and profitability,

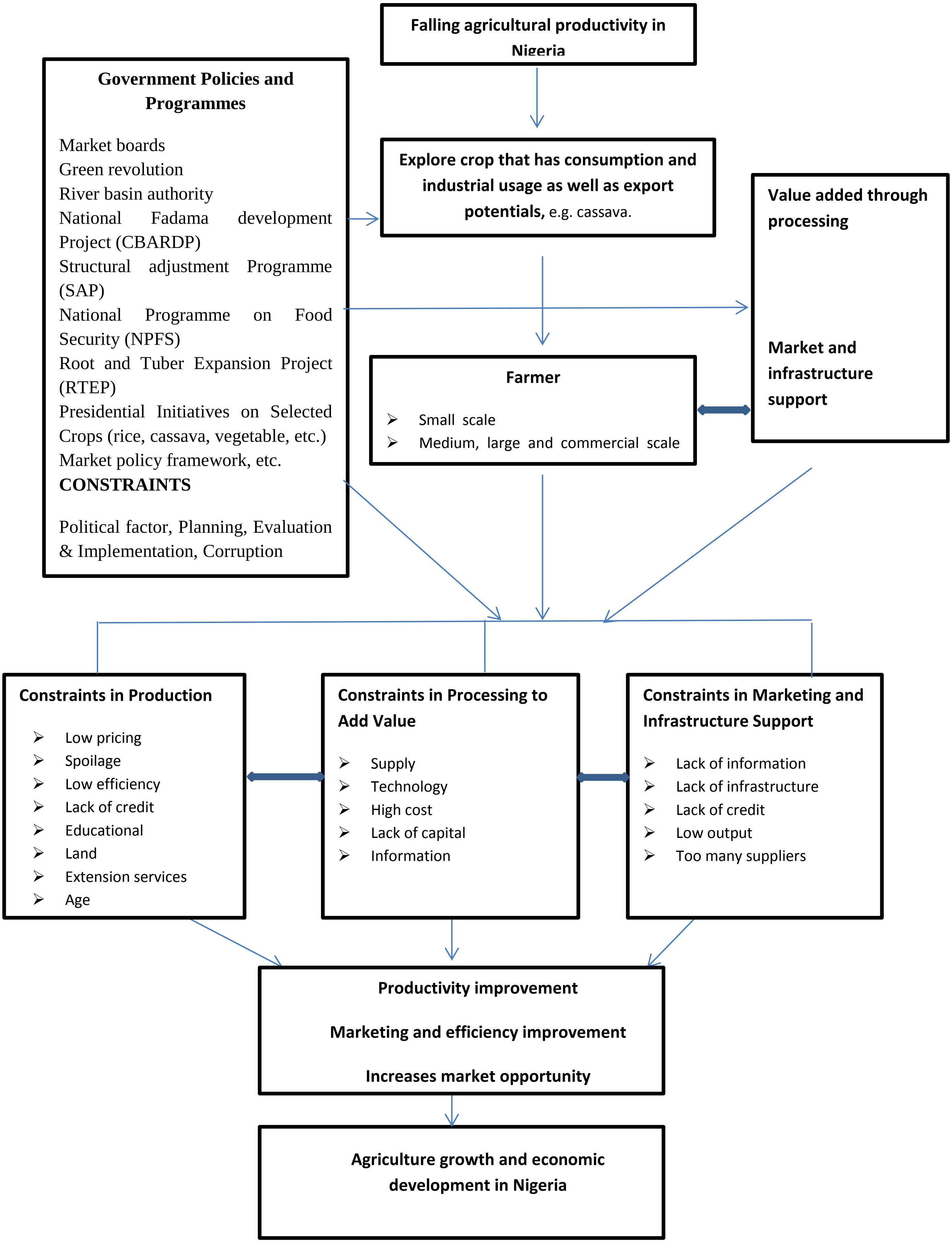
(3) There is a positive relationship between processed CRT and marketing efficiency, and finally,

(4) There is a positive relationship between changing Nigerian agricultural policies and production of cassava over time.

1.7 The conceptual framework

The main assumption underlying this research study is that opportunities exist in the Delta State of Nigeria to achieve agricultural growth from the production, processing and adding value to cassava through processing. The goal is to aid agricultural growth and economic development through the provision of reliable and stable markets which also encourage prices that will sustain farmers in agriculture, while processing for added value will increase revenues and marketing margins from the sale of products, increase shelf life and reduce

Figure 1.1 Conceptual Framework



wastages (Barrett and Mutambatsere, 2005; Pritchard, 1995). Vertical integration in production is, thus, seen as instrumental to the linkages between productions and markets (UNDP, 2005; Boland, 2005; Fuglie, 2004; Delgado, 1995).

The framework starts with the realization that agricultural productivity has been falling in Nigeria over time. The key is to explore potential of a crop that has multiple uses, such use as staple crop, and that also has demand for industrial uses as well as for export in various processed forms. Cassava, therefore, is the ideal crop of choice that fits most of the aforementioned criteria. However, above discussion has highlighted that desired results of cassava efficiency have not been achieved so far due to a host of reasons that are not yet fully known. The conceptual framework of this study thus attempts to trace key constraints that may have hindered the realization of such opportunities at various levels of the production process, including problems faced by producers as well as the nature of policies and programmes and operation of the market. Figure 1.1 highlights the main conceptual diagrammatic expression of this framework.

As Figure 1.1 shows, the first step is to examine programmes and policies, legal provisions and infrastructure which have effects (differential or similar) on small, medium, large and commercial farmers. Nigeria, like most other LDCs, witnessed several attempts to create programmes and policies to improve agricultural productivity (Liverpool-Tasie, et al. 2011; Nancy, 2002). Many of these policy initiatives were not successful because they lacked focus, consistency, and were poorly planned and evaluated and implemented ineffectively. Although, several authors were of the opinion that some of the programmes and policies were successful to a certain level, slow growth in the Nigerian agricultural sector could not contribute successfully to economic development as there are few linkages both between these policies and programmes and between the agricultural sector and other sectors of the economy. Additionally, most of the relevant staple root crops (e.g., cassava, yam, and cocoyam) have been neglected in favour of cash crops (e.g., cocoa, rubber, oil palm, groundnut among others). The Nigerian government also invested little to support research on staple crops and in the provisions of infrastructure.

Some recent programmes established to boost agricultural productivity in Nigeria includes: (1) Green Revolution program; (2) National Fadama and Development Program (NFDP), (3) Commodity Based Agricultural and Rural Development Project (CBARDP), (4) National Program on Food Security (NSPFS), (5) Root Tuber Expansion Program (RTEP), (6) Presidential initiative on selected crops (e.g., rice, cassava and vegetable), (7) Marketing policy framework among others. Most of these programmes encouraged technology adoption and expanded some farmers' access to input use, credit and extension services (Orounye, 2011; IFAD, 2009). However, although some of these programmes led to slow increases in production (Oni et al. 2009, Liverpool et al. 2006), they did not translate into increases in revenue, profits and efficiency for farmers (Agom et al. 2012, Eyitayo et al. 2011, Liverpool-Tasie et al. 2011). Many authors have particularly argued that these programmes were not successful since they are unable to explore and exploit the potential of CRT and other crops as a source of raw material for agro-industries to gain a wider market for local, regional and international markets.

As Figure 1.1 suggests, the next step is to examine the series of constraints affecting the cassava production system. These range from constraints in production, processing (to add value to cassava) marketing, and infrastructure support. The constraints in production may include low prices of output, spoilage, low level of efficiency, lack of credit facilities, education and literacy of the farmers, land availability and farm size, extension services, age of farmers, and level of modern technology adoption. Constraints in potential to add value in cassava are due to lack of supply of CRT as not all CRT produced are diverted for processing, level of technology involved, high costs of processing, lack of operational capital and information. Constraints in marketing and infrastructure include in particular lack of information, lack of basic infrastructure such as all-weather roads, storage facilities, electricity, transportation facilities, lack of credit, low levels of productivity of processed cassava products, and too many suppliers suppressing market prices.

Proper identification and examination of the extent of these production, processing and marketing constraints will, therefore, enable improvements in productivity and efficiency of cassava production, as well as processing and marketing, that will ultimately benefit the farmers, processors, and traders linked to the supply chain of the cassava production system. Thus, this study assumes that promotion of cassava will contribute positively to agricultural growth and economic development of Nigeria.

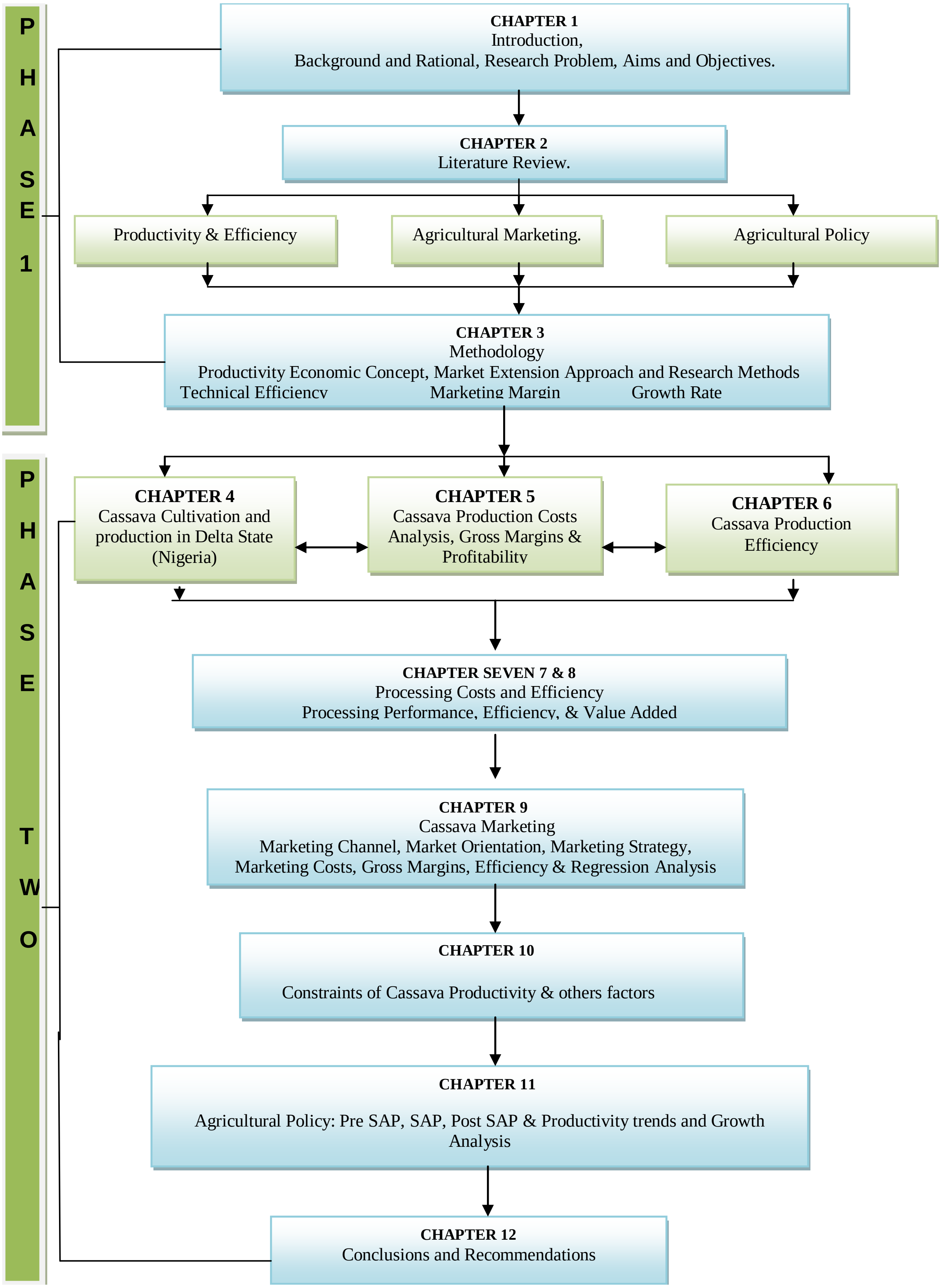
1.8. Organisation of the Study

The structure of the thesis is organized into two parts and comprises 12 chapters as shown in Figure 1.2: Part 1, comprising of Chapters 1, 2 and 3. Chapter 1 discusses the background and rationale of the study aim and objectives, research hypothesis and the conceptual framework. Chapter 2 presents the literature review of related studies including identification of the knowledge gap in the literature. Chapter 3 discusses the research methodology including a description of the study areas, data collection procedures and analytical methods used to achieve the objectives.

Part 2 is the main body of the study results including discussions and conclusions arranged in 8 chapters. Chapter 4 reports physical productivity of cassava; it discusses the physical relationship between input factors of production and output. This is followed by Chapter 5 which evaluates the economics of cassava production by analysing costs of cassava production, gross margin and profitability of cassava in the case study area. Chapter 6 estimates the various efficiency measures of cassava production, with a focus on technical, cost and allocated efficiencies in cassava production, and identifies sources of inefficiencies. Chapter 7 examines the processing of Cassava into its most popular use gari, and examines how additional value could be generated into cassava root tubers through processing into gari. The costs, gross margin and profitability of cassava processing are also discussed. Chapter 8 then estimates all the aforementioned efficiency measures for processed cassava (*gari)* and examines the potential market for value added cassava products. Chapter 9 is devoted to analysis of market and marketing of cassava. It examines marketing channels, marketing chains and structures, and also assesses cassava marketing costs, margins, profitability and marketing efficiency. It also examines the factors that affect the gross margin of cassava marketing. Chapter 10 discusses the production, processing and marketing constraints of cassava as revealed by various stakeholders engaged in the production, processing and marketing of cassava.

Chapter 11 provides an analysis of agricultural policies implemented over a 39-40 year period in Nigeria. This chapter particularly analyses the growth in production of cassava and other important staples, and also assesses the effects of agricultural development policy on production of cassava and other agricultural products in Nigeria over time. Finally, Chapter 12 synthesises the main findings, and draws conclusion and policy implications arising from this research. The chapter also makes some recommendations for future research.

Figure 1.2 Thesis structure



CHAPTER TWO

Review of Literature on Agricultural Productivity and Cassava Production

2.1 Introduction

The measurement of productivity performance has remained an important area of research in developed and developing countries. This is of great importance for developing countries in particular when considering the potential to increase agricultural production through enlarging cultivated areas, in addition to developing and adopting new technologies which in many cases is very limited. Studies on the measurement of productivity performance can inform policy to promote agricultural growth and development through increases in production, for increases in farm level efficiency (utilising existing resources and technology) or the diversification of output produced (Ball and Norton, 2002).

This chapter begins with a discussion of the definition and key terms concerning productivity and agricultural productivity, the key contemporary measures of productive efficiency and the major factors affecting productivity. Having established this foundation, the chapter focuses next on evidence from the wide range of empirical studies, first, on the production and processing of cassava; second, on the use of the contemporary measures of productive efficiency for a range of crops; and third turning to evidence of the efficiency of production and processing of cassava. This naturally then leads to a review of the position of marketing in economic development, a key consideration in this study and an area which often presents major constraints in many developing countries. Finally, attention returns to the position of agriculture in the 'growing' of a national economy and the place of agricultural policy in the promotion of such growth in developing economies. The chapter concludes by identifying the research gap which provides the focus for this study.

2.1.1 Conceptualising of Productivity and Efficiency

The productivity of a production unit means the ratio of its output to its input, and productivity will vary according to differences in technology, in the efficiency of the production process and in the production environment (Kaitpathomchai, 2008). The terms productivity and efficiency are often used interchangeably but they are not the same (Jayamaha and Mula, 2011). Productivity is an absolute concept and, as mentioned above, is measured by the ratio of outputs to input. The maximum possible output becomes relevant in order to find answers to certain economic questions, such as the measurement of the efficiency of an enterprise.

According to Bifirin et al (2008) “Efficiency is a very important factor of productivity growth, especially in developing agricultural economics, where resources are meagre and opportunities for developing and adopting better technologies are dwindling” (Ali and Chaudhry, 1990). Jayamaha and Mula (2011) define efficiency in terms of the comparison of two components (inputs and outputs), with the highest productivity level from each input level referred to as the ‘efficient situation’. This has led to the introduction of frontier production functions which estimate the maximum output as a function of inputs. Similarly, this could also be applied to cost functions, which would give the minimum cost as a function of output quantity and inputs. In this case, efficiency is measured by comparing observed and optimal values of the output produced from the inputs.

Coelli et al (2005) mention a detailed treatment that is provided by Fare, Grosskopf and Lovell (1985; 1994) and Lovell (1993). They explain that efficiency measurement began with Farrell (1957), who drew upon the work of Debrew (1951) and Koopmans (1951) to define a simple measure of firm efficiency that accounts for multiple inputs. Coelli et al (2005) further stated that Farrell (1957) proposed that the efficiency of a firm has two components: technical efficiency, which reflects the ability of a firm to obtain maximal output from a given input, and allocative efficiency, which reflects the ability of a firm to use the inputs in optimal proportions, given their prices and production technology. These two measures are then combined to provide a measure of the costs or economic efficiency. The TE (Technical efficiency) formulation for all multiple input-output productions is:

$$TE = \text{Aggregate output measure}/\text{Aggregate input measure} \qquad (2.1)$$

This can also be considered as the weighted sum of outputs to the weighted sum of inputs.

TE for an enterprise therefore relates to its ability to:

1) Produce maximum outputs for constant input usage (as output-increasing efficiency) or to
2) Use minimum inputs to generate a constant output production (as the input-reduction efficiency)

According to Ogundari and Amos (2012), and Fried et al (1993), TE measurement generally involves comparing the production plan of decision making units (DMUs) that lies on the efficient production frontier or isoquant. The basic aim of producing efficiently is for profit maximization.

2.1.2 Agricultural Productivity

The measurement of productivity and efficiency in agriculture has been the subject of interest and great concern in the area of economic development, and increases in agricultural productivity are often seen as necessary for economic growth (Ball and Norton, 2002). According to Liverpool-Tasie et al (2011), agricultural productivity is measured as the ratio of final output, in appropriate units, to input. It also refers to output produced by a given level of input in the agricultural sector of a given economy (Fulginiti and Perrin, 1998). According to Olayide and Heady (1982), agricultural productivity could also be described as the ratio of the value of total farm output to the value of total input used in farm production. Umeh et al (2006) assert that agricultural production means the amount of agricultural production in relation to inputs (land, labour, capital, material and technologies, etc.).

Oni et al (2009) and Adewuyi (2006) posit that increasing agricultural productivity requires one or more of the following: increases in output and input, with output increases proportionately greater than increased levels of input; an increase in output, while the level of input used remains the same; a decrease in both output and input with input decreasing more, in proportion to output; or where output remains the same with reductions of input. Liverpol-Tasie et al (2011) assert that increases in production input, in order to raise output, involves raising both the quality and quantity of inputs, such as the use of mechanization in agricultural processing, the use of high yield varieties, fertilizers, irrigation in areas where rainfall is inadequate, and the use of agrochemicals. Langyintuo (2011) argues that increases in agricultural productivity growth by 10 percent can reduce poverty by 4 percent in the short run and 19 percent in the long run, yet agricultural productivity growth in Africa has been disappointingly low. Although the potential for productivity improvement exists, smallholder farmers, making up the vast majority of farmers in developing countries, often cannot afford to invest in these inputs due to their limited resources and restricted access to credit. The critical factors that determine the success or failure of any agricultural policy include the involvement of actors and the consistency of the policy over a range or a period of time. The performance of the agricultural production sectors of every economy hinge on the institutional framework; policy formulation; technology availability and use; and the environment within which these policies are implemented, including the problems and features of the sector, the objectives set and related growth targets (Liverpool Tasie et al. 2011; Ramaila et al. 2011).

2.1.3 Production Technology Sets for Agricultural Production

The concept of production is used to describe the technology or technical relationship between the input(s) and output(s) in the production process of a firm or the decision making units (DMUs), as in microeconomic theory. Production technology, is therefore, very important and provides a key focus in production analysis.

Production analysis is defined as:

The set (X, Y) such that inputs:

$X = (x_1, x_2, x_3, \dots \dots, x_n) \in R_+^i$ transformed into outputs

$Y = (y_1, y_2, y_3, \dots \dots, y_m) \in R_+^i$

Fare et al (1994) describe production technology with the following equation.

$$L(y) = \{x: (y, x) \text{ is feasible}\}, \tag{2.2}$$

Here, the technology set is composed of pairs, (y, x), such that x can produce y or y can be produced from x. Furthermore, the technology set is also known as a 'production possibility set' which explains technical input-output relationships. Agricultural production is commonly related to two types of production technology as with multiple inputs with a single output, and/or multiple inputs with multiple outputs.

According to Kiatpathomchai (2008), the input space or input requirement set, L(y), represents the set of all input vectors that can produce the given output vector y (at least scalar output). The input requirement set which explains the technical-input-input relationship can be defined as follows:

$$L(y) = \{x: x \text{ can produce } y = \{x:(x, y) \epsilon T\} \qquad (2.3)$$

The output set, P(x) represents the set of all output vectors that can be produced by using the given input vector x. The output set which describes technical output-output relationships can be defined as (3) with ϵ as the given technology and T (;) as the technology set.

$$P(x) = \{y: x \text{ can produce } y\} = \{y: (x, y) \epsilon T\} \qquad (2.4)$$

2.1.4 The Production Function

Production technology can be described by using production functions, cost functions, profit functions and revenue functions (Javed, 2009; Coelli et al. 2005). A production function is defined as the relationship between the output and the input of a given production system. Production functions can be represented by a mathematical function or graphical expression. Production functions relate the amount of output (Y) as a function of the amount of input (X) used to generate the output and this input is expressed as:

$$Y = f(X) \qquad (2.5)$$

Where Y is an output, X is a vector of inputs and f(X) is a suitable functional form.

Inputs used in the production process can be grouped into two: variable inputs and fixed inputs (Javed, 2009). The variable inputs are those inputs where quantity changed can be varied and/or used up during a specific production period or circle. Fixed inputs are those inputs which do not change during a specific period of production or circle. In the long run, all production inputs used in the production process are considered as variable inputs.

This can be specified as:

$$Y = f\,(X_1/X_2) \qquad (2.6)$$

Where Y is an output, X_1 is a variable input and X_2 is a fixed input.

Assumptions of a Production Function

According to Beattie and Taylor (1985, cited in Javed, 2009:13, and Varian, 1992, a typical production function is based on the following assumptions:

1. Production activity of a firm is so arranged as a production circle or within a given period and is totally independent of the production in other periods.
2. All inputs and outputs of an enterprise firm are homogeneous
3. The production function is twice continuously differentiable
4. The production functions, output prices and inputs prices are known with certainty
5. There is no limit to input availability
6. The overall objective of a production enterprise is profit maximization or to minimize cost for a given output level

2.1.5 Frontier Measurement Approaches

This study will seek to measure productivity as it affects crop production and processing, as directed by elements of the Cassava Diversification and Marketing Framework (CDMFW), previously discussed in the conceptual framework, in Chapter One. There are several ways in which production efficiency could be measured, and this section will examine the two most common approaches; stochastic production function (SPF) and data envelopment approach (DEA) (Bifarin et al. 2010, Javed, 2009).

Stochastic Production Frontier Function (Parametric Approach)

The parametric frontier approach (econometric) involves an assumption about the distribution of the error terms and the specification of a functional form for production technology. The main strength of the stochastic approach lies in its ability to deal with stochastic noise and to permit the statistical testing of hypotheses pertaining to production structure and the degree of inefficiency (Coelli, 1995). Furthermore, this provides a measure of the reliability of the technical efficiency estimates by means of the standard errors of the model parameters. However, this benefit comes at the cost of imposing assumptions about the functional form of the production technology and the distribution of the inefficiency term. These assumptions affect the analysis and distort efficiency scores (Fraser and Cordina, 1999).

The Stochastic production function assumes the presence of technical inefficiency of production; hence the function is defined by:

$$Y = f(X_i - A_i)\exp(v_i - u_i) \qquad i = 1,2,\dots\dots.,n \tag{2.7}$$

Many econometricians (Saingbe, 2010; Bifarin et al, 2008) have, at various times, criticized the approach for the following reasons:

1) Stochastic frontiers rely on functional form
2) There is no priori justification for selection of a particular distributional form for a one-sided inefficient term
3) According to Fried et al (1993), the distribution of one-sided error must be specified when the model is estimated. This imposes an additional structure on the distribution of technical inefficiency
4) The stochastic frontier production function model cannot easily incorporate multiple outputs

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a mathematical linear programming and non-parametric production performance assessment measurement, originally developed by Charnes, Cooper and Rhodes (1978) to measure the relative efficiency of organisational or decision making units (DMUs). The DEA is deterministic and attributes all deviation from the frontier to inefficiency; a frontier estimated by DEA is likely to be sensitive to measurement error or noise in the data (Bifarin et al, 2008). Avoiding the assumptions inherent in the stochastic approach described above is an advantage of the DEA approach (Jafarullah and Premachandra, 2003). The minimum assumption that DEA requires is the monotonicity and convexity of the efficient frontier (Abdulwadud, 2000). The DEA approach applies linear programming techniques to compute inputs consumed and outputs produced by each DMU and constructs an efficient production frontier based on best practices. The DMU's efficiency is then measured relative to this frontier. This relative efficiency is calculated by obtaining the ratio of the sum of all weighted outputs and the sum of all weighted inputs. The DEA approach is concerned with TE, that is, the physical level of outputs produced and inputs used as compared to Allocative Efficiency (AE), that is, optimum input mix, given input prices and price or Cost Efficiency (CE) and optimum output prices.

DEA measurement allows the analysis of multiple-input multiple-output production technology without requiring the price or cost of variables. Furthermore, it is not necessary for the variables to have the same measurement units. This is very important in this study, where some of the variable costs were not available. The DEA measurement also helps to identify any inefficiency within DMUs, as well as the sources and amount of inefficiency of inputs and/or output. It also incorporates both input-reduction and output –increasing production, as well as constant return to scale and variable return to scale. The input and output orientations will produce the same measurements under constant return to scale but will be unequal under variable return to scale. There are various model specifications used to measure DEA; this study adopts the Charners, Cooper and Rhodes model (CCR) and the Banker- Charnes-Cooper model (BCC) as discussed below.

The CCR Model

This model allows input-reduction and output-increasing orientations and assumes constant return to scale (CRS). The model is an extension of Farrell's (1957) work on technical efficiency and needs complete information on inputs and outputs from a set of homogenous DMUs. The model is a fractional linear program which compares the efficiency of each DMU with all possible linear combinations of other DMUs under consideration. This can be expressed in mathematical terms as follows, for a set of n DMUs, where j has a:

production plan (X_j, Y_j), with $X_j = x_l, x_2,...., x_m)$ inputs; and $Y_1 = (y_1, y_2,...., y_s)$ outputs

Let U = $(u_1, u_2,...., u_m)$ and V= $(v_1, v_2,..., v_s)$ be weight vectors

Let the variables be defined as follows:

c = DMU of TE being measured

x_{jk} = quantity of input used by DMU k

y_{jk} = quantity of output used by DMU k

u_j = weight assigned to input i

v_j = weight assigned to output j

ε = very small positive number

The CCR model is then written as:

$$\max \frac{\sum_{j=1}^{s} v_j y_{jk}}{\sum_{i=1}^{m} u_j x_{ik}} \tag{2.8}$$

subject to $\frac{\sum_{j=1}^{s} v_j y_{jk}}{\sum_{i=1}^{m} u_j x_{ik}} \leq \quad k = (1,2, \ldots \ldots, n)$ (2.9)

$u_i \geq \varepsilon$, $i = \{1,2,\ldots..,m\}$ (2.10)

$u_j \geq \varepsilon$, $j = \{1,2,\ldots..,s\}$ (2.11)

Where TE = 1 indicates full efficiency scale or CRS and TE < 1 indicates scale inefficiency. However, following the successful proliferation in the use of DEA methods, the original model version of the CCR model is seen to be not very convenient for a linear programme, as it has more restraints than variables, making it difficult to solve (Shafiq and Rehman, 2000).

BCC Model

Gul et al (2009) state that Cooper etal. (1978), who introduced the basic CCR model, modified this model to account for the variable return to scale (VRS) condition by adding a convexity constraint in the new BCC model expressed as follows by Banker et al., 1984:

$$Max \quad \sum_{j=l}^{s} v_j y_k$$

$subject\ to \ \sum_{i=l}^{m} u_i x_{ik} = 1$ (2.12)

$$\sum_{j=l}^{s} v_j y_k - \sum_{i=l}^{m} u_i x_{ik} \leq 0 \qquad k = \{1,2, \ldots., n\} \qquad (2.13)$$

This is an input oriented BCC model and could be given as follows: (n) Decision Making Unit (DMU), each producing (m) outputs by using (k) different inputs (Coelli et al. 1998):

$Min_{\theta,\lambda}\ \theta$, (2.14)

Subject to $-y_i + Y\lambda \geq 0$,

$\theta x_i - X\lambda \geq 0$,

$N1'\lambda=1$

$\lambda \geq 0$,

Where;

Ɵ is a scalar, and could be obtained from the efficiency score for the i-th DMU.

$N_{1'}$ is convexity constraints,

y represents output matrix,

x represents input matrix

λ is N x 1 vector of constant.

The value of Ɵ will be the efficiency score for the i-th firm. This linear programming problem must be solved for (n) times, once for each firm sample. A Ɵ value of (1) indicates that the firm is technically efficient, according to the Farrell's (1957) definition. In addition; Aikhathlan and Malik (2010) state that BCC widened the CCR model to account of VRS by adding the following constraints to CRS linear programming:

$$\sum_n \lambda n = 1 \quad (2.15)$$

During the second stage, regression can be used to explain the efficiency scores for various firm-specific factors, so as to identify the factor/key factors affecting technical inefficiency. This analysis can be used to establish the importance of socio-economic and demographic factors, among others. Tobit regression is discussed below as one of the methods used to identify the possible factors associated with inefficiency measurement.

In the model, enterprise specific TE is used as a dependent variable, and its scores are regressed on the explanatory socio-economical and demographic (among other) variables. Dummy variables are also used to measure other levels of group variable.

The Tobit regression to estimate an equation of the general form is:

$$TE = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3, \dots \dots + \beta_n x_n + \epsilon_n \quad (2.16)$$

Where:

TE = mean efficiency scores (latent variable)

x_1, ... x_n socio-economical variables (explanatory variables)

α = parameter

β = parameters that denote the relationship latent and the explanatory variables

ε = error term

This could be alternatively written as (Galannoouolos et al. 2006):

$y_i^* = x_i\beta + u_i$

Advantages of DEA Approaches

The DEA non-parametric approach has the following advantages:

1) It provide a means of decomposing economic efficiency into TE, AL and CE
2) It does not require the assumption about the distribution of the underlying data
3) It does not require the assumption of a functional form to specify the relationship (Coelli et al. 2005)
4) It could easily incorporate multiple input and output cases
5) Application of inputs and outputs can have very different units of measurement without requiring any *a priori* trade-offs or any input prices or costs
6) It is good at estimating "relative" efficiency of a DMU (Saingbe, 2010).

DEA approaches, being mathematical programming methods, are relatively less restrictive but not statistical, and therefore preclude hypothesis testing and the construction of confidence intervals (Lee and Zepeda, 2007). Furthermore, Saingbe (2010) argues that the main criticism of deterministic frontiers is that they rule out the possibility of a deviation from the frontier being caused by measurement error or other noise (such as bad weather). Therefore, any deviations from the estimated frontier are attributed to inefficiency, although “the major weakness of DEA relates to its inability to account for measurement error” (Kalyan, 2002). In addition, Latruffe (2010) argues that DEA results may be affected by sampling variation, suggesting that efficiency scores are likely to be biased toward high scores. Latruffe (2010) also asserted that this bias occurs when the most efficient firms within the population are not contained in the sample at hand, which results in keeping inefficient firms away from the envelopment frontier. It was thus concluded that this limitation could be removed by a new technique of bootstrapping (see Latruffe, 2010:22). However, Banker (1996) and Fare and Grosskopf (1995) propose several statistical tests which have subsequently made DEA a powerful tool for efficiency analysis. Despite its limitations, DEA is surely a competitor with the stochastic production frontier inefficiency analysis. Several researchers, such as Dalton (2004); Reig-Martinez and Picazo-Tadeo (2004); Wadud (2000); Ogunyinka et al. (2004) and Helfand (2003) have used DEA for estimating technical efficiency in agriculture.

Return to Scale

In production theory, the change in output levels as a result of changes in inputs is known as ‘return to scale’ (Fried et al. 1993). Return to scale can be constant or variable. Constant returns to scale (CRS) means that increasing input levels by a given proportion results in increases in output levels in the same proportion (Javed, 2009). On the other hand, variable return to scale (VRS) means that an increase in input level does not necessarily lead to proportional increases in output levels. Thus, output levels could increase (increasing return to scale) or output levels could decrease (decreasing return to scale) by different proportions compared with the input increment (Javed, 2009). Coelli et al. (1998) suggest that the use of a constant return to scale DEA model is appropriate when all firms are operating at optimal scale. The use of the DEA model is therefore appropriate in the agricultural context, however due to a number of unpredictable constraints it is not possible to use it without modification. According to Javed (2009), the use of the constant DEA model results in measures of technical efficiencies that are confounded by scale efficiencies. Bankers et al. (1984) have therefore modified the constant return to scale DEA model to the variable returns to scale model by adding convexity constraints. Convexity can be seen as the second-order condition: the maximum output increases at a non-increasing rate as input levels increase or the marginal product of input is non-increasing (Kiatpathomchai, 2008). Javed (2008) further explains that the use of the variable return to scale model allows the calculation of technical efficiency free from the effects of scale efficiencies.

2.1.6 Methods to Investigate Production Efficiency and Production Constraints

The study of growth rate in agricultural production identifies potential sources of inefficiency and examines potential constraints in the context of agricultural production, thus providing an important step towards improving agricultural productivity (Ball and Norton, 2002).There are several approaches to investigating the relationship between production inefficiencies and various socio-economic and production specific factors. Gul et al. (2011), for example, use two step regression input oriented DEA and Tobit regression to identify the determinants of technical efficiency. In this study, results showed that cotton farmers can save on inputs by at least 20 percent whilst remaining at the same production level. These authors assert that factors strongly affecting the efficiency level of farmers were found to be farmers' age, education level and geographical areas.

In a similar way, Kilic et al (2009) investigate the efficiency of hazelnut farmers on Carsamba plain in Samsum, Turkey. Using DEA and Tobit regression analysis, they found that the production efficiency of hazelnut farmers ranged from 26.1 percent to 100 percent, with mean average of 73.5 percent. Moreover, a significant positive relationship between farmer's education and the efficiency of use of inputs was identified, alone with a significant relationship between farm fragmentation and efficiency.

Dhagana et al. (2000) assert that the technical inefficiency scores from the use of the DEA approach are limited between 0 and 1, and state that the dependent variable in the regression model does not have a normal distribution. This suggests that ordinary least square regression (OLS) is not appropriate and that could lead to biased parameter estimates (Krasachat, 2003). Furthermore, a large data set is required in order to obtain reliable results in OLS methods, and where the regression results are very sensitive to functional form if the error term is not adequately interpreted, this could lead to various conclusions and also may result in biased intercepts. This discussion is not within the scope of this study. In view of these reasons, this study used the Tobit model for second stage regression.

2.1.7 Factors Affecting Levels and Efficiencies of Agricultural Production

According to Olayide and Heady (1982), the classical economics of Adam Smith and David Ricardo focus on physical resources in defining factors of production and they go on to discuss the distribution of cost/value among these factors, referring to them as "component parts of price" simplistic driving forces of production including;

1) Land or natural resources – naturally-occurring resources such as water, air, soil, minerals, flora and fauna that are used in the creation of products
2) Labour – human effort used in production which also includes technical and marketing expertise
3) Capital stock – human-made goods (or means of production), which are used in the production of other goods

4) Entrepreneurs – co-ordinators or managers who combine the other factors of production (land, labour, and capital) in an innovative way to make profit (see also Prahalad and Hammond, 2002).

The productivity of crops also depends, to a greater or lesser extent, on the marketing and distribution of the produce/product to the point of final consumption, which implies provision of a good policy environment to encourage farmers to produce to the satisfaction of consumers and market demand. Moreover, the provision of better processing facilities, good marketing facilities and services, coupled with good infrastructure facilities for market accessibility and information are also important. Research has shown that methods to achieve these have varied enormously over time and space and for different economies. This is mainly due to the endogenous and exogenous factors: availability of natural resources; accessibility of the resources; level of awareness and education; the prevailing climatic condition; technological development; cultural history or value; population factors and the enabling policy framework within which the system and the economy operates (Kiatpathomchai, 2008; Ball and Norton, 2002).

The production of food from the farmer and the processes involved in its marketing and distribution until it gets to final consumption vary globally, and are commonly shaped by different driving forces. For this study, the forces or factors are divided into socio-economic, technological and natural factors. Some of the variables of these factors have great influences on the product itself (e.g. policy, trade, price, research, etc), whilst other variables influence the consumption of the produce (e.g. culture, gender, ageing, information, etc) (Emma, 2011; Akinnagbe, 2010; Phillips et al. 2008; Chukwuji et al. 2007; Grote, 2001). Such variables are discussed in detail in the ensuing sections.

Socio-Economic Factors

Adeoye et al. (2011), Nya et al. (2010), Idiong et al. (2007) and Abang and Agom (2004) discuss the socio-economic characteristics of education, farm size, family size, sex, age, cultivar types planted and source of finance/credit, as they affect crop production.

Education: The educational status (here generally equated to literacy rate) will affect the rate of innovation and the process of information gathering. Abang and Agom (2004), in work carried out in Cross River State, Nigeria, involving 350 farmers, showed that 21 percent of the sample population had no formal education, whilst a further 25 percent had primary education. 36 percent of the farmers had secondary education; the highest proportion. In the sample, only 3 percent of the 350 farmers had higher education (postsecondary). The implication here is that a high proportion of these farmers who can read and write owned cassava farms.

Farm size: According to various studies, farmers with smallscale holdings, those ranging from (0.01 to 1.99 ha), were in the majority, accounting for 75 percent and with a further 19 percent (2.00-4.6 ha) as medium holdings. The remaining farms were greater than 4.6ha and were counted as larger farms (Chekezie et al. 2011; Eze et al. 2011; Ogunbo, 2011; Abang and Agom (2004). So the vast majority of farmers are shown to be small scale farmers. In such populations it can be assumed that it will be very difficult to mechanize farming systems, since small-scale farmers lack capital and credit provision to acquire modern farms inputs and technology.

Age: The predominance of farmers of the younger age bracket indicates the ease of entry into the farming enterprise (Abang and Agom, 2004).

Credit/finance: In a numbers of studies in developing economies, the finance of farmers mostly came from personal savings, family sources and cooperative savings, with bank loans being generally difficult for smallholding farmers to access (Phillips et al. 2008; Okoh, 1999). The limitation of the latter source of finance leads in many ways to inadequate capital to provide for sustainable capitalisation and non-human development, which in many cases, in itself, is responsible for the slow growth of the agricultural sector in many developing countries. Unless this problem is resolved through consistent, sustainable and relevant policy instruments, agricultural development in developing countries will continue to be a mirage according to a number of authors (Carter et al. 2004; Fafchamps and Minten, 2001; Ukpong and Usman, 1991; Osakwe and Ojo, 1986). Whilst other studies suggest that off-farm income and credit facilities are important, it is noteworthy that the use of fertilizer and improved seed is also likely to increase both returns and variance of those returns (Savadogo et el., 1994).

Technological Factors

Improved technologies in the area of breeding, nutrition, improved seed varieties and health are key factors in the future growth of small farmers in mixed crop-livestock systems. A study by Dorward et al. (1998) showed that the last four decades have seen impressive gains in food production, food security and rural poverty reduction in South Asia. Heightened intensification of agriculture through irrigation, fertilizer and pesticide use, along with high yield varieties (HYVs) in more-favoured high potential zones, were the major driving forces for success. Most LDCs have the potential to create skilled workers and investment in research and development to produce innovative new technologies to create new products and to identify more innovative ways of growing and producing high quality products, thus enabling the long-term ability to generate cash flows from investments. This assessment was supported by Asekenye (2012) on the evaluation of the productivity gap among smallholder groundnut farmers in Kenya and Uganda.

*Advanced transport and storage***:** Good distribution networks of roads and communication will provide a range of reliable choices for agribusiness producers to get their products to customers – from place of production to other parts of the district, or other regions of the world. In fact, according to a number of authors, provisions of good infrastructure will increase the efficiency and reduce costs of production, therefore leading to increases in profitability (Gajigo and Lukoma, 2011; Yakassai 2010).

However, many have low precipitation of rainfall, like much of the Semi-Arid Tropics (SAT) and including SSA, have not benefited from improved technology for storage or irrigation (Salami et al. 2010). According to Efole (2004), Low productivity of rain-fed agriculture, coupled with widespread poverty, a changing global environment, water scarcity, and degradation of productive resources (land and biodiversity) are threatening to further marginalize agriculture and livelihoods in such areas.

Access to markets: the distance to towns and major centres has been established as a proxy indicator for market access, with smaller distances to good market facilities encouraging the production of produce for market. This is identified in much work on agricultural growth (Barrett, 2008; Brummett et al., 2008; Gerdin, 2002; Wood et al. 2004; Renkow et al., 2004; Bingen et al., 2003). Part of this factor is that farmers lack information concerning the market for their produce, as well as a lack of a good transportation to the market and other issues around infrastructural facilities.

Natural Factors

Traore et al (2013) and Barrios et al. (2008) list the dominant factors determining crop production as climate (temperature, precipitation, evaporation, light intensity), population, soil classification and soil properties (total-C, total N, CEC, exchange cations, available P, etc), quality of river and ground water available for irrigation, among other factors. Potential crop productivity could be affected as a result of climatic conditions, soil property, and water quality or water irrigation information such as prevalence of flooding or drought. Seasonal variations in precipitation and water requirements of various crops also affect the opportunity to achieve target yield (Mukoto, 2007). Farmers' choices of cropping sequences are also conditioned by socio-economic consideration, just as much as agro-ecological (or natural) factors according to Traore et al (2013).

Political Factors

Apart from the influence of socio-economic, technological and natural factors on crop production as discussed above, political factors can also affect production positively or negatively. Fiscal policies determining measures on prices of farm inputs and outputs, levels of subsidies, tariffs, and budgeting allocation, among others, all have effects on agricultural production (Okoro and Ujah, 2009).

Policies on protectionism, structural adjustment, liberalisation and globalisation are political decisions used to regulate agricultural production and markets (Calva, 2004; Daramola et al, 2007; Chinedu et al., 2010). Agricultural policies set the agenda that will encourage countries to produce enough to satisfy the demand of their populations and to regulate the use of raw materials for industrial processes, such as providing the form in which surpluses could be put to the global market (Fechameps, 2004; Fistscher, 2004).

Several studies have argued that government budgeting and its implementation has direct impacts on the provision of infrastructure, education, extension services, credit facilities with affordable terms and conditions, research on the application of new technologies. These are shown to have affected the costs of production, prices of outputs, profitability of farm produces and overall yield/ha (Kani, 2008; Mogues et al. 2008; Walkenhorst, 2007).

While technological change and increased producer efficiency has contributed more to growth outputs to date, future growth of crop productivity in LDCs will be greatly enhanced by complementing this with policies that favour growth of domestic demand and/or the ability to export in an increasingly competitive international market, through provisions of useful information on markets and technologies, as well as research linkages between institutions and farmers (Nin-Pratt and Yu, 2009; Doiuf, 1989).

In addition, studies have argued that fluctuations in prices; low prices and policy instability have led to declining agricultural production in SSA countries (Mayo et al. 2009; Phillips et al. 2009; Walkenhorst, 2007). Thus, an economic context providing attractive producer incentives, government commitments to develop and willingness to establish a stable policy framework is important for increasing productivity. Furthermore, provision of increases in investments, the existence of clear property rights (which are an incentive for development), use of land and the availability of complementary resources are also important. Lastly, investment in crop related and extension services research has been low (Mayo et al. 2009), with several studies showing that a lack of application of appropriate technology has been an obstacle to the growth of crop production outputs (Mayo et al. 2009; Nin-Pratt and Yu, 2009). Policy that will encourage increased investment in areas as mentioned above may lead to boost increases in crop production.

2.2 Review of Empirical Evidence

Following the review of the concepts of productivity and the consideration of major factors in the evaluation of production and productivity efficiency, this section considers empirical studies. Firstly, studies looking at cassava production are examined, secondly the efficiency of crop production is explored, and finally research on the production and processing of cassava in Nigeria is reviewed in detail.

2.2.1Empirical Studies of Cassava Production

This section examines key empirical studies on cassava production in the last twenty-five years in an endeavour to further determine the key factors influencing production (see Table 2.1). Seasonal variability and price instability are among a range of factors adversely affecting cassava production, with challenges asserted in studies by Okoh (1999) and Okumadewa (1990), where price movement was reported between the seasons of abundant rainfall and late rains and the periods of harvest. Prices were always low during flooding periods. Awoyinka (2009) and Ojo (1990), reporting on the effects of agricultural food production policies, argue that policy has effects on agricultural production. Although productivity increased during SAP and post-SAP periods, the production growth rate in Nigeria, remains low. This will be further examined in Chapter 11.

More specifically concerning constraints of cassava production, several studies indicate that the major constraints on production, at the farm level, were low levels of education, lack of credit provision and the use of low performing varieties of seed (Sanni et al., 2009; Liverpool et al., 2009, Nassar & Ortiz, 2007; Chukuigwe & Onyegraul, 2001). Lack of information was also one of the key factors found to be frustrating policy attempts to improve food production.

Table 2.1 Review of empirical studies on cassava production

Authors	Focus of Studies	Key Points for this Study
Okoh 1999; Okumadewa 1990	Food price behaviour, pricing and marketing integration of cassava roots and products	Seasonal variability of gari and cassava prices.
Awoyinka 2009; Ojo 1990	Effects of SAP on agriculture, the effect of presidential initiative on cassava production efficiency	The impacts of agric. policy on food production.
Liverpool et al 2009; Sanni eta l 2009; Nassar & Ortiz 2007; Chukuigwe & Onyegraul 2001;	Technological constraints to small cassava producers, cassava improvements challenges and impacts	The impact of technology, policy, yield etc. in cassava production
Blair 2010; Echebiri & Edaba 2008; Phillips et al. 2004; Nweke 2002, 2003; Kuglie 2002; Ospina & Wheatley 1991; Gregory et al 1992.	Increases uses of cassava production and processing of root tuber crops, new economics of starchy staples, and assessment of value chain	Identification of new uses of cassava, price competitiveness of cassava and sweet potatoes and new markets, input substitution and creation of employments
Yakassai 2010; Emokaro et al 2010; Brown and Kennedy 2005.	Agric. and human value, economic contribution of cassava production, profitability and viability of cassava marketing in lean and peak seasons	The impact on farm margin and provision of infrastructures on choice of crop production
Mohammed et al 2010; Asere et al 2009; Bamidale et al 2008; Okoye et al 2008; Chukwuaji and Ogisi 2006; Asogwa et al 2006; Ogundari & Ojo 2006.	Empirical evidence of Inverse relationship between farm size and production output, evaluate responses of factors to productions	Identification of production determinants and their effects
Kaine 2011; Davies et al 2008; Odebode 2008; Chukwuji et al 2007; Siregar 2006; Adebayo & Sangosina 2005; Adebayo et al 2003; Camara et al 2001.	Determinants of TE in cassava processing; appropriate technology in cassava processing	Formulating policies that would reduce inefficiencies
Emokaro et al 2012; Amao et al 2007; Graffham et al 2000.	Industrial markets for starch based products	Assessment for import substitution, determination for market potentials and profitability

Source: Compiled by author

Additionally, low levels of processing and/or lack of processing facilities, poor marketing information and low levels of infrastructural provision were noted as major constraints to agricultural growth.

Within this context, however, there has been a good degree of interest in creating and expanding uses of and the market for crops like cassava which could have the potential to hasten agricultural growth rates and economic development. Increases in producers' incomes might also arise from the value added through processing, at the same time reducing waste and, importantly, increasing product shelf life (Blair 2010; Echebiri & Edaba 2008; Phillips et al 2004; Nweke, 2003 among others).

Lastly, Yakassai (2010), Emokaro et al (2010) and Brown and Kennedy (2005) agree that a key prerequisite for the development of the potential for cassava is the improvement/development of infrastructural provision, thus reducing costs of production, and leading to increases in levels of profitability for cassava farmers.

2.2.2. Empirical Studies on the Efficiencies of Crop Production

A large number of studies have examined the issues of productivity and technical efficiency of farmers. However, very few of them focus on Sub-Saharan Africa (SSA) and a very limited number have focussed on the Delta State, in the Niger Delta region of Nigeria. This section will present a brief review of empirical studies of efficiency and its determinants across the globe (Table 2.2) and then move specifically to the discussion of studies in Nigeria in section 2.2.3 below.

Table 2.2 Empirical studies on efficiency measurement on crops

Authors	Country: production	Efficiency approach	Data set	Main results	Determinants
Piya and Yagi 2012	Nepal: Rice farms	SFA: MLE	Two 60 household sample from 2 regions	TE=0.74 & 0.67	Degree of commercialization, education, age, agric. income
Aneani et al 2011	Ghana: Cocoa	Two stage SFA	Multi stage cross-sections, 300 farmers	No results, OLS regression was used	Age, household sizes, education level
Kilic et al. 2009	Turkey: Hazelnut production	DEA and Tobit regression	Two stage sampling process: 78 farmers	TE = 0.74	Education, Farm fragmentation
Gul et al. 2009	Turkey: cotton farms	DEA and Tobit regression	Cross-sectional from 2 growing regions: 78 farms	TE = 0.80	Age, education level and cotton growing regions
Murthy et al 2009	India	Two stage DEA	90 farmers	TE = 0.51 AE = 0.06	Farm size, inputs
Javed et al 2008	Pakistan: Rice-wheat	Two stage DEA	Cross-section, 200 farms	TE = 0.83 AE = 0.48 CE = 0.40	Age, family size, education, labour
Kiatpathomchai2008	Thailand: Rice	Two stage DEA	Multi stage cross-section, 276 farmers	TE = 0.14 AE = 0.32 CE = 0.70	Variety, soil type
Khai et al 2007	Viet Num: Soybean	Two stage DEA	113 farmers	TE = 0.74 AE = 0.51 CE = 0.38	Region
Hauliang Hu 2006	China: Vegetable	DEA two stage	Cross-section: 86 farms	TE = 0.98	Transport cost, information and negotiation cost
Vicente 2004	Brazil: Cotton	Two stage	Aggregate crop output	TE = 0.72	Irrigation,

Authors	Country: production	Efficiency approach	Data set	Main results	Determinants
		DEA	(1995)	AE = 0.47 CE = 0.36	Experience
Chirwa, 2003	Malawi: Maize	SFA	Stratified random selected:156 farm households	TE = 0.53 for small size TE = 0.58 for large	Plot size, hired labour, hybrid seeds and members of farm association
Rahman, 2003	Bangladesh: Rice	SFA profit frontier and inefficient Effect model	Cross-section random sampling: 380 farmers	TE = 0.77	Extension services, modern varieties, Farmer ownership, Better access to input markets.
Colli et al 2002	Bangladesh: Rice	Two stage DEA	Cross-section 406 farms	TE = 0.69 AE = 0.81 CE= 0.56	Tenancy, infrastructure, land cultivated, farming years
Shafiq & Rehman 2000	Pakistan : Cotton	Two stage DEA	Cross-secton,120 farms	10 farms on $TE_{(CRS)}$ frontier 30 farms on $TE_{(VRS)}$ frontier	Quantity of inputs
Wadud and White 2000	Bagladesh: Rice	Comparison of SFA & DEA	Cross-section, 150 farms	TE = (SFA) = 0.79 $TE_{o(DEA/CRS)}$ = 0.79 $TE_{o(DEA/VRS)}$ = 0.86	Environment, irrigation infrastructure
Asogwa 2011	Nigeria: Farmers resources mgt.	Two stage DEA	396	TE = 0.55 AE = 0.74	

Authors	Country: production	Efficiency approach	Data set	Main results	Determinants
				CE = 0.70	
Asogwa et al 2011	Nigeria: Rural farmers	SFA	Cross-section, 224	TE = 0.32	
Ogunniyi & Oladejo 2011	Nigeria: Tomatoes	Two stage DEA	Cross-section 150 farmers	TE = 0.42 AE = 0.55 CE = 0.10	Education, experience, diversification, marital status, gender
Eyitayo et al. 2011	Nigeria: Cocoa farms	DEA	Multi stage cross-section, 60 farms	TE = $0.17_{crs,}$ 0.68_{vrs} 0.21_{se}	
Saingbe et al 2010	Nigeria: Groundnut processing	Two stage DEA	100 processors	TE = 0.80 AE = 0.83	Capital, processing machine
Rahman & Umar 2009	Nigeria: Crop	SFA	100 farms	TE = 0.70	
Ebong et al. 2009	Nigeria: Farmers	SFA	Random: 75	TE= 081	Farm size, capital, manure, planting material
Ajibefun 2008	Nigeria: Food crop	SFA & DEA	Geographical cross-section 200 farmers		
Bifarin et al 2008	Nigeria: Plantain processing	Two stage SFA	Cross section, 276	TE = 0.74 AE = 0.57 CE = 0.43	Age, credit
Idiong et al 2007	Nigeria: Rice	Two stage DEA	Multi stage cross-section, 96 farmers	TE = 0.77 & 0.87	Age, education years, association membership, credits
Okoye et al 2007	Nigeria: Cocoayam	SFA	Cross-section, 120 farmers	TE= 0.59	Age, education, farm size

Source: Compiled by author

These studies demonstrate a number of key factors affecting crop production and exemplify several modes of productivity analysis, which are summarised according to the following themes:

Education

Various studies (Piya and yagi, 2012; Aneani et al. 2011; Kilic et al. 2009; Gul et al. 2009), argue that education has a positive influence in the efficiency of crop production, while, the studies of Okoye and Okuha, (2008) and Erhabo and Emokoro (2007) suggest a contrary view. Okoye and Okuha (2008:7) state that “The signs of the coefficient for education and age were negative and significant related to labour productivity of men and women. This implies that increases in education and age will lead to a corresponding decrease in labour productivity”. They conclude that the negative effect of education is unexpected and may suggest that there are strong competing effects of diverting skills to other off-farm employment opportunities as education level increases (Okoye and Okuha 2008:7, citing Holloway et al. 2000). These studies are supported by similar studies in Nigeria, which also show that farmers with more education are more likely to adopt new technologies (Kaine, 2011; Ogunniyi and Oladejo, 2011; Iheke, 2008; Idiong et al., 2007; Okoye et al., 2007 and Chukwuji, 2007).

Farm size

Efficiency analysis has also been applied to determine the relationship between farm size and production output, as stated in Chapter One. Some empirical studies have shown inconclusive results, while Kilic et al. (2011) and Aneani, (2011) have asserted that increasing farm size has a positive impact on technical efficiency. Similar studies in Nigeria, including Anyaegbunam et al. (2012); Okoye et al. (2009); Okoye et al. (2007); Ogundari and Amos, (2006) suggest that farm size has an inverse relationship with efficiency, with the study pointing to calls for policies aimed at land distribution, targeted encouraging small-scale farmers in order to improve productivity and production efficiency. However, Eyitayo et al (2011) Ebong et al (2009) and Idiong et al (2007) assert a contrary view suggesting that whilst increasing farm size might lead to economies of scale, many smallholder farmers are actually more efficient in the use of scarce or limited resources. According to Murthy et al. (2009), large size farms are more technically efficient. However, it is the small farmers who have emerged as price-efficient producers in terms of lower costs of production and higher unit profit.

Other factors

Factors such as age, extension contacts, family sizes, marital status where found to determine the level of inefficiency. This is because older farmers, or those with more years of experience, are more efficient in allocating resources than younger and less experienced farmers. This assumption is consistent with the findings of Gul et al. (2009), Javed et al. (2008), and Wadud and White (2000).

Another important factor influencing inefficiency, according to Ogunniyi and Oladejo, (2011) and Quisumbing, (1995), includes gender, which does have effects on technical efficiency, as females are more restricted in terms of access to inputs. Lower yields produced by women in these areas may be attributed to lower levels of inputs and less financial stability than men.

Productivity analyses

According to Mussa et al. (2012), analysis of resource use efficiency in smallholder mixed crop-livestock agricultural systems in Ethiopia suggests that smallholder farmers are resource use inefficient in the production of major crops with mean technical, allocative, and economic efficiency level of 0.74, 0.68 and 0.50, respectively. This study also supports the view that large family size, and membership of relevant associations leads to higher levels of resource use inefficiency. However, Oladeebo and Olawaranti (2012) and Chukwuji et al. (2007), in their studies in Nigeria, indicate that household size and farm size were major significant factors which influenced profit levels, positively. These studies suggest to policy makers that there is a need for policy to focus on these profit efficiency factors.

Furthermore, Aneani et al (2011) examines the allotment efficiency (Allotment efficiency occurs when a firm chooses resources and enterprises in such a way that a given resource is considered efficiently utilized in production if its marginal value product (MVP) is equal to its marginal factor cost (MFC)) and technical efficiency of resources used. A multi-stage cross-section sampling approach was used to collect data from 300 cocoa farmers and OLS regression was used to show that the coefficient or elasticities of age, household size, farm size, insecticides, fungicides and fertilizer had a significant and positive impact on cocoa output.

In addition, Hauliang Hu (2006) evaluates the TE for vegetable producers in the Nanjing area of China. A two stage value chain model was used as applied previously by Sexton and Lewix, (2003), with data collected from 86 tomato farmers. The two-stage model involves the use of output orientation, assuming variable returns to scale, and revealing that with a simple sample, in which one DMU consumes input, produces and consumed as intermediate product, and use to produce another output (final), i.e. a key marketing function exists. The main advantage of the two stage DEA model is that it is capable of evaluating the relative efficiency of each DMU and its sub DMU in a value chain. This model treats the vegetable marketing chain in addition to the production and marketing operation. The managerial remedies for inefficiency will be different within each stage, and it is very important to identify the extent of such inefficiency at each stage. The results suggest that vegetable production in Nanjing is of low efficiency, with a mean TE of 0.74 TE differ both as channel and stage level. Moreover, the study reveals that direct marketing has the least efficient chain, followed by the chain to sell to trader, whilst the wholesale market has the highest chain efficiency. Efficiency scores were 0.67, 0.80 and 0.85 for the three chains respectively. The study concludes that, apart from monetary costs, all transaction costs decrease significantly at the TE level for all three chains of the production stage.

Javed et al (2008) examines the TE, AE and EE to investigate subsequently the determinants of farm inefficiency for rice-wheat production in Pakistan's Punjab, with a cross-section, multistage random sampling techniques of 200 farmers. The results reveal that the means for TE, AE and EE were 0.83, 0.47, and 0.42, respectively. An econometric analysis, based on the Tobit regression model show that farm size, age, education level, number of contacts with extension agents, access to credit and farm to market distances were significant determinants of TE. Education level, number of extension contacts and access to credit had in turn, the greatest impact on AE and EE.

Kiatpathomchai (2008) examine the technical, economic and environmental efficiency of rice farmers in Thailand. Using two stage DEA and Tobit regression to analyse data from 276 farmers, the empirical results showed that 0.17 percent, 0.2 percent and 0.2 percent of the sample farms were on technical, economic and environmental efficiency frontiers, respectively. The mean technical, economics of environment inefficiency were 14 percent, 32 percent and 46 percent respectively. The significant variable affecting efficiency in this case was soil quality and rice variety.

Khai et al. (2007), examines TE, AE and EE and the determinants of inefficiency for farmers involved in agricultural activities in Mekong River Delta of Vietnam. Cross-section data was obtained from 113 farmers. The results show the average TE, AE and EE as 0.74, 0.51 and 0.38, respectively. In a second step analysis between TE, AE and EE, results showed that large scale farms are more technically efficient. Other factors that influence efficiency levels were found to be: levels of training, access to credit, policy environment, levels of experience in farming and geographical location.

Vicente (2004) measured the level of TE, AE and EE on agricultural crop production in Brazil, using a non-parametric frontier model (DEA) under constant return to scale. The secondary aggregate crop output of 1995 season was used. The results show that TE, AE & EE were 0.72, 0.52, and 0.36, respectively. The study found out that irrigation provision and farming experience do have effects on efficiency. Rahman (2003) examines the production efficiency of 380 Bangladeshi modern rice farms, using the stochastic profit frontier approach and inefficiency effect models. The mean level of profit efficiency for modern rice farming was estimated at 0.77, and had a range between 0.59 and 0.83. Other results showed that farmers with more experience in growing modern varieties, better access to input markets, located in fertile regions and doing less off-farm work were more efficient. The study also revealed that owner operators were more efficient than tenants, and that extension services had a positive impact on the profit efficiency among modern rice farmers in Bangladesh. Salim and Hussian (2006) assessed the impact of farm specific characteristics and some policy variables on farm level productive efficiency, and observed that studies applied either the non-parametric or the conventional stochastic frontier models, which do not take account of individual input responses (arising from the application of input) and their effect on output when measuring productivity efficiency. The stochastic frontier models, it was noted, arbitrarily impose a particular distribution for the farm-specific performance related error term. They concluded that there is no economic reasoning or theoretical justification for this assumption, noting that domestic and international economic policies influence the production behaviour of firms, but not all farms are equally influenced by these policies (Guirkinger and Boucher, 2007; Grote, 2001).

Furthermore, Grote (2001) concluded that these policies did not result in sustained increases in production, although production efficiency was increased. This may be explained as the gap between demand for and supply of agricultural inputs has been widened over the years, with policies helping to create an open market economy that makes agricultural inputs readily available for farmers, ensuring food security and guaranteeing fair commodity prices (Salim and Hussian, 2006).

Another study by Chirwa (2003) measured TE for 156 farm households in Southern Malawi. A stratified random sample was used and SFAs, translog production function estimates were used to analyse the data. A major finding was that one of the constraints in achieving food security has been the small size and fragmentation of land holdings across a large proportion of households. The mean TE results were 0.53 and 0.58. The study identifies the sources of inefficiency as including plot size, use of hired labour, hybrid seeds and membership of grower association.

Coelli et al. (2002) investigate TE, AE CE and SE of Bangladeshi rice farmers. The results indicate the Mean technical, allocative, cost and scale efficiency as 0.69, 0.81, 0.56 and 0.95, respectively, estimated for dry rice. Similar results were also found for wet rice. The study suggested that farmers' access to input markets, doing less off-farm work and greater degree of contact with extension agents were more efficient.

In addition, Shafiq and Rehman (2000) examined the TE of cotton production under the cotton-wheat production system in Pakistan's Punjab using the input-oriented DEA approach. Cross-sectional data from 120 farms was used for analysis, based on output/ha of cotton with various combinations of inputs: nitrogen fertilizer, phosphorous fertilizer, pesticides, and irrigation, labour and tractor costs. The main results indicated that the numbers of farms which lie on the technical frontier under CRS and VRS assumptions are 10 and 30 farms respectively.

Lastly, Wadud and White (2000) measured the TE of rice farmers in Bangladesh, using cross-section data from 150 rice farms in irrigated areas. The SFA and DEA approaches were employed to analyse the data, using the translog stochastic production function and output-oriented DEA analyses, using Decision Making Units (DMUs) of rice outputs and inputs (per unit cost) of irrigation, pesticides, fertilizer, labour and land. The hypothesized farm-specific variables with the greatest impact on efficiency were: years of farming experience of the farmer, land fragmentation (farm size), education level, irrigation infrastructure (dummy), and environmental degradation (dummy). The results indicate that the average level of technical efficiency (SFA) technical efficiency (CRS) and technical efficiency (VRS) were 0.79, 0.79 and 0.86 respectively. Second stage regressions reveal that the significant positive determinants of technical inefficiency, i.e. the negative impact on technical efficiency of both approaches, were irrigation infrastructure (including access to a diesel pump) and environmental degradation.

Indications from all these studies imply that age, education, farm size, extension services, household size among other efficiency and output performance. The following section will consider these findings in the context of Nigeria

2.2.3 Empirical Studies of Efficiency Measurements on Crop Production in Nigeria

Several studies have been carried out in Nigeria to investigate the technical, allocative and costs efficiency of input use and the outputs and their relationship with socio-economic and demographic characteristics of farmers at the farm level. It is noted that, to date, in the Delta states of Nigeria, no studies have been undertaken to measure the technical, allocative and cost efficiencies, and their determinant input factors, on crop production. Therefore, policy formulation has been hampered by this lack of relevant empirical studies at the farm level.

Ogunniyi and Oladeyjo (2011) estimate the TE index and examine the factors determining this for tomato farmers in Oyo State, Nigeria. Cross-sectional data was obtained from 150 tomato farmers, with the DEA and a second step regression model applied to determine key farm specific attributes. The Tobit regression shows the TE index under both CRS and VRS specification were 0.42 and 0.55, respectively. Also, the key determinants of TE were seen as education, farm experience, diversification, marital status and gender.

Furthermore, Saingbe et al (2010) evaluates the economic empowerment potential of women in a rural area of North Central Nigeria, using a cross-sectional random sampling technique to collect data from 100 farm respondents. The data collected was analysed using simple descriptive statistics, the Net Farm Income model and DEA. The result showed average net returns as N10, 586.6 per ha for processing groundnuts, the mean pure technical and scale efficiency scores were 0.80 and 0.83, respectively. The authors argue that the major constraints confronting groundnut processing include inadequate capital for expansion and lack of processing machines, concluding that a significant opportunity exists for rural women through groundnut processing.

Ebong et al (2009) and Rahman and Umar (2009) examine the determinants of TE in urban farming at Uyo metropolis and Bunue in Nigeria, while Idiong et al. (2007) examine rice farmers in Cross River State in Nigeria. Similar studies have also been conducted by Ajibefun (2008) and Bifarin et al. (2008) in Nigeria, using SFA and DEA to analyse data randomly collected at farm-level. The findings reveal that a mean TE ranges from 0.22 to 0.81 and that the co-efficients of farm size, capital, manures and planting materials are positively and significantly related to TE, age, education level, farmer experience, marital status, diversification, gender among others influences TE, AE and CE farm output. The results show that TE was 0.65, with key factors influencing efficiency being age, gender and household membership (Rahman and Umar, 2009). This was supported by Asogwa et al. (2011) that TE, AE and CE were low in Nigeria.

In summary, from the twenty-seven studies shown in Table 2.2 above, some important factors are highlighted regarding farm efficiency in general and in Nigeria in particular. The above table indicates that SFA was used in 9 studies; DEA used in 16 studies and 2 studies make use of both SFA and DEA to examine data at farm-level. Results indicate that TE ranges from 0.14 - 0.98, with the average mean of about 0.70. AE ranges from 0.06 to 0.83 with mean of about 0.53, and CE results range from 0.7 to 0.70 with an average mean of 0.45. On percentages interval range; TE with 20.8% (<.50); 20.8% (0.51-0.60); 33.3% (0.61-0.70); 12.5% (0.81-0.90) and 4.2% (0.91-1.0), while the AE is 45.5% (<.50), 18% (0.51-60), 9.1% for (0.61-0.70 and 0.71-0.80) and 18.2% (0.81-0.90) respectively. Range intervals for CE are as follows: 66.7% (<.50), 11.1% (0.51-.060) and 22.2% (0.61-0.70), respectively. This is an interesting observation which might suggest that only a few farmers could approach the maximum production frontier range, which should be emulated. DEA is more favoured globally and it will be interesting to see how this compares with the results of the present study. Factors noted to most influence efficiency in this literature review were age, education, household size, land tenure, capital (credit), weather, extension services, management skills, land quality, seeds, information, labour etc. The present study will therefore examine the extent to which efficiency levels identified here vary from those found in other studies.

2.2.4. Empirical Studies on Efficiency of Cassava Production and Processing

Few studies have been done on the efficiencies of cassava production and processing together, at the farm level; even in most of the empirical studies under review, the focus is on either crop production or crop processing. However, this thesis will investigate the results for both crop production and crop processing aspects. Table 2.3 shows the summary of methods, analysis and results of empirical studies on the efficiency on cassava production and processing as discussed in Table 2.3 below.

Table 2.3 provides a review of Nigeria agricultural efficiency literature review on cassava production/processing with a total of 15 frontier studies. The review suggests that the parametric production frontier is used. Cassava production efficiency is low ranges from 0.53 to 0.97, with the mean is about of 0.93. While the range of efficiency of cassava studies in

Nigeria indicates that levels of TE are between 7.1 percent (<0.70 and 0.91.1.00), 36.7 percent (0.71-0.80) and the remaining percent (<0.69). The percentage of farmers that are close to the efficiency production frontier is very small when compared to that of other regions, shown in Table 2.2. This means that efficiency in Nigeria could be considered to be very low. Here, in contrast to the studies shown in the section above, more SFA was used in the efficiency studies. Therefore, the current study will examine whether the result will vary

Table 2.3 Empirical Studies on the Efficiency on Cassava Production and Processing

Authors	Country: production	Efficiency approach	Data set	Main results	Determinants
Oladeebo & Oluwaranti 2012	Nigeria: Cassava	SFA	Cross-section, 109 farmers	TE = 0.79	Household size, farm size
Kaine 2011	Nigeria: Akpu processing	Two stage SFA	Cross-section, 258 farmers	TE =0 .83	Age, household size, experience, education
Ogundari and Brummer 2011	Nigeria: Cassava and other crops production	SFA	Farming season 2006/07-2008/09	TE = 0.72	Fertilizer, pesticides, farm size/pesticides, labour/fertilizer, extension, credit, occupation
Adeyemo and Akinola 2010	Nigeria: Cassava production	SFA	Cross-section, 200 farmers	TE = 0.89	Age, farming experience, cost of fertilizer, cost of herbicides, membership of cooperative, level of education
Okoye et al 2009	Nigeria: Cassava	SFA	Cross-section, 90	TE = 0.90 farmers	Age, farm size
Edeh and Awoke 2009	Nigeria: Cassava production	SFA - MLE	Multi stage cross-section, 120 farmers	TE = 0.92	Farm size, Education, fertilizer, tractor
Awosyinka 2009	Nigeria: Cassava production	SFA - MLE	Cross-section, 290 farmers	TE = 0.88	Policy effects, farm size, family labour, hired labour, Seeds, fertilizer, education level
Oronkwe et al 2009	Nigeria: Cassava production	SFA	Cross-section, Male (90) and farmers(90)	TE Male = 0.89 Female = 0.53 Average =0 .71	Fertilizer, labour, farm size, capital, education, extension, marital status, experience, household size
Onu and	Nigeria:	SFA	Cross-section,	TE = 0.88	Local varieties

Authors	Country: production	Efficiency approach	Data set	Main results	Determinants
Edon 2009	Cassava production		180 farmers	TE = 0.81 Ave. = 0.85	Improve seed
Adeleke et al 2008	Nigeria: Cassava production	SFA	Cross-section, 120 farmers	TE = 0.97	Fertilizer, herbicide, pesticide
Iheke 2008	Nigeria	SFA	Cross-section, 160 farmers	TE = 0.77	Education, experience, credit, associate members
Chukwuji 2007	Nigeria: Gari processing	Two stage SFA	Multi stage cross-section, 100 processors	TE = 0.65	Age, family size, education, association membership
Udom & Etim 2007	Nigeria: Cassava production	SFA - MLE	Farm level, 180 farms	TE = 0.74	Experience, education, land, labour, seeds, inorganic fertilizer
Erhabor and Emokoro, 2007	Nigeria: Cassava production	SFA	Cross-section, 156 farmers	TE = 0.82	Education, age, farm size, experience, gender, seeds, family size
Ogundari & Ojo 2006	Nigeria: Cassava	SFA two stage	Multi stage cross-section, 200 farmers	TE = 0.90 AE = 0.89 EE = 0.81	Farm size, labour

Source: Compiled by author

NOTE: DEA = data envelopment analysis SFA = Stochastic frontier analysis TE = technical efficiency AE = allocative efficiency EE = economic efficiency CE = cost efficiency VRS = variable return to scale CRS = constant return to scale

from the outcome of these studies. Based on the findings from 22 factors influencing efficiency (outlined below), education is recognised to be a very important and significant determinant of efficiency in cassava production, with 16.1 percent of studies showing this as the most influential factor. This view is supported by Ogundari et al. (2012) in a review of Nigerian agriculture efficiency literature. Education is followed in terms of significance by other key determinants like: farm size (14.3%), fertilizer (12.5%), age (8.9%), labour (7.1%), capital (credit), cassava cuttings, membership of cooperative (5.4% each), herbicides (3.6%)

and others like policy effects, tractor use, gender, land tenure, pesticides, occupation, marital status, being shown to be the most important in less than 0.05% of the results. All the studies use the SFA, with none using DEA to evaluate cassava production, although the list may not be exhaustive. The importance of these sections is to help to establish the main determinants of cassava production efficiency in the study area (this discussion is continued in Chapters 6 and 8).

Returning specifically to studies in Delta state, studies on production and processing efficiency in Delta state (Kaine, 2011; Chukwuji et al. 2007 and others) failed to determine technical, allocative and cost efficiency which are important to policy makers in order to make policies that facilitate improvement in cassava production efficiency. This present study aims to fill this research gap by examining the TE, AE and CE in Delta state. The review of the empirical evidence above indicates that most studies focus only on one aspect of performance measurement, such as improvement in crop varieties or measuring and determining the sources of efficiency for different enterprises. None have used a single source to identify the performance efficiency in production and processing in Delta state or in Nigeria. According to Nweke et al. (1997), some studies have been made conducted on the efficiency of gari processing. However, few studies have been undertaken to specifically establish the degree of technical efficiency of gari processors at farm level. Perhaps closest to the present study is work by Chukwuji et al (2007:328) who examine the economics of gari processing, with focus on the major factors affecting technical efficiency of the farming system in Delta state. The current study goes further determining the TE, AE and CE of cassava production and processing, and employing a holistic approach. This study also examines the key determinants of efficiency with reference to raw product and processing from the same data sources. The knowledge gained from this study will, it is hoped, serve to inform policy makers in future policy formulation and implementation.

2.3 Marketing: Structure, Channels and Strategies

Several studies (Chukwuji et al. 2007; Liverpool-Tasie et al. 2011) suggest that any attempt to increase productivity growth and production efficiency in crop production and processing without also expanding the markets for its products is unlikely to result in success. Further, Sugino and Magrowani (2009) indicate that increases in demand for processed crop products have the tendency to lead to increases in processing by processors. This section defines and explains key concepts used in marketing, and reviews contributions from empirical literature concerning marketing structures, channels and performance, and their role and influencing the marketing of primary and processed crop products such as cassava.

2.3.1 Marketing: Meaning and Concepts

A market is defined as the interaction of the forces of demand and supply, irrespective of the physical location, or means of information that link buyers and sellers (Adekanye, 1988). Thus, a market may be local, national and/or international. There are many alternative definitions of marketing. A study of Emam (2002, cited by Emam and Malik, 2011:1025) describes the process of marketing as "a series of services involved in moving a product or a commodity from the point of production to the point of consumption". Alternatively, focusing more on the role of marketing, Adekanye (1988:1) defines marketing as, "really a method of bringing the impersonal forces of demand and supplies together irrespective of the location of the market."

Kohls and Uhls (1990:5) provide another definition, more specific tofood or agricultural marketing, which is perhaps a little more all-embracing and certainly more applicable to the current research. They identify that marketing is the "performance of all business activities involved in the flow of goods and services from the farm gate where they are produced until they are in the hands of the final consumer. Marketing is a productive process that adds form, place, time, and possess utility to farm produces". The adding of value in the food marketing process complements the productive processes in farming, and the marketing process forms a vital link between farmers and consumers, all influenced by technological factors, socio-economic factors, natural resources, legal frameworks and norms of the society.

Frequently, the particular form of definition reflects the preoccupations of individual authors. Most definitions share certain basic characteristics which are the major elements of modern marketing:

1 *It is operational:* Managers must take action to achieve results. Benefits will not emerge from a passive attitude to the exchange.
2 *It is customer-oriented.* It makes the firm look outside itself, focusing on the needs or requirements of the customer. Its effectiveness lies in finding solutions to the challenges posed by these demands.
3 *It emphasizes mutuality of benefits.* The exchanges work and persist because it is in the best interests of both parties to continue. Through this both prosper, as consumer needs are satisfied by goods and services which suppliers will continue to supply because they profit.
4 *It is value driven*. "The culture is based on a desire to build the enterprise through meeting needs and responding to the market." (Cannon, 1998:5)

Cannon (1998:20) argues that the global concept underlying the marketing approach to business could be seen in the way in which it is adopted across much of the world, with marketing as a process, fully harmonized with the general business strategy of an organization, aiming to satisfy the needs and wants of a specific target group of customers through creating and selling products. This suggests a clear relevance to the role of government policy, as well as carefully considered planning by the farmer of each element of the 'marketing mix'.

The need for marketing arises with increased productivity, where the surplus can be exchanged for a nominal income. The major activities performed in the marketing function involve many aspects of business, including: buying, selling, processing, storage, transportation, standardisation, financing risk-bearing and provision of market information. The equitable participation of few farmers in the market, with incomes and profits (margins) derived from the sale of produce will be determined by their access capacity. Therefore, the creation of prosperous and equitable agricultural sectors depends on agricultural marketing environments (Zepeda, 2007; Abang et al., 2004; Adekanye, 1988). Marketing functions and infrastructure provisions serve as a basis for assessing all markets (including those for agricultural products), and can also be used to assess the involvement of all direct and indirect participants within a chain ranging from production to consumption (Renko et al.2002). However, when an analysis is carried out of how the market for agricultural products functions, Renko et al. (2002) note that often only the participants of the transactions are taken into account, while the significance of the accompanying institutional and infrastructural support, which affects to a large extent the functioning of the market, are neglected. This is in contrast to the common characteristic of developed countries where there is interaction of the market players and where support is provided throughout the chain ranging from production to final consumers. The support includes information organizations, particular institutions of executive and legal authority, as well as scientific research, developmental and educational bodies.

The basic functions of the state are to create the conducive environment for functioning of the market and to encourage market developments (Liverpool-Tasie et al. 2011; Okoro and Ujah, 2009; Renko et al. 2002). Most developing economies, and those in transition where the market mechanisms have failed, have disadvantageous market systems due to the inherited disadvantages of imperfect markets characteristics. The state should be involved in the process aimed at: improving the agrarian sector; increasing the competitiveness of local producers; and identifying, developing and applying appropriate modern technologies (Huang et al. 2002; Hooley, 2000; Okoh, 1998; Adekanye, 1988).

Markets play a fundamental role in risk management, associated with demand and supply shocks, by facilitating adjustment in net export flows across space and storage over time, thereby reducing the instability faced by producers as well as consumers (Mutambatsere and Christopher, 2005). Thus, markets perform multiple valuable functions: the distribution of inputs and output across space and time, the transformation of raw materials (produce) into value-added products and transmission of information and risk (Emam, 2011; Hines, 2004; Okoh, 1998). Well-functioning markets underpin important opportunities at the micro-level of welfare improvements that aggregate into sustainable macro-level growth (Renko et al. 2002). Without good access to distant markets which could absorb excess local supply, the adoption of more productive agricultural technologies would result in decreases in farm-gate producer prices, removing all or many of the gains to producers from technological change and, hence, damping the incentives for farmers to adopt new technologies that could stimulate growth if market provisions were expanded (Barret and Mutambatsere, 2005; Awerije, 2004). This point has particular resonance in many developing countries.

Several studies analysing market based orientation or market led research agree that the micro-level realities of agricultural markets in many LDCs include poor communications and transport infrastructure, limited rule of law and restricted access to commercial finance. All of these lead to increased transaction costs and higher marketing margins which are associated with inefficiency and imperfect market operations (see for example Alene, et al., 2008; Jayne, et al. 2006; Barret and Mutambatsere (2005); Renkow, et al. 2004; Winter-Nelson, 2002; Daviron and Gibbon, 2002).

For the past two decades, recognition of the critical role of markets in economic development has prompted sweeping market reforms across many LDCs. Studies (e.g., Burton et al., 2001; Barrett, 2005; Verhees, 2005; and OECD-FAO, 2006) have identified that, in spite of these reforms, symptoms of poorly functioning markets in many sub-Saharan African countries, and in most LDCs, were still evident in the segmentation of the markets, low investment in infrastructure, lack of market information, lack of access to market, high marketing costs, market thinness, and the limited progression toward more complex arrangements such as contracting, outsourcing, target marketing. Notable among them are studies by Ikpi et al., (2007), Okoh, (1999), and Ekpi and Gebremeskel, (1989) who conclude that marketing infrastructure; such as access roads, transportation services, market stalls and marketing information in LDCs generally are undeveloped and thus very inefficient. In addition, Gabre-Madhin (2001) identifies considerable variation in the exploitation of the benefit of vertical and horizontal integration to increase domestic and international shares of agricultural produce.

In recent years, there has been increasing recognition of the importance of institutions and transaction costs and their impact on trader, producer and consumer behaviour (Barham, 2006; Renkow et al., 2004; Lapar et al., 2003). Despite the increased attention on market institutions, relatively little institutional research has addressed the role of marketing intermediaries, such as brokers or commission agents, who facilitate exchanges between anonymous trading partners. There is also little institutional analysis undertaken on the process by which these intermediaries can add value to the products of LDCs. According to Gabre-Madhin (2001), very little attention has been given to critical transaction costs, or the costs of searching for buyers or sellers. Furthermore, only a few empirical studies have attended to quantifying transaction costs, partly due to the difficulty in obtaining data on these costs.

The next section seeks to examine the ways in which the production and marketing constraints, identified above, have discouraged productivity and the marketing of non-tradable agricultural produce, like cassava, in order to find ways of eliminating their effects.

2.3.2 Marketing Channels

A marketing channel is simply the name given to the path of a commodity from its raw form to its finished form. It is important in evaluating marketing systems because it indicates how market participation is organized to accomplish the movement of a product from producers to consumers (Mari, 2009; Olukosi and lsitor 1990). Mallen (1976) sees marketing channels as the movement of ownership, the negotiation of title and the physical movement of products. This suggests a place where the farmer's products are brought together in large quantities to the central and terminal markets. Here the products are bought by processors, wholesalers, commission men and brokers. In the marketing channel, wholesalers and processors may buy from the farmers. Most agricultural commodities, including cassava in Nigeria, are marketed through such a channel.

Identifying the complexity of some marketing channels, Lambros (2008) argues that they constitute a system of interrelated and interdependent components engaged in producing an output. In such a channel, a farmer is clearly dependent on agents throughout other parts of the channel (wholesalers, retailers and so on in getting products to the final consumer and, thereby, achieving objectives such as profits. To a greater or lesser extent, marketing channels exist as part of an economy, which is part of the national environment and as a subset of the international environment. In turn, and adding to the levels of complexity, the national and international environments are influenced by physical, economic, social, cultural, technological and political factors (Stern et al., 1992), as exemplified in the National Agricultural Policy, the Common Agricultural Policy of the E.U., and the WTO (formerly the GATT Agreement) at a global level.

This study will investigate the complexities of supply and demand for cassava in Nigeria, along with the various marketing channels (local, national and international) used for cassava in raw and processed forms.

2.3.3 Marketing Orientation and Conduct

The market structure for food is highly competitive, with barriers to the entrance into production characterised by the presence of large buyers and sellers, and the relatively small volume of trade. There are also increasing numbers of brokers or agents in the marketing channels, whose activities increase costs and reduce competitiveness in the market system (Okon, 1999). The presence of market associations in the marketing system in most LDCs, particularly at the wholesale level, constitutes a barrier to free entry of non-members of the association and makes markets void from government regulation (Okoh 1999). This author also argued that there are large numbers of small traders in cassava products in the Delta State of Nigeria.

The seasonality of the production of cassava and most staple crops and their products does not significantly affect price movements, especially relative to the availability and costs of labour. However, the seasonal availability of labour does have effects on productivity and price. Nweke (2003) agrees that labour constraints have significant impact on the prices and supplies of cassava and other foodstuffs in sub-Saharan African countries and most LDCs. Cassava cultivation requires hired labour for land preparation, harvesting and processing. During the dry season, most hired labour seeks higher wages in the building and construction sectors (Okoh, 1999; Nweke, 2003) leaving them unavailable for cassava farming.

2.3.4 Marketing Margins

The Marketing margin is related to the difference between what the consumer pays for the goods/services and what the farmer or service provider receives. It is thus the price of all utility adding functions and activities performed by marketing firms, including all the expenses incurred in performing marketing functions, as well as profits. It is usually expressed as a percentage of product prices. Marketing margin is the portion of the consumers' food cost that goes to food marketing firms (Kohls and Uhls, 1990). Alternatively, each margin is seen as made up of the returns to the different factors of production used in marketing, such as land, labour, capital, entrepreneurs, and so on (Emam and Malik, 2011; Achike et al. 2010; Adekanye, 1988). Marketing margins differ for different goods and services depending on the nature of commodity and the marketing function involved. They may also be different from one marketing level to the other, and are very likely to vary between developing countries and developed countries. Min and Wolfinbarger (2005) viewed profit margin, market share and marketing efficiency as measures of retailing performance. Marketing margins could be expressed as the percentage of the final weighted average selling price taken by each stage of the marketing chain (FAO (1999), and could also be viewed as the difference in prices at two different points in the marketing chain (Kahkonen and Leathers, 1999). The marketing margin varies among commodities and its size depends on the cost of the marketing function performed. Kohls and Uhls (1980:222) have stated that the "…marketing margin is the most controversial aspect of marketing when its size, composition and behaviour are considered. As the efficiency in the marketing margin could not be determined by the large or small margins."

Marketing margins can be estimated at different levels of the marketing chain, either at the retail or wholesale level. The size of the margin depends on a number of factors ranging between the degree of processing of the product; the perishability of the product; its bulkiness in relation to value; any specific extreme seasonality of the product and institutional factors (Olukosj and Isitor, 1990). The margin also is influenced by the volume of the product bought and sold, buying and selling prices of the product, the number of middlemen involved and the distance between markets (Adekanye, 1988, Kohls and Uhls, 1985). Adrangi and Chatrath (1999) argue that margins have a negative impact on trading activities in terms of all types of trading, although there is some evidence that margin alterations bring about changes in the makeup of the market.

Several studies have provided estimates for margins of different commodities in Nigeria including cassava, at different levels in the marketing chain. Olukosi and Isitor (1990) report a margin of 33.0 percent, 33.5 percent and 29 percent for producers, wholesalers and urban retailers of tomatoes respectively, in Sokoto State. They also reported margins of 68.2 percent 9.1 percent and 6.6 percent for producers, local assemblers and urban retailers of millet in Zaria, Kaduna State. Arunsi (1998) reports margins of 12.44, percent 10.73 percent and 12.89 for Kano, Zaria and Jos wholesale palm oil for producers, wholesalers and retailers percent respectively. Frank (2004) reported a margin of 33.82 percent for palm wine wholesalers in Akwa Ibom State. He concluded that there was a positive influence on the margin arising from larger quantities of the product bought, control over transport cost and the buying and selling price of the product; while there was a negative effect in correlation with the number of middlemen in the buying markets.

The size of marketing margins for farmers is most commonly influenced by the level of efficiency, their storage capacity, and the amount of value added to their product. In addition, according to Wobst (2003), Minten and Kyle (1999) and FAO (1999), the key factors influencing the proportion of the retail price received by farmers are: the level of marketing service provided by the grower; transportation costs; storage capacity and other marketing costs in economies with poor infrastructure and/or long transit distances. Minten and Kyle (1999) further argue that the institutions through which the food distribution is organised also generate costs, and poor infrastructure also decreases the rate of diffusion of price information, with a negative impact on price transmission and price integration.

2.3.5 Marketing Efficiency (ME)

Marketing efficiency is the provision of the desired level of services to the consumer at the lowest possible cost. Hosseini et al. (2009) argue that the marketing system should be designed to deliver both efficiency (lowered marketing costs for a given output) and effectiveness, to achieve greater customer satisfaction and retention. Ike and Chukwuji (2005) suggest that high marketing margins sometimes indicate inefficiency because a high cost is incurred in the provision of marketing services. Therefore it is necessary to see marketing efficiency as the maximization of an input-output ratio.

ME could be expressed as:

ME = Gross Market Margin/Marketing cost x 100 (2.17)

Also 'Shepherds' formula techniques was used as follows:

ME = Consumers prices / Total market cost – 1 (Sashimatsung et al. 2013; Thamizhselvan and Murugan, 2012)

As a staple food in Nigeria, efficiency in the marketing of cassava is of paramount importance in determining not only the level consumer living costs but also the related level of producer incomes. Efficiencies from 'farm to plate' are therefore a key factor in increasing productivity. Enete (2009) identifies that marketing margins have been seen to decline with improved marketing access conditions and reduced costs of processing technologies in the production of granules, both equating to improvements in marketing efficiency for cassava. Moreover, Akinpelu and Adenegan (2011) assert that the level of efficiency in marketing is assisted by policies directed toward reducing transportation costs or rent charges by local government authority, in addition to the provision of micro credit facilities.

Adesope et al. (2009), examining the marketing of pineapples, reveals that an effective marketing system helps to harmonize demand and supply and can also stimulate production.

Data collected from 100 marketers indicate that purchase cost, transport cost, labour cost and costs of losses are all significant factors influencing the selling price of pineapples.

2.3.6 Key Constraints to Agricultural Marketing in Developing Countries

Agricultural productivity in LDCs such as Nigeria is often being constrained by several factors which have direct or indirect impacts on production. According to Muhmmad-Lawal and Atte (2006), the principal constraints to growth of agricultural production are that the structure and methods of production are on the whole rudimentary and remain undeveloped. Volatile agricultural commodity prices and costs of production, among other factors, have tended to increase the vulnerability of farmers in developing countries. This is further hampered by poor infrastructure and level of political development. As mentioned earlier, sustaining and improving production efficiency in agriculture requires improvements in the level of education, infrastructure and new technology, among others. All of these issues may also have an impact on the efficiency of marketing in agriculture.

The production and marketing of agricultural produce is regarded as unique and deserving of specialised attention, due to the perishability and bulkiness of the products involved. Effective production in the agricultural sector and the marketing of its products depends on the creation of a conducive environment, as well as the provision of resources and services which could lead to the reduction and/or removal of identifiable constraints (Bery et al. 2006; Lemchi et al., 2005; Fafchamps et al., 2005; DFID, 2003). Both endogenous and exogenous factors influence the markets for various commodities. According to Adekanye (1988), exogenous economic, psychological, sociological and political factors affect marketing. Several economic factors exist, namely consumers' incomes, their propensities to consume or save and others including business spending, investment and government taxation. In most

LDCs, consumers spend about 40–50 percent of their income on food items, while in developed countries people spend less than 10 percent of their income on food (OECD 2006).

Netz (1995) showed that the volume of storage available can contribute considerably to overall returns in Chicago, USA. The increase in storage sensitivity means that storage will absorb a larger proportion of demand and supply shocks and reduce spot price volatility. He noted that policy reforms that affect the distribution of household incomes will basically govern decisions on production, consumption and labour allocation. This may significantly increase the costs of production, which, in cases where other objective market advantages (for example, bulk volumes, high selling prices, proximity of the market of final consumption, special quality demand and so on) are not available, competitiveness may be constrained. This makes the placing of the products extremely difficult (Renkow et al., 2002).

Adekaneye (1988) notes the importance of transportation links, identifying these as not insufficiently developed to facilitate efficient levels of mobility in the ECOWAS (Economic Community of West African States) region. The railway systems of the ECOWAS member-states were built to inferior technical specifications with inferior rolling stock facilities. The inadequacy of roads and rail links is a serious obstacle to the development of intra-regional food trade in ECOWAS. Other market constraints are the severe shortage facilities, as most distributors use their dwelling places for storage purposes and losses under this traditional storage are high. For cereals, storage losses have been estimated at between 25 and 50 percent due to insect, rodent and fungal attacks. There are also problems of grading and standardisation of produce; for example most produce sizes were observed not to be uniform in Kano, Nigeria (Okoh 1999 and Adekanye, 1988).

Gabre-Madhin (2001) observes that the markets in sub-Saharan Africa are poorly functioning, arguing that this is evident in the segmentation of the market; low investment in marketing infrastructure; the persistence of high marketing margins; the market thinness (reducing the scope of marketing) and the limited progression towards more complex market arrangements, such as forward contracting. In addition, this author notes that there is little institutional research into the role of market intermediaries, such as brokers or commission agents, in facilitating exchange between anonymous trading partners.

Both tariff level and quota policies are seen to affect expansion and contraction of the market (Lee and Kennedy, 2007). Bullock (1994) and Von Cramon (1992) argue that empirical work began in this area with Russser and Freebairn (1974) who estimated political preference weighting under the U.S. beef import quota. A number of empirical studies involve in the analysis of political aspects for commodity markets, including Im (1999) and Oehmke and Yao (1990). The conclusions of these studies suggest that policy interactions between domestic and international markets do have a significant impact on marketing.

This review of empirical studies from the developing world has focused on gross margins and the analysis of performance. The present study aims to forward this research by determining the efficiency of cassava marketing, with the hypothesis that further processing of cassava will lead to increases in profitability. Furthermore, the present study examines the effects of infrastructure, storage and processing facilities as they influence the cost of production by affecting the efficiency of the use of factors of production. It will also explore viable marketing strategies which might increase productivity and improve a wide range of different actors' incomes through investment in basic infrastructure like good road networks; increases in research activities to improve seed varieties; better storage facilities; better extension services and making technology available to add value. This study thus aims to provide an up to date critical analysis of the situation for cassava production and agricultural programmes in Delta State, Nigeria.

2.4 Adding Value to Agricultural Commodities

This section provides a review of the literature concerning the diversification from primary forms of products, particularly in LDCs, through adding value at the farm level in an endeavour to expand markets, increase margins and reduce risks of price fluctuations.

“Value added” can be defined as processing involving raw material grown by the farmer and used to produce another product with a higher net value or where functionality is improved (Percy, 2005; Hines, 2004; Kohls and Uhl, 1990). As an example, value added products may be derived from fruit or vegetables which are transformed into gourmet food items. Other typical value added products include jams, jellies, preserves, fruit sauces and spreads, pickles, preserved vegetables, tapenades, hot chilli sauces, extra virgin appellation olive oils, herb-flavoured olive oils and vinegars, and salsas. Value added can also include other types of products: cut flowers, dried flower arrangements, wreaths and wall swatches, braided garlic, painted gourds, dried herbs, sachets, soaps made from home-grown herbs, and herbs grown and sold for medicinal properties (Ramirer, 2002). Any product can be considered for value added if it is originally grown by the farmer and increased in value "by labour and creativity" (Ramirez, 2002; Nakamoto et al., 1991).

Value added products are now being developed by small to medium-scale farmers in developing countries, who often do their own processing and sell direct to customers through farmers markets, individual or direct wholesale orders, or a website (Goletti and Wolff, 1999;

Nakamoto et al., 1991). Growers also typically sell wholesale to speciality outlets, such as high-end grocery stores or to exclusive catalogue businesses. The common factor is that the farmers develop and process the end product themselves.

Vazquez-Navarrette (2007) and Cox (1999) describe value added as a utility chain linking organisations in a win-win relationship. These relationships involve all actors in the agribusiness/food chain, that is, from producers, through suppliers to retailers, and each actor adds value to the product or service. Value added is also a concept that has gained currency in the small farm policy debate, in response to the concern that the proportion of consumer incomes spent on food continues to decrease (which, some small farm advocates contend, is due to the excessive profit-taking by processors and retailers). Thus, value added agriculture might be a means for farmers to capture a larger share of the profits from consumer sales. Examples include direct marketing, farmers' ownership of processing facilities, and products with a higher intrinsic value (such as identity-preserved grains, organic produce, free-range chicken and so on), for which buyers are willing to pay a higher price than for more traditional farm commodities (Ramirez, 2001). Ramirez (2001), in his study on the impact of non-traditional crops on livelihoods of rural producers in Mexico, reported that improved market linkages and product diversification increased income by 58 percent, while value added activities accounted for a 350 percent increase in farmers income.

2.4.1 Factors Influencing the Outcome of Adding Value (Processing)

Generally, factors which may affect the potential of adding value can be grouped into exogenous and endogenous assets (Abdoulaye et al. 2006; Swanson and Samy, 2002). Endogenous assets include factors such as farmers' skill (often dependent on age and years of education), resources (size of farm, storage capacity, drying facilities, capital and sources of capital) and the willingness of the farmers to join and/or invest in value-added endeavour. The exogenous factors included domestic and international markets, natural resources (topography and the soil structure, growing season, rainfall, transportation infrastructure, technology, government policy, and the availability and dissemination of information) (Iniodu, 2002; Taiwo, 2006). Thus, in a modern economy, a typical product passes through several value adding activities before reaching the final consumer.

There are five general ways by which value may be added. Value is added by: (1) physically changing the form of raw materials or intermediate products, for example, Butchering beef, milling wheat into flour or canning pineapple slices; (2) location; (3) time values are added by transporting and storing goods so that they will be conveniently available for consumer purchase; (4) possession value is added by wholesalers, retailers and others who facilitate trade. Activities here include the use of credit, insurance and the transfer of ownership rights; and finally (5), value is added by providing information about products. Advertising and promotion, grades and standards, trademarks and labels are typical examples. Possession and information value are also associated with the status and the image of a product, as is exemplified in extreme cases by products such as Mercedes cars, Gucci handbags and Kona coffee (Vazquea-Navarrette, 2007; Engindeniz, 2007; Nweke, 2003).

Oluwansola (2010) evaluates the economics of cassava processing by rural farm households to establish the socio-economic and policy strategies required to stimulate rural enterprise. Multistage sampling techniques were used to collect data from 150 farm respondents in Nigeria. Descriptive analysis, budgetary analysis and Cobb-Doulas regression function were used to analyse data collected. The results indicate that gross margin and net income were N324, 178.00 and N68, 119.00 respectively, and the internal rate returns were 1.84, while the cost benefit ratio was 1.17. The regression results showed that age and size of enterprise were significant determinants of profitability in the cassava processing enterprise with the conclusion that policy should be geared towards accessing processors with local facilities, while policy, research and extension services regarding food processing should be tailored to overcome constraints experienced by processors.

Amao et al. (2007) have examined the processing of cassava into *gari* in Oyo State, Nigeria. Cost and returns analysis revealed that *gari* processing is profitable and lucrative, with a gross margin profit of N7, 360.00 per bag (50kg). Profit was regressed against socio-economic factors and results showed that age, marital status, level of education and years of experience had positive effects on the levels of profit made by processors. Conversely, gender and family size had inverse relationships. The study found that constraints included inadequate raw material supply, lack of credit facility, poor road networks and lack of availability of labour.

2.4.2 Cassava Demand and Supply

An ever increasing world population, which some estimates put at about 11.2 billion in 2050, places a good deal of pressure on the supply of staples like rice, corn, wheat, and barley. To meet these food requirements, existing food production must be set to double (Rosen and Shapouri, 2012; USDA, 2010; FAO, 2006). Cassava root tubers (CRT) have the potential to contribute to the achievement of this target. In turn, this has put pressure on levels of productivity of cassava in tropical countries such as Nigeria. The main area of CRT utilization is as a traditional staple food, and processing is done at home. It is estimated that 88 percent of cassava produced in African countries including Nigeria is consumed as staple food in the form of *gari*, *fufu*, *akpu* among others (Kaine, 2011).

The demand for cassava chips, flour and pellets, especially for animal feeds is just emerging and undeveloped research is in for the possible uses of CRT and its leaves for biofuel. However, there is already existing high demand for other products such as starch for the textile industry, pharmaceutical products, pulp and paper, adhesives for packaging industries and flour for bakeries and confectionery industries. According to the Raw Material Research and Development Council (RMRDC) (2004), it is estimated that more than 40 million tonnes of cassava would be needed to meet current industrial demand in Nigeria.

Abolaji et al. (2007) argue that, beside local demand, there is a high demand for cassava-based products in foreign countries, such as an urgent demand for 400,000 tonnes of cassava chips (about 1.6 million tonnes of CRT) for animal feeds in South Africa and Botswana. However, the current supply may not be enough even to satisfy local demand. The main reasons for this are low pricing, which is discouraging farmers from expanding their output, the use of low yielding seed varieties and low efficiency in productivity (Liverpool-Tasie et al. 2012).

The present study will try to evaluate the marketing costs of cassava and its products and assess the likely level of profit margins from the producer markets which would encourage farmers to increase their production of cassava.

2.4.3 Economics of Cassava Processing

Processed cassava products including *gari*, starch, *akpu*, *fufu*, tapioca have been an important source of staple food apart from rice, maize and millet in Nigeria. Cassava processing represents one the most important sources of income for farmers, middlemen and marketers in most tropical countries, especially Nigeria, and also as a viable cash crop for poor subsistence farmers. According to IITA (2011), *gari* is the most popular processed cassava product (constituting 80 percent of household processing and 70 percent output by processing enterprises). Levels of demand and supply of cassava and its products influence their prices in the market, and consequently the level of farmers' incomes (Oluwasola, 2010). Besides the low quality of the product, the low use of processing technologies also affects production costs. Also, there are other constraints that affect cassava productivity, cost of production and profit margins, as discussed in Chapter 1. These will be further discussed in Chapter 10. According to a number of studies in Nigeria and Ghana (Olukunle, 2013; Onyemauwa, 2012; Achem, 2011; Ellul, 2010; Oyewole and Phillip, 2009; Addy et al., 2004 and Nweke, 2004) despite these constraints affecting the processing of cassava, adding value to CRT remains a source for adding additional revenue to farmers, guaranteeing higher prices and therefore is potentially more profitable than additional efforts in marketing CRT for farmers.

2.4.4 Vertical integration

Vertical integration is described as a special form of diversification which is of great significance to producer and agribusiness firm growth. It involves an increase in the number of intermediate products that a farm produces and may be utilised through innovation and technology (UNDP, 2005). Focussing on post-harvest activities, differentiated value added products and increasing links with niche or targeted market would be a strategy open for smallholders, as well as increases in the quality of storage for crops, increases in producer/enterprise profit margin, among others. This implies the creation of wider markets and employment opportunities in the processing of cassava.

In summary to this section, it should be noted that adding value to cassava will lead to price stability, increases in the uses of cassava, increases in cassava production and may enable farmers to sell cassava products other than those used as staple food. The identification of alternative markets will boost levels of processing of cassava (Knipsccheer et al. 2007). This recognition leads to the next section on the development of marketing strategy, and will encourage uses of cassava which increase farmers' income, and facilitate agricultural growth and economic development.

2.5 Marketing and Strategic Development

The purpose of this review is to understand the underlying factors that enable crop producers to improve their situation in the market, to see if this could be accelerated through a market led approach, thus leading to increases in farmers' productivity and income. Of paramount important here is the identification of an effective marketing strategy to be used for trade in agribusiness commodities.

Abdoulaye et al. (2006) note that the introduction of new technologies in the semi-arid region of the Sahel proved difficult due to three price problems: first, the staple price collapses annually during harvesting time; second, there is a between year price collapse in good and very good years due to inelastic demand for the principal staple crop, i.e., millet; with large fluctuations in levels of supply due to weather and other stochastic factors. The third main problem is price changes arising from intervention by the government and NGOs in adverse rainfall years, with the objective of driving down price increases to support consumers. Abdoulaye et al. (2006) propose marketing strategies to solve the first two price problems and a change in public policy for the third. They observed that the new technologies would be introduced anyway with or without marketing strategies. However, with the introduction of marketing strategies, the technology introduction process is accelerated if accompanied by further increases in the income position of farmers.

Ebrahimi (2005) noted that there are two major crosscurrents of theory and practice that have emerged in post-adjustment Africa which are defining major policy directives concerned with boosting agricultural income in Africa and LDCs in general. First, agricultural development will not occur without engaging smallholder farmers. According to the majority of actors in this sector, smallholder farmers must be made central to any marketing strategy to revitalize not only the agricultural sector, but also the economy as a whole (Diao and Hazell 2004; Omamo and Farrinton 2004; Wiggins 2000). The second realisation, which would intersect with the first, is that the major difficulties facing smallholder led agricultural-growth are around a lack of market access. Thus, major proponents of this perspective contend that enhanced market access will lead to increased incomes and food security, more opportunities for rural employment and sustained agricultural growth (Dorward et al., 2003; Stiglitz, 2002; Scofer et al., 2000). The additional factor seems to be that for farmers to thrive in the global economy, it will be necessary to create an entrepreneurial culture where farmers produce for the market rather than trying to market what they produce (Lundy et al., 2002).

The focus and emphasis is thus on both production regulated programmes and market oriented interventions. Jayne and Jones (1997) argue that a way of looking at future strategies to strengthen the performance of grain marketing systems in Eastern and Southern Africa is to move beyond liberalisation reforms, and to focus on developing financially sustainable marketing systems to raise productivity in smallholder agriculture. This can be achieved by creating a more effective market oriented mechanism to reduce price vulnerability and supply instability, which could include elements of input delivery, farm finance and reliable output markets. They concluded that smallholder agriculture, in Zimbabwe and Kenya, could grow rapidly if given a conducive set of incentives, including access to inputs, credits, reliable outputs markets and a viable technical package.

Putterman (1995) suggests that the development community should develop models on how to use the above ingredients sustainably and they could be combined given limited available resources. Furthermore, it has placed renewed attention on institutions of collective action, which are most often realized through the structure of farmer groups. These are recognised as an efficient mechanism to enhance marketing performance of smallholder farmers (Kariuki and Place 2005). One of the ways of making production and marketing successful would be to enhance farmers' stock of human and social capital through establishing new groups, strengthening existing groups, providing skills training in marketing and entrepreneurship and by linking these groups to other chain actors to improve market relations and forge new business partnership Ebrahimi, 2005). (Ebrahimi 2005) argues that this is by no means an exhaustive list, but it does highlight many of the collective actions that farmers' groups have attempted to undertake in order to improve their market situation. As for the benefits accrued from such actions, these include increased incomes through increased sales and/or higher profit margins, a more reliable or steady income flow and enhanced levels of food security.

Although the export behaviour of small and medium-sized enterprises (SMEs), particularly in the high technology sector, has attracted considerable research attention, relative little is known about the key influences on successful international marketing among agri-food firms (Adekanye, 1999; Ibeh et al., 2006). Most of the existing studies come from the discipline of economics (specifically agricultural economics), with its traditional focus on national comparative advantage and factor efficiency (Schimpelfenning and Thirtle, 1999). A related reason is the influence of national, regional and super-national governments in the export of agricultural products.

According to Ibeh et al. (2006), the dearth of research is particularly noted in its absence in view of the urgent need for a greater international marketing focus among firms in the agri-food sector. Ibeh et al. (2006) attempted to identify the key factors that underpin the international marketing success of small enterprises in the UK. They focused on the relative extent of market orientation (Narver and Slater, 1990; Hooley et al., 2004) among a range of internationally successful agri-food firms; the perceived importance of marketing competencies of these firms on their international market success; the perceived impact of marketing resource factors, including people's skills and brand/reputation; resources; levels of international success and the competitive marketing strategies favoured by these agri-businesses. It is envisaged that a greater understanding of these critical success factors, core competencies and critical resources might improve the overall efficacy of the sector, if guidance is provided by managers and policy makers seeking to enhance the performance of UK agri-food enterprise in international markets. In other words, there is merit in finding a way in which small and medium size agri-businesses may fit in with the international market (Porter, 1996).

The marketing strategy could be linked to a value-development process which involves processing to create value throughout the production chain, such as the procurement strategy, new product and service development, design of distribution channels, vendor selection, strategy partnerships with service providers, providing strategy development and, ultimately, the development of value propositions for customers (Poulton and Dorward, 2003; Scoffer et al., 2000).

Porter (1996) suggests that some industries are inherently more attractive than others and that the factors driving industry competition are the key determinants of profitability. Approaches to the development of marketing strategies may include a resource based view of the firm or a focus on core competencies. Other main alternative approaches include the following: (see also Prahladachar and Hamed, 1990, Wernerfelt, 1984, and Hooley et al., 1998):

- *Product-push marketing:* Under this approach, firms centre their activities on existing products and services, and look for ways to encourage or even persuade customers to buy
- *Customer-led marketing:* Under this approach, enterprises chase their customer at all cost. The goal is to find what consumers want and then to supply them (Slater, 1998)
- *Resource-based marketing:* This is the middle ground between the two extremes, where marketing strategies are based on equal consideration of the market and the potential of the business

Ibeh et al (2006) argue that international market success can be achieved by adopting a market-focused perspective and deploying appropriate advantage-generating marketing competencies, resources and competitive strategies in properly selected international markets.

This section has examined the role of marketing and strategic development in establishing the critical issues concerning competitive positions and market choices for farm producers, from farm to final consumer. This involves the move towards value creation and delivery to customers that transcends traditional departmental boundaries in the context of marketing orientation.

The next section, being the final section in this review of literature, discusses the role of agricultural policy development towards encouraging growth in the agricultural sector, reflecting on the evidence of success or failure in the literature.

2.6 Agricultural Policy and Productivity

According to Eze et al (2010), policy intervention consists of actions taken by government, management or individuals to influence or arrive at predetermined outcomes. Agricultural policy describes a set of rules or laws relating to domestic agriculture and imports of foreign agricultural products. Agricultural policies are implemented with the goal of achieving specific outcomes in relation to the productivity of the domestic agricultural sector. Such policies cover guaranteed supply levels, support services, price stability, exchange rate policy measures, product quality, product selection, land use and the roles of various stakeholders (MANR, 2006; Yusuf, 2001). Agricultural policy may also be concerned with marketing challenges, such as: the international trading environment, including barriers to trade in the world market (Grote, 2001); provisions of infrastructure; information facilities; farming techniques and new technologies (Jayne et al., 2006; Yusuf, 2001).

The basic policy tools may be summarised as price control, subsidies, tariffs and market regulation (Gijigo and Lukoma, 2011; MANR, 2006; Jayne et al., 2006 Yusuf, 2001). As stated at the start of this chapter, the productivity of agriculture can be improved by improving efficiency, but also, in addition, the use of factors of production, marketing, and other drivers of inputs may all be influenced and determined by the structure of trade and agricultural policy. Farmers tend to increase production of their produce if they have markets and can maximize profits (Prahaladachar and Hammond, 2002; Fafchamps et al., 2005).

2.6.1 Policies to Promote Agricultural Growth

The role of agriculture in economic growth and development arises from its linkage to other sectors of the economy. The African export crop sector has witnessed significant changes in recent years. In the mid-1980s, the purchasing, processing and exporting of commodities was almost entirely in the hands of marketing boards (Wiggins, 2005; Garba, 2000). Many of these boards also played a significant role in the supply of inputs to farmers on credit. With the advent of new policies of liberalisation, some marketing boards have ceased to exist whilst others continue to operate but are generally losing out to competition with private entrepreneurs. Others have been converted into non-trading industry boards dealing with promotion and regulation (Fafchamps et al., 2005; Shepherd and Farolfi, 1999).

Seesahai and Henry (1998) observe that two significant aspects of government policy of most developing countries which has continued to provide a strong basis for sustainable production of root crops are: (a) the maintenance of a broad genetic base of planting material; and (b) the use of training programmes provided both in-house and in the field. Studies on the impacts of trade liberalization on export supply in Nigeria (Ugwu and Kanu, 2012; CBN, 2000) indicate that after the post-SAP period, trade liberalisation did not significantly increase the importance of non-oil exports relative to oil export in Nigeria. Instead, this has declined significantly between the post-war reconstruction period and the pre-SAP period. On the effectiveness of agricultural policies in contributing to Nigerian economic development, it is further stated that trade liberalisation only stabilised the ratio of contributions of the non-oil sector to total export earnings in the post-SAP period relative to the SAP period. The study also observed that policies to encourage export supply involved liberalisation, the diversification of produce and the provision of incentives to farmers to encourage them to increase production (CBN, 2000). Nwagbo (2000) argues that policy agendas which address the availability, access and distribution of channels could also lead to increases in food production. Further discussion of the agricultural policy situation in Nigeria is found in Chapter 11.

Productivity growth is one of the key focuses of agricultural policies. It reflects improvements in the efficiency of farmers and the efficient use of inputs, in combination to produce output (Gray et al. 2012). The examination of trends in agricultural productivity is useful for monitoring and evaluation of changes in agricultural performances over time. The next sub-section will examine past empirical studies on agricultural trends and growth rate.

2.6.2 Empirical Studies on Agricultural Production Trends and Growth Rates

A number of studies have been completed on the characteristics and impacts of agricultural policy in a range of different countries across the globe. One or two notable works from Iran and Bangladesh are first discussed, followed by some initial discussion of the impacts of changes in agricultural policy for Nigeria.

For Iran, Shadmehri (2008) examines the trends in area, production and yield of Iran's agricultural production of food grains. The results reveal that agricultural performance was slightly better during the pre-revolutionary period, when compared with the post-revolutionary period. The study stated that production yield of total food grains growth rate is higher during the pre-revolution period, with the provision of input subsidizes by government that encourage more use of inputs (fertilizer, pesticides and irrigation). The study concludes that the main source of growth in agricultural production in the period in question was the growth in yield per hectare and expansion of the irrigated areas. In contrast, Chandral et al. (2011) in the study of the impact of land management in Himalaya, argue that increasing interest in environmental issues suggests that policy should be focused on improving land productivity rather than the expansion of land area utilised for cropping. They also note that improved inputs in technology, such as high yielding seed varieties, fertilizer, disease resistance stocks, off-season irrigation methods and so on, have not led to appreciable growth in yields.

Secondly, and mindful of demands for food sustainability in Bangladesh, Rahman (1998) uses data for rice and wheat over 47years in a linear-semi-log trend function to analyse compound growth rates. The findings suggest that agricultural growth is constrained by both agro-ecological and physical constraints. Using data from 1948 – 1994, grouped into the technological change period (1947/48-1967/68) and the post-technological change period (1969/70-1993/94), the study shows the productivity growth rate of rice was higher in the post-technological period. Turning finally to Nigeria, Antia-Obogn and Bhattarai (2012) estimated trends in growth rates of output, yield, harvested area and sources of output growth in Nigeria, with the focus on oil palm and groundnuts during the period 1961-2007. The results indicate that groundnut output and area harvested had increased over time, except for the period of 1970-1985, where harvested area and output decreased, and in the 1961-1969 periods when yields also decreased. The harvested area and output of oil palm for the period 1961-69 were both seen to fall, whilst the other sub-periods showed positive growth rates. The authors found that the main source of growth in output was through expansion of area under cultivation for both crops, concluding that policy should be focused on increasing productivity, labour and capital availability, whilst the processing of both crops into a variety of products should be encouraged to improve their value or enhance their industrial application, in order for farmers to obtain a better return. Also in Nigeria, Iganiga and Unemhilin (2011) examined the effects of government agricultural expenditure on the value of agricultural outputs. The study found that government expenditure was positively related to agricultural output, concluding that government spending should be also complemented by monitored credit provision.

Okoye et al. (2008) examined trends in the production, area and productivity growth of cocoyam for the period 1960/61 to 2003/2006. Secondary data from CBN and FAO on area, output and production yield were used for the analyses. The period was grouped into Pre-SAP (1960/86-1984/85) and Post-SAP (1985/86-2003/06). The growth rate was calculated by fitting exponential functions in time to the data. The estimated linear log function in time variables suggest that output, area and productivity of cocoayam exhibited negative trends in Pre-SAP periods, whereas output and cocoayam showed positive trends in Post-SAP period. The authors concluded that increases in cocoayam production levels are due to increases in the area of cultivation, and thus that policy needed to be directed at measures aimed at improving the yield and efficiency of resource utilisation. The importance of agricultural policy that will boost the use of farm inputs, encourage the use of improved seeds and irrigation may not be overstated in achieving increases in the growth rate of agriculture.

2.7 Synthesis of Literature Review and the Research Gap

This review of literature clearly shows that there are a range of approaches that are used to examine the performance of crop production. These range from a simple approach of gross margins, profitability and benefit-cost ratio analysis, to more sophisticated methods of measuring productivity and efficiency, using either parametric approaches (i.e., stochastic production frontier) and/or non-parametric approaches (i.e., DEA). Regression approaches are also used to determine predictors of inefficiency by using a range of socio-economic factors that are under the control of the farmers. Also, in order to measure marketing performance, analytical approaches include the examination of marketing channels, market structure and levels of marketing efficiency.

The review of empirical studies of production performance of crops reveals that, in general, the productivity and efficiency of crop production are low in most developing countries, including Nigeria (see Table 2.2). Also, the few studies that have conducted productivity performance analysis on cassava have showed only slightly higher levels of technical efficiency than that found with other crops. Since cassava is a crop that has multiple usages potential, that is, both as a staple and as an industrial, exportable crop, it is important to judge the merit of this crop by investigating a range of aspects regarding its potential for agricultural growth and development. At the production level, it is important to examine not only productivity and technical production efficiency, but also allocative and economic efficiency, so that cassava producers remain competitive in the world market. Next, it is also important to know who produces the raw product (i.e., only cassava root tubers) and also who further processes it.

Equally, it is important to identify whether the same farmers produce cassava root tuber and also process it further into *gari*, in order to reap the potential benefit of higher returns. In this respect, it is also important to determine whether the level of performance, in terms of productivity and all efficiency measurements, varies between raw cassava production and *gari* processing, as this may have important policy implications. It is also necessary to determine which set of factors affect the efficiency of cassava production and whether they are the same for processed cassava (primarily *gari*). Finally, since marketing is crucial for trading the cassava crop, it is important to identify the appropriate marketing channels, market structure and marketing efficiency levels, to appreciate any barriers to potential agricultural growth using cassava.

The major thrust of this study is to address all those aforementioned aspects related to cassava production, processing and marketing in Nigeria, in order to provide a comprehensive picture of the sector, so that informed analysis can be undertaken to inform the development of this sector as an engine of agricultural growth for the Nigerian economy. The present study thus contributes to the existing literature in the following ways: first, despite the economic importance of CRT as a potential source of growth and economic development, the crop has remained under-researched compared with similar crops that have similar attributes. The present study addresses this significant gap in the literature.

Secondly, as yet no work has covered CRT production, processing and marketing simultaneously, as emphasized above; no study has been conducted involving the comprehensive measurement of the performance of a single crop, especially a staple crop like cassava, to examine its potential for adding value through processing into *gari*. Most studies have either looked at efficiency of production or at efficiency of processing, independently from one another, with different sets of data collected from different locations.

Thirdly, this study has an advantage over all previous studies in that it uses the same set of data to analyse the performance of raw produce and processed produce, as well as the issues involved in the marketing of the crop within the study area.

Fourth, although a few empirical studies have dealt with the limited range of technical efficiency analysis of cassava production in Nigeria, hitherto none have covered the Delta State. Despite the fact that cassava cultivation is among the most important crops in Delta State, the fact that the State ranks among the major producing states in the Niger Delta region and that Nigeria produces the largest output of cassava in the world (IFAD/FAO, 2005), this state remains under-researched. A few works, including Kaine (2011) and Chukwuji (2008), have attempted such a focus but have largely failed to ascertain the differentials in cassava production among the agro-climatic regions within the Delta state. There is need for a study which examines all the aforementioned aspects of the cassava crop, while accounting for regional variations to some extent. Therefore, this study will inform policy makers with such evidence, providing the opportunity to boost efficiency, profitability and productivity of cassava in the study area, as well as other parts of Nigeria, in order to develop the agricultural sector to its full potential.

The next chapter describes the study area, elaborates on the methods of data collection and presents the various methodological approaches to examine all the aforementioned aspects of the cassava crop sector in this study.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The primary purpose of this research is to evaluate the present performance of cassava root tubers, in terms of productivity and efficiency, and to see how value could be added to reach a wider market than is possible given present socio-economic and agricultural policy environments in Nigeria. The research is geared towards formulating policy guidelines and strategies to explore cassava root tubers as a tool for agricultural development and growth. The study has specific scope and limitations, imposed by the geopolitical nature of the Delta state of Nigeria which is a leading producer of cassava in addition to many other annual and perennial crops.

Given the aims and objectives of the study, the research methodology involves a mix of relevant quantitative and qualitative techniques. The research is designed with a conceptual framework and proposes an empirical study to answer the questions raised therein. The following sections discuss and provide details of the research design and methodologies employed in this study.

3.1.1 Methodological Approaches

The research is based on an extensive literature review as well as primary and secondary data. Aggregate data was collected, coordinated and screened from secondary sources, while primary data was collected through intensive field surveys, using structured questionnaires for different stakeholders, farmers and policy makers.

Analysis of the primary data collected specifically to address seven of the eight objectives forms the backbone of this study. The principal assumptions and justifications regarding the use of cross-sectional data to address the specified objectives, which are also very common in agricultural economics literature/studies, are as follows:

(1) Farmers are assumed to be at various stages of learning regarding their production processes due to a number of factors, including variation in the levels of resource endowments at their disposal, thereby leading to wide variation with respect to resource allocation decisions, production decisions and product mix and so forth amongst themselves.

(2) Since statistical procedure is used to collect sample farmers, the assumption is that the samples thus collected adequately captures all possible variations that exist among the farming population with respect to conditions mentioned above in (1), thereby enabling this cross-section of data to serve as a good proxy of information that would otherwise be available through collecting longitudinal data from a set of farmers to reflect their changes in production practices and decision making processes.

(3) The cost of conducting such longitudinal studies is beyond the scope of financing in a research degree project.

(4) The time needed to generate longitudinal data is also not feasible for the present research.

The methodological approaches used in secondary and primary data collection for the project are outlined below.

3.1.2 Secondary Data Sources

Secondary time series data on major crop outputs and selected inputs and a number of crop products which could be substituted for cassava products were gathered from banks, research institutes, FAOSTAT, Federal Office of Statistics, the Ministry of Agriculture and Natural Resources. Information on budget allocations to the agricultural sector was also collected. Other data collected includes the area cultivated, total production and yield per acre of cassava, maize, groundnut, yam and millet covering the period 1970–2009. Information also includes on total fertilizer use, GDP, allocation to agriculture, share of GDP to agriculture and the major crops prices.

3.1.3 Primary Data Source

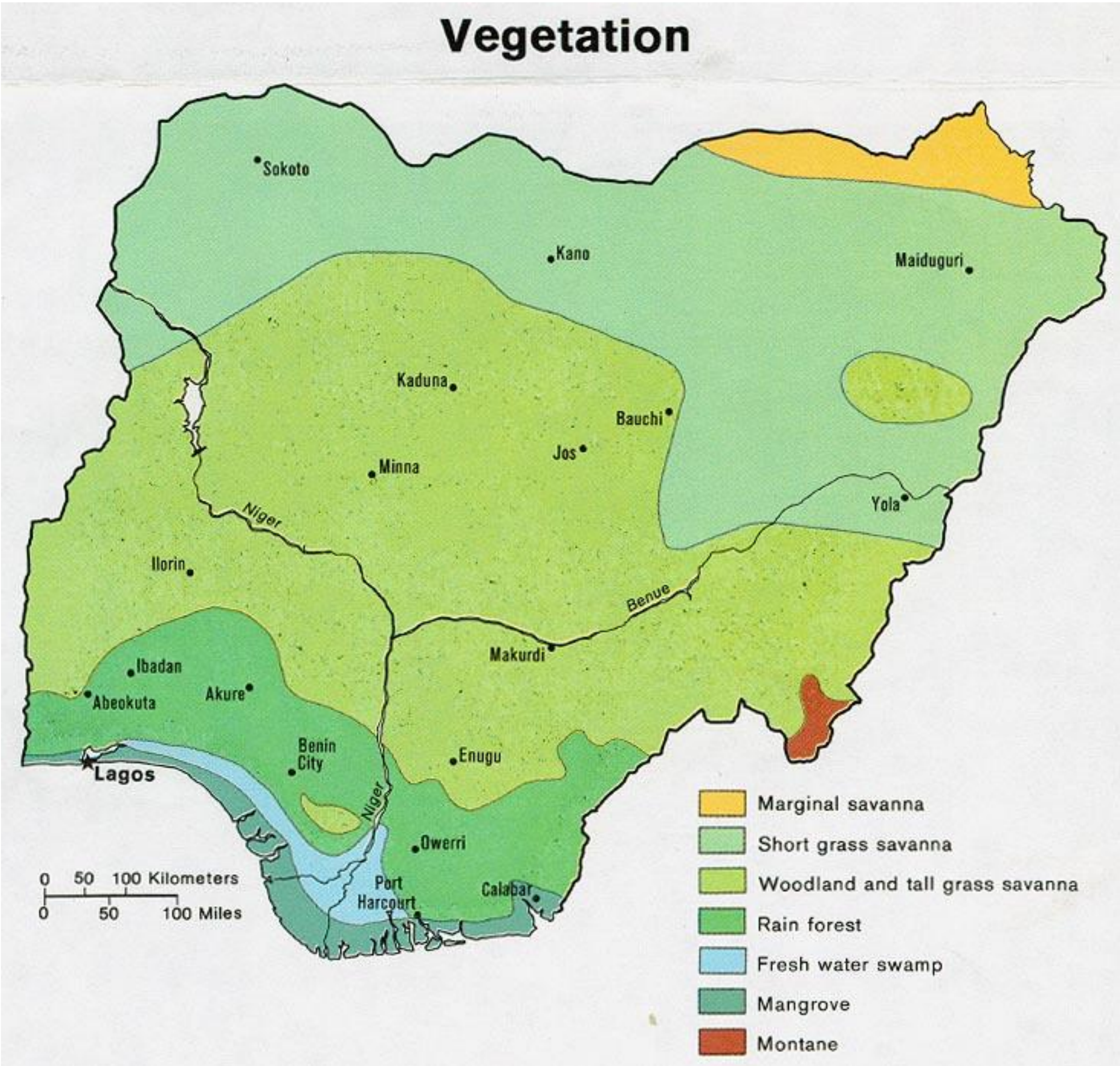
Primary data for this study is an important element in order to understand cassava production performance and processing at the farm-level including factors influencing farmers' performance, nature and structure of marketing of cassava and its products, marketing margins and marketing performance.

Primary studies were conducted with farmers, marketers (both wholesale and retail) and key stakeholders (policy makers, bankers, and researchers) in the Delta state. The selection of respondents was based on two criteria. Firstly, three senatorial geographical zones in the Delta state were selected. Second, Annual Development Program (ADP) Cell structure was used to select nine local government areas. Data collected included information on farm household demographic characteristics (such as farmers' age, gender, household members, working household members, farming experience, and educational level) and farmers' socio-economic characteristics (such as farm size, farming systems, crop varieties, area cultivated, farm outputs, farmers output use, consumption, quantity sold and its values, farming implements and their costs, production costs, capital source, inputs used in production, pesticides use information, weeding, the different forms in which cassava root is sold, food stock and storage facilities, and processing at the farm-level, value added, farming constraints, measurement use in selling and associated selling problems, off-farm income, farmers marketing margins, marketing distribution and channels). Other information included additional sources of income, credit facility, characteristics of the infrastructure provision, information on impacts and farmers assessment of agricultural policy, extension service provisions and agricultural policy programmes who have farmer participation - as used by many researchers such as Asogwa et al. (2011), Onuk et al. (2011), Ibrahim and Onuk (2010), Javed (2009), Rahman and Hasan (2009), Rahman and Umar (2009), Ajibefun (2008), Vazquez Navarrete (2008), Lambros (2008), Okoh (1999), Perdomo and Mendieta (2007), Mutoko (2007), (1999), Rahman (1998).

Data collected in the marketing survey includes respondents' demographic information (e.g., marital status, family size, geographical location or regions, main occupation), marketing characteristics and infrastructure; including source of marketing crops and their products, prices, marketing channels and their distribution, and of marketing systems. Other data include marketing margins, provision of infrastructure, sources of marketing information, sources of capital and measuring implements and business size.

Information gathered from other stakeholders includes their views on types of policies and their assessment as used by Odoemenem and Obinne (2010), Afolabi (2009),Mari (2009), Enete (2009), Adetunji and Adesiyan (2008), Lambros (2008). All variables mentioned are associated with the performance of the farmers at the farm-level and the market.

Figure 3.1 Map Showing Types of Vegetation in Nigeria



Source: University of Northern Iowa, 2007

3.2 Study Area

3.2.1 Agro-economical Characteristics of the Study Areas

The Delta State is one of 36 states in Nigeria, and is rich with agricultural and natural resources. Apart from its abundant petroleum and natural gas resources, its climatic condition favours cultivation of a wide variety of agricultural products, including both perennial and annual crops, and rainfall is the main source of water supply for agriculture. Rubber and oil palm are the two major cash crops and are widely grown in the central and northern zones, respectively. Figure 3.1 is the vegetation map of Nigeria indicating various climatic and vegetative zones in Nigeria.

The major foods grown in Delta state are cassava (leading producer), yam, plantain, maize, and vegetables. Other indigenous food crops include rice, cowpea, groundnut, okra, melon, sweet potatoes, millet, cocoyam, pineapple, pepper, banana. The major tree crops are oil palm, rubber, cocoa and citrus. Other agricultural activities include livestock production, pig farming, sheep and goat rearing, cane-rat production, snailery, apiculture, fisheries and lumbering. It is estimated that 80 per cent of the working population in Delta state is engaged in agriculture (MANR 2006).

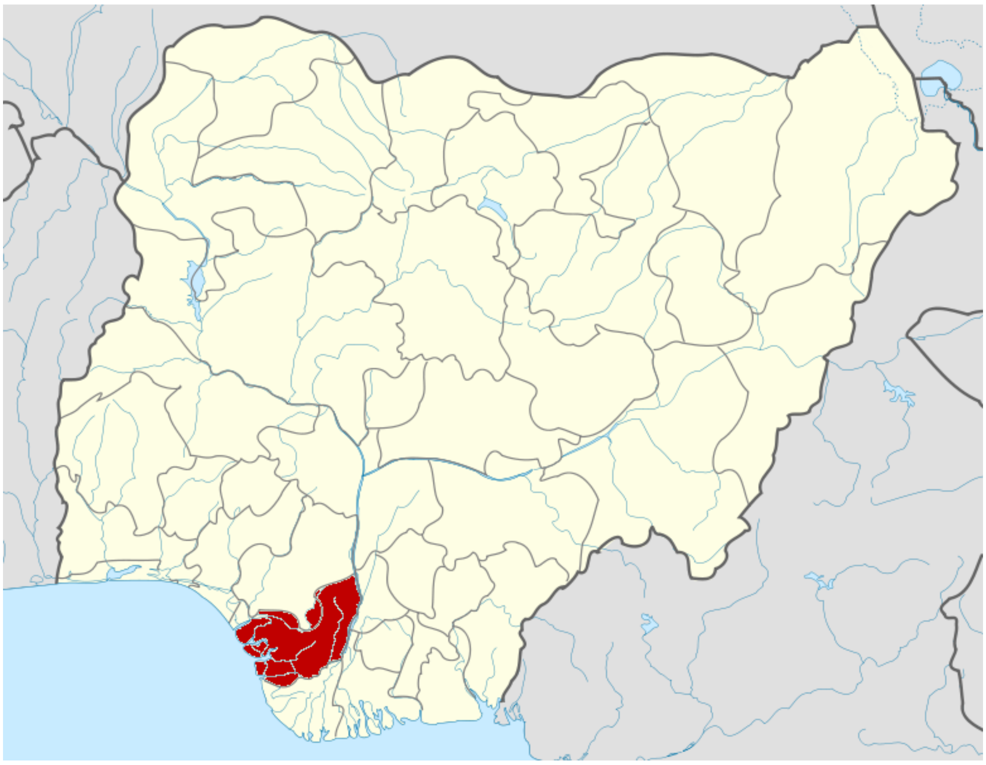
3.2.2 Location and geographical characteristics of Delta State

The area chosen for this study is Delta state of Nigeria which is one of six states in the South-South geopolitical zone as shown in Figure 3.2. This state has a deep coastal belt, interlaced with rivulets and streams which form the Niger-Delta. It was created out of the defunct Bendel state on the 27th August 1991, with Asaba as its capital. The total land area is estimated at 17,698 sq km. The state lies between longitude 50°00” and 6°45” North. The Atlantic Ocean forms its Southern boundary with a coastline of 160 kilometres, and latitude 5°00″ and 6°00″ with a population of 4,098,291 million people (see Federal Republic of Nigeria, Official gazette, 2007; Statistical Bureau, 2006). Figures 3.2 and 3.3 show the location of Delta state in Nigeria. It has two agro-ecological zones: riverine and upland, and consists of three vegetation types which include mangrove salt swamp area, rainforest area and upland areas (as shown in Figure 3.1).

Figure 3.2 Map of Nigeria Showing Location of Delta State and other States in Nigeria

Source: University of Northern Iowa, 2007

Figure 3.3 Map Showing location of Delta State in Nigeria



Source: University of Northern Iowa, 2007

Delta State has abundant natural resources backed by oil wealth and serves as a potential food basket for Nigeria. About 1,770 sq km of the area is made of fresh water swamp, 5,840 sq km of mangrove swamp and 10,058 sq km of rain forest. The annual rainfall varies from 2,665mm at the coast to 1,905mm at the hinterland, with average temperature range from 30°c to 44°c (Anon 2004). The state has two distinct seasons, the dry and rainy seasons. The dry season occurs from November to April while the rainy season period is from May to October, punctuated by a brief dry spell in August (Anon 2003).

The state administration is made up of 25 local government council areas constituted into three senatorial districts: Delta South, Delta Central and Delta North (MANR 2006) as shown in figure 3.4. Urhobo, Isoko, Igbo, Izon and Itsekiri are the major ethnic tribes and languages, with more than 25 other tribes and languages. English is the main official language.

Figure 3.4 Map of Delta State

Source: Okoh, 1999

3.2.3 Choice of Location

Delta state was selected as the case study area for this research due to a number of characteristics. Cassava grows best in areas where annual rainfall is about 1,000-2,500mm and is well distributed, as in Delta state. It can tolerate drought and may even survive 4-6 months of dry weather, provided this dry weather does not occur too soon after planting. Because of its drought tolerant nature, cassava can grow in areas with as little as 600mm annual rainfall (Erhabor et al. 2007). It does require some period of dry season weather during maturity before harvesting. Delta state has ideal climatic and soil conditions for the cultivation of cassava. Cassava is very important crop in the state based on its extensive use as a staple food for most Deltans and Nigerians. The state has comparative resource advantages in the production of cassava (Agricultural policy 1998; MANR 2006), and is one the leading producing states with about one million metric tonnes of fresh tuber per annum (Statistical Handbook 2005). In addition, a single state focus for the research was necessary due to time, financial and other resource limitations. Figure 3.4 shows a map of Delta state.

3.3 Sampling Procedure, Sample Frame and Sampling Size

3.3.1 Sampling Procedure

In an empirical investigation it is impossible to collect information from the whole population. Therefore, researchers are often forced to make inferences based on information derived from a representative sample of the population. The size of the sample and amount of variation usually affect the quantity and quality of information obtained from the survey. Both factors can be controlled using appropriate sampling methods (Scheaffer, 1979). The aim is to devise a sampling scheme which is economical and easy to operate and provides unbiased estimates with small variance (Barnett, 1991). The main characteristics of sampling theory applied in this study are discussed below.

3.3.2 Sampling method

The selection of a sample from the population is commonly used in economics, marketing, production and other disciplines because of limitations of covering the whole population Barnett (1991) and Kinnear and Taylor (1987) consider that cost is the main constraint to carry out interviews of the whole population. Given limitations in terms of resources and the demands of data management, a sample is a more appropriate method. They argue that sampling not only saves cost and time but can also give more accurate results than a census. In a census survey, more staff is required to carry out the task, therefore, supervision of staff and management problems will arise. Sampling theory provides an opportunity to minimize cost and to achieve acceptable results (Casley and Kumar, 1988; Kinnear and Taylor, 1987). However, a sampling procedure involves the following steps: defining the population, sample frame, sample size and sample selection procedure.

3.3.3 Defining the population

Classification of the population is the first step in the sampling procedure, namely, the sector or element under investigation, the sampling unit, the area or extent of investigation, and the duration of investigation (Kinnear and Taylor, 1987). Under investigation is those involved in the production and processing of cassava, and the sector which adds value to cassava root tuber crop and its marketing. The sampling units cover cassava producing and marketing households in the Delta State of Nigeria and actors in the marketing chain including commission agents, wholesalers and retailers.

The main limitation of this study is that it uses cross-sectional data within a farming season, but covering a wide area and range of farm size groups. This is common practice in the literature. The main assumption is that sampling from within a large section of farmers from different location captures variations in farmers' socio-economic conditions, production experiences, farm size and other resource endowments, and so forth. In other words such variation across the sample approximates variations that one would observe or identify by following a fixed set of farmers over a long period of time and can simultaneously provide a 'snapshot' of the population and the characteristics associated with it at a specific point in time. Therefore, the limitation of time may not have any important influence on the results of the study.

3.3.4 Sample Frame

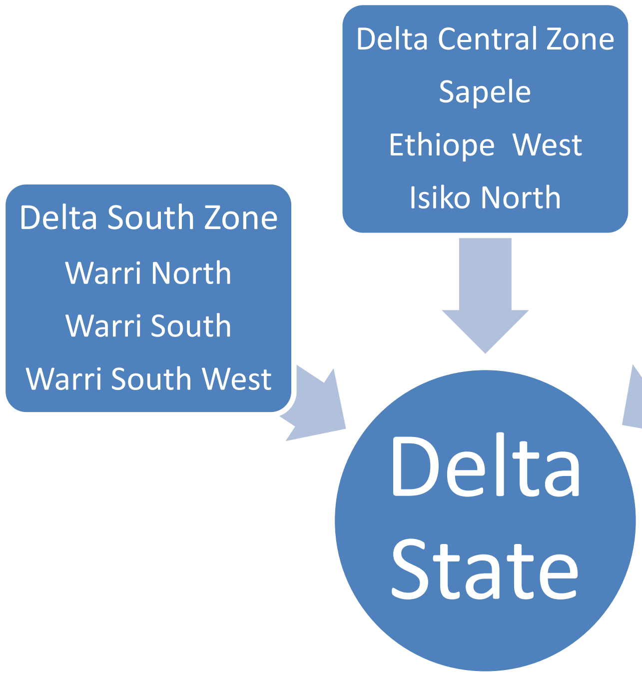
The sample frame consists of farm household respondents, marketing respondents and stakeholders in agricultural policy. All of these groups of respondents qualified to be included in the sample by virtue of their involvement with cassava production. Using these three groups in analysis will enable scrutiny of ways in which value can be added throughout the chain of production of cassava, from farm-level to market.

Criterion for marketing survey is the market for cassava root tubers and other crops. The important criterion in selection is marketing of root tubers and its products. Finally the agricultural policy stakeholders are included. This includes agricultural officers working in the state and federal Ministry of Agriculture, bankers, researchers, statisticians and industry representatives.

3.3.5 Sample Size

The Delta state ADP's cell structure was used for the selection of surveys and the respondents were randomly selected from the selected areas. 35 respondent farm households were selected from 9 local government council areas, which were spread equally in the three agricultural-climatic and geographical zones of the state. This makes a sum total of 315 farm households. Also, 35 respondents selling cassava root and cassava products were selected from each zone, making a sum total of 105 marketing respondents. Thirdly, the last sample was 30 respondents, who are the state stakeholders in agricultural policy sector. Statistical test is of no value when the sample size is too small to ensure that certain conditions are met (i.e., no expected value of zero, fewer than 20 per cent value less 5) (Lovett, 2005). To ensure spread of sample among the respondents and stakeholders without bias and to ensure adequate conditions for detailed cross-tabulation and test, one third of geographical cassava growing area within the three selected zones was randomly chosen, as shown in Figure 3.5 and Table 3.1. The Delta state ADP does not have an extensive list of the farmers in the state.

Figure 3.5 Survey LGA Areas



As a result of this, the law of large samples or numbers was used in choosing the size of sample. According to Sen and Singer, (1993); Gillham, (2000) and Ross (2009), the law states that the sample mean converges to the distribution mean as the sample size increases. It also stated the mathematical premise that the greater the number of exposures, (1) the more accurate the prediction, (2) the less the deviation of actual losses from the expected losses (X-x approaches zero) and (3) the greater the credibility of the prediction. Gillham (2000) asserted that for any given study area the chosen size of sample should be greater than 300 and for this reason a sample size of more than 300 respondents was used for study.

Table 3.1 Delta State ADP Cells Structure and Survey Samples

Zones	Block	LGA/Blk use	Cells (effective)	No of respondents	Farm households	Marketing respondents	Stakehoders	Total
Delta Central	10	3	63	140	105	35	10	150
Delta South	6	3	72	140	105	35	10	150
Delta North	9	3	18	140	105	35	10	150
Total	25	9	153	420	315	105	30	450

Source: Adapted from DSAPDP (2004)

Table 3.1 elaborates on the sample size for the primary data. A total of 140 respondents per zone were selected which were distributed into 105 farmers, 35 marketing respondents and 10 interviews with key stakeholders (e.g., policy makers, researchers). The main purpose was to have at least 300 farmers. The number of marketing respondents was decided based on arriving at a respectable sample size of at least 100.

3.4 Data Collection Methods

3.4.1 Triangulation

Data for this research was gathered from multiple sources. This approach enables 'triangulation', where two or more distinct methods are employed to measure the same phenomenon but from different angles (Arksey and Knight, 1999:23). Denzin (1989:93-94), stated that there are four types of triangulation including data source, investigator, theory and methodological. These techniques enable researchers to maximise understanding of the research question. It enables studies to develop converging sources of inquiry (Yin 2003). Therefore, the data source triangulation technique was used in this study where 'questionnaire', 'familiarisation', in-depth interviews and secondary data were the avenues of this investigation. Triangulation of methods reduces the weakness and deficiency of one method, which would be covered by the strength and effectiveness of the other (Hoggart et al. 2002).

3.4.2 Questionnaires

Questionnaires are one of the major tools of research survey. Surveys are usually aimed at a comparative and representative sample of a particular population (Gilham 2000). Survey methods were used in this research. This section will justify why and explain how a questionnaire was conducted in this study. The advantage of the interview-administered method is that it is highly effective in low literacy populations (Gillham 2000 and Brain 2002) such as in this research. Table 3.2 show the advantages and disadvantages of the use of questionnaires in research surveys.

Table 3.2 Advantages and Disadvantages of Using Questionnaires in Research.

ADVANTAGES	DISADVANTAGES
Participants can see what is asked so can give informed consent.	Participant may not be trustful so responses may lack validity.
Close questions are quite easily analysed.	Closed questions mean participants cannot give all information data may be lost.
Can be reliable, because can easily be repeated.	If repeated on a different day, different answers might be given.
Low cost in time and money.	Problems of data quality (completeness and accuracy).
Easy to get information from a lot of people very quick.	Need for brevity and relative simple questions.
Respondents can complete the questionnaire when it suits them.	Misunderstanding cannot be corrected.
Less pressure for immediate response.	Questions wording can have a major effects on answers.
Respondents' anonymity.	Respondent's literacy problems.
Can provide suggestive data for testing a hypothesis.	Impossible to check seriousness or honesty of answers.
Standardization of questions (but true of structured interview).	Respondents' uncertainty as to what happens to data.

Source: Adapted from Gillham (2000) and Brain (2002)

Harmonies between research features involving topics, aims and objectives, availability of funds, the choice and use of certain techniques and so on play a major role in research design, and this also affects selection techniques. Various types of questionnaire survey techniques include interview-administered (face to face), poster, internet and telephone based techniques (Parfitt 2005). The interview-administered (face to face) questionnaire was chosen for this research study. Although it is time consuming and expensive given the sample size, the other methods are too expensive and will not be effective given respondents' low rate of literacy and poor communication facilities, with little or no access to electricity, phone networks and internet. In constructing the questionnaire, attention was paid to ensure clarity and ease of understanding all questions. A pilot survey was conducted in this study which helped to refine difficult and vague questions.

This research study used a structure questionnaire to collect raw data for subsequent statistical analyses. Questionnaire surveys to analyse farmers' and marketers' demographic, socio-economic constraints were also used by Vazquez-Navarretee (2007) Abang (2006) and Rahman, (2003, 1998); and this can be attributed to the fact that a questionnaire survey is a popular tool used in primary data collection (Prafitt 2005; Gillham 2000). According to Gillham (2000), questionnaires offer only limited insight into the decision-making process and the interaction between other factors in this process (Newman 2006; Darnhofer et al. 2005). Furthermore, this survey allows for the quantification of investigated factors and that requires a large number of participants (Hoggart et al. 2002). This allows the conclusions drawn here to present a representative view of the entire population without the need to survey everyone and as a result, the quantitative methods appeals to many researchers and policy makers (Burton 2004a; Nweke 2003).

3.4.3 Questionnaire Structure

There are several important factors that influence construction of a questionnaire (Parfitt 2005; Brain 2002): these are; research aims and objectives, which are based on the conceptual framework. . These are taken into consideration when forming research questions. Also, attention was given to the different principles of question writing such as avoiding double negative questions. Another factor that contributes to the success of a questionnaire is the choice of question types (Parfitt 2005; Gillham 2000). Varieties of open and closed questions were included in this questionnaire. While open questions allow respondents to give any response using their own words, closed ones offers a fixed set of response from which the respondents should select answers (Neuman 2006). Closed questions are usually used for explaining specific facts about respondents, and were used in this survey to show or explain types of farming methods, sources of incomes, methods of harvests and so on.

Another example of a closed question used in this questionnaire is the rating questions. (Gillham 2000) constructed a Likert scale format to obtain certain facts about respondents' views on government agricultural policy, provision of infrastructure, cassava and farm produce most traded in the markets, products that have a wide marketing value and their demands. In this respect, different statements, allowing agreement or disagreement; least important or most important to be rated, were employed. The use of the Likert Scale was developed by Rensis Likert in the 1930s and can be attributed to the fact that it is easily constructed and can be easily tested for reliability (Neuman 2006). In addition, points are more likely to be equidistant in terms of gaps between them, but some researchers have argued that the gap will lead to a loss of vital information and when the range is more than five, as respondents may be unable to express their views accurately (Sproll 1988; Gillham 2000). Likert-type questions are used by various authors (Ajzen 2006; Abang 2006).

Neuman (2006) asserted that coding of responses to open questions is difficult. It gives different degrees of details provided by different respondents. Different answers to a specific open question may have multiple meanings (Parfitt 2005). Open questions are used occasionally in questionnaire because although these are more difficult to analyse and more troublesome for respondents to answer, they lead to a greater level of discovery. However, their number and use has to be restricted to justify additional cost implications (Gillham 2000).

Two sets of structured questionnaire schedules were administered to collect information from Delta State of Nigeria on the following (see Table 3.1):

(a) Survey of Farming Households

Detailed statistics on household characteristics, such as: farm assets and liabilities; costs of production; values of total farm production; costs of processing; different products of cassava; non-farm income; other occupations and wages; provision of infrastructure; constraints to farming; modes of processing and marketing; education; credit for farming inputs and agricultural policy assessments (see farm household questionnaire in the appendix A).

(b) Survey of Marketing Households

Market level questionnaires were conducted to provide information on the provision of: marketing infrastructure; constraints to marketing; marketing trends; margins; channels; types of markets; and the demand and supply of cassava and cassava products. Hoggart et al. (2002) state that checking credibility by administering a pilot survey is an important element in survey work. Indeed, running a trial test is important as it allows effectiveness of the questions to be tested and correction made before a large-scale investigation (see marketing household questionnaire in the appendix C).

3.4.4 Interview of Stakeholders

Agricultural policy stakeholders are the government officers, research workers and private institutions such as bankers, statisticians and industrial representatives that are major actors in research, planning, formulation, evaluation and implementation of government policy programmes and objectives. The information collected from the stakeholders includes: age; number of years in position; involvement in policy formulation with regard to research, planning, execution, monitoring and evaluation of government agricultural policies and programmes; and their views on the effects/impacts of these program/programmes (see the list of key stakeholders interviewed in the appendix B).

3.4.5 Participatory Rural Appraisal

This research survey used fortnightly participatory rural appraisal meetings in the Delta state Ministry of Agriculture in assessing the needs of, and the constraints to, farming and agricultural marketing activity in the state.

3.4.6 Pre-Test recognisance Survey

A pre-testing of the questionnaire and recognisance survey was conducted in Delta State. This informal survey was carried out to achieve the stated objectives. The purpose of this survey was to gather quick information on various aspects of the study, organize a fieldwork plan, test the validity of the questionnaire and estimate various cost components such as financial costs, travel time, interview time and so on. This preliminary survey provided an opportunity to understand existing labour use, as well as input and output costs. During the informal survey, interviews were held with a producer or group of producers on one or more aspects of the study and field notes were prepared. Based on this preliminary information, the investigator developed the questionnaire for final surveys.

3.4.7 Conducting the Survey

The field surveys were carried out from September to November 2008. Three agricultural officers and their assistants were involved in administering the questionnaire using face to face interviews. They were fully trained by the lead researcher, to ensure effective and efficient administration of the questionnaire. The interview took about 25-45 minutes depending on the literacy level of the respondent. This survey achieved a response rate of approximately 98 percent for farmers and 100 per cent for the marketing and stakeholders' survey. This high rate could be attributed to the interest shown by both the respondents and the interviewers. Respondents were also incentivized to participate in the research by offering light refreshments. Most respondents see participation in research such as questionnaires as an opportunity to inform researchers and the government about the constraints and problems related to cassava.

Wilson (1996) argued that farmers decisions are not individually taken, but they are informed by professional views which influence some of their decisions. Furthermore, Winter (1997) asserted that agricultural policy has always been made in order to promote farming and increase farmers' incomes. Therefore, it can be noted that policy-makers have an important influence on farmer's decisions. In view of the above, in-depth interviews with key stakeholders involved in agricultural policy were also used in the survey from the Delta state and the researcher also participated in the fortnightly agricultural meetings of the state ministry of agriculture.

3.5 Methods of Analysis

Both quantitative and qualitative analyses were used in analysing the data gathered from the surveys. Quantitative analysis include descriptive statistics (e.g., frequency counts, percentages, means, and standard deviations), inferential statistics (e.g., ANOVA, and t-tests) to examine regional differences and or differences across gender and other socio-economic characteristics, regression analysis to identify relationships between key variables of interest with farmers socio-economic characteristics, chi-square analysis to compare relationships amongst qualitative attributes of farmer socio-economic characteristics with their decision making processes regarding marketing and value-adding actions. The main softwares used for analysis are SPSS, STATA and DEAP2.1. Details of each method used to address specific objectives and/or main research questions are discussed below.

3.5.1 Time-series analysis of the secondary data

In order to examine changes and performance of Nigerian agricultural policy and programmes over time, trend analysis of cassava production and yield covering the period 1970 – 2009 were conducted at the national level. The method used is the standard semi-log trend function to compute growth rates:

$$\ln Y = \alpha + \beta t + \varepsilon \qquad (3.1)$$

Where:

Y = the dependent variable of which growth rate is to be estimated

t = time;

α and β = parameter, to be estimated

ε = error term; ln = natural logarithm

The parameter β is the average annual compound growth rate.

Trend analyses of production and yield of cassava, yam, maize, groundnut and millet over the period of 1970-2009 were conducted. The period covers pre-SAP (<1986); SAP (1986-1992) and post- SAP (>1993) periods so that the trends can be examined in relation to these policy phases. This is a common method to examine growth rates over time (Okoye et al., 2008; Shadmehri 2008; Deosthali and Chadraheklar 2004; Rahman 1999).

3.5.2 Analysis of production performance of Cassava at the farm-level

To assess the production performance at farm level, the following types of analysis were conducted

- Economic analysis of the production costs, revenue, gross margin and net farm income.
- Chi-square analysis to test some aspects of the relationship between socio-economic characteristics of farmers and farm characteristics.
- ANOVA is applied to see regional differences, gender differences, farm size categories on production and yield.
- Data Envelopment Analysis (DEA) to estimate technical, cost and allocative efficiencies in cassava root tuber production, as well as processing into gari for individual farmers, i.e. decision making units (details discussed below).
- Tobit regression analysis to identify the socio-economic determinants of technical, cost and allocative efficiency scores obtained by applying DEA (details discussed below).

3.5.3 Assessing Markets for Cassava

To assess the market for cassava, marketing structures, marketing channels, marketing margins, and market segmentation descriptive statistics were used. Also ANOVA was used to see regional differences, differences according to farm size or gender of household head etc. To determine the market for cassava root and products, or the market segmentation for cassava, multiple regression analysis was used to determine factors affecting gross margins for cassava and *gari* marketing.

3.6 Productivity and efficiency in cassava production and processing using DEA

Farm efficiency and the question of how it is measured is an important topic of study in developing economics of the world (Eyitayo et al. 2011; Okoye and Onyeweaku, 2007; Fried et al. 1993). There are four major approaches to measure efficiency (Coelli etal., 1998). These are the non-parametric programming approach (Charnes et al,. 1978) the parametric programming approach (Ali and Chaudry, 1990; Aigner and Chu, 1968) the deterministic statistical approach (Flemming et al., 2004; Schippers, 2000; and Afriat, 1972) and the stochastic frontier approach (Kirkley et al., 1995; Aigner et al., 1977). The non-parametric programming approach is known as Data Envelopment Analysis (DEA) and is a popular approach. The Data Envelopment Analysis approach is preferred for assessing and measuring efficiency in agriculture (Ogunniyi and Oladejo, 2011; Murthy et al, 2009; Javed et al, 2008; Coelli et al, 2001).

The focus of this section is to present the analytical framework to measure performance of cassava production and processing into *gari* using DEA approach. According to Okoye and Onyenweku, (2007), the cost function approach combines the concepts of both technical and allocative efficiency and when they occur together provides optimum condition for achieving economic efficiency (Yotopoulous and Lau, 1973). Economic efficiency is the ability of farms to maximize profit. It is also described as the product of allocative and technical efficiency (Adeniyi, 1988).

Most studies which seek to measure efficiency differentials among farms are dominated by the use of simple partial measures, such as yield per hectare and cost per unit of output, which are easy to calculate and understand, but tell very little about the reasons for any observed differences among farms. Yield-per-hectare figures are of little use when the amounts of non-land inputs used (such as labour and fertiliser) differ among farms. Cost per unit of output figures go some way towards addressing the problems with yield comparisons, but they can also be quite misleading measures of performance when input prices differ across geographical regions, as is the case in Nigeria. According to Ogunniyi and Oladejo, (2011); Murthy et al., (2009); and Coelli et al., 2002, simple cost comparisons do not tell us what portion of the cost difference is due to inefficient use of the given input bundle (technical inefficiency) and what part is due to the incorrect choice of input ratios, given the input prices faced by the farmer (allocative inefficiency). In addition, neither yield nor unit cost measures tell us anything about the existence, or otherwise, of scale economies (Ogunniyi and Oladejo, 2011; Coelli et al., 2002).

This study attempts to avoid the problems inherent in these simple measures by constructing non-parametric production frontiers using DEA, and then using them to produce a range of efficiency measures. The study uses three different measures: technical efficiency, allocative efficiency, and cost efficiency measures, described below. An advantage of using DEA is that it is not necessary to assume a simplistic functional form, such as the Cobb-Douglas, which imposes constraints on the production technology, such as constant production elasticities and unitary elasticities of substitution. The next section describes the measurement methods of DEA.

3.6.1 Technical Efficiency

According to Coelli et al. (2002; 1996), technical efficiency relates to the degree to which a farmer produces the maximum feasible output from a given bundle of inputs, or uses the minimum feasible amount of inputs to produce a given level of output. These two definitions of technical efficiency lead to what are known as output-oriented and input-oriented efficiency measures, respectively. These two measures of technical efficiency will coincide when the technology exhibits constant returns to scale, but are likely to differ otherwise. This study uses input-oriented efficiency measures because they lead to a natural decomposition of cost efficiency into its technical and allocative components. This is not expected to have a large bearing on the results, given that the sampled farmers have very small areas of land, so technology is unlikely to be significantly affected by non-constant returns to scale (Ibrahim and Onuk, 2010; Ajibefun, 2008 and Javed et al., 2008).

The DEA production frontier is constructed using linear programming techniques, which give a piece-wise linear frontier that 'envelopes' the observed input and output data. Technologies produced in this way possess the standard properties of convexity and strong disposability, which are discussed in Fare et al. (1994).

The DEA model is used to simultaneously construct the production frontier and obtain technical efficiency measures. The model is presented for the case where there are data on K inputs and M outputs for each of N farms. For the *i*th farm, input and output data are represented by the column vectors x_i and y_i, respectively. The K×N input matrix, X, and the M×N output vector, Y, represent the data for all N farms in the sample.

The DEA model used for calculation of technical efficiency is (Coelli et al., 2002; 1996):

$$\text{Min}_{\theta,\lambda}\ \theta,$$

$$\text{Subject to:} \quad -Y_i + Y\lambda \geq 0,$$

$$\theta X_i - X\lambda \geq 0,$$

$$N1'\lambda = 1$$

$$\lambda \geq 0, \qquad (3.2)$$

Where: θ is a scalar, N1 is an N×1 vector of ones, and λ is an N×1 vector of constants. The value of θ obtained is the technical efficiency score for the *i*th farm. It will satisfy: θ ≤ 1, with a value of 1 indicating a point on the frontier and hence a technically efficient farm, according to the Farrell (1957) definition. Note that the linear programming problem must be solved N times, to obtain a value of θ for each farm in the sample.

In algebraic form, the above set of equation for a single farmer (i.e., farmer 1 from the total sample of 315 farmers) can be expressed as:

Technical efficiency for farmer No 1

$$min_{\theta,\lambda} \quad \theta = \theta_0 = y_1$$

$$s.t. \; -y_1 + y_1\lambda_1 + y_2\lambda_2 + y_3\lambda_3 + \dots\dots + y_{315}\lambda_{315} \geq 0$$

$$x_1\theta_0 - x_{11}\lambda_1 - x_{21}\lambda_2 - x_{31}\lambda_3 - \dots\dots\dots - x_{315}\lambda_{315} \geq 0$$

$$x_2\theta_0 - x_{12}\lambda_1 - x_{22}\lambda_2 - x_{32}\lambda_3 - \dots\dots\dots - x_{315}\lambda_{315} \geq 0$$

$$x_3\theta_0 - x_{13}\lambda_1 - x_{23}\lambda_2 - x_{33}\lambda_3 - \dots\dots\dots - x_{315}\lambda_{315} \geq 0$$

$$x_4\theta_0 - x_{14}\lambda_1 - x_{24}\lambda_2 - x_{34}\lambda_3 - \dots\dots\dots - x_{315}\lambda_{315} \geq 0$$

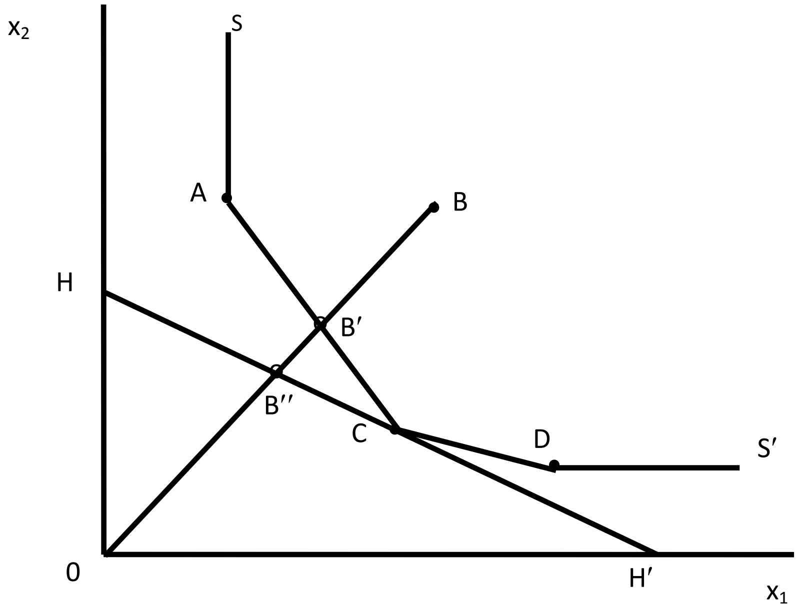
$$x_5\theta_0 - x_{15}\lambda_1 - x_{25}\lambda_2 - x_{35}\lambda_3 - \dots\dots\dots - x_{315}\lambda_{315} \geq 0$$

$$\lambda_1 \geq 0, \lambda_2 \geq 0, \lambda_3 \geq 0, \dots\dots\dots, \lambda_{315} \geq 0 \qquad (3.3)$$

$$\theta_0 \text{ is unrestricted sign}$$

The DEA problem in equation (1) has an intuitive interpretation. The problem takes the *i*th farm and then seeks to radially contract the input vector, x_i, as much as possible, while remaining within the feasible input set. The inner-boundary of this set is a piece-wise linear isoquant (SACDS′ in Figure 3.6), determined by the frontier data points (the efficient farms) in the sample. The radial contraction of the input vector, x_i, produces a projected point, (Xλ,Yλ), on the surface of this technology. This projected point is a linear combination of these observed data points. The constraints in equation (1) ensure that this projected point cannot lie outside the feasible set (Coelli et al., 2002).

Figure 3.6 Technical and Allocative Efficiencies



In Figure 1, the four farms (A, B, C and D) are producing the same level of output, using various amounts of two inputs, denoted by x_1 and x_2. Farms A, C and D form the production frontier (or isoquant) because it is not possible for any of these farms to radially reduce their input usage, and still remain within the production possibility set. Farm B, however, is inefficient because it can reduce its input usage to the projected point B′, so its technical efficiency (TE) is 0B′/0B.

3.6.2 Allocative Efficiency and Cost Efficiency

If input price information is available, allocative efficiencies can also be measured using the isocost line, HH′, which is tangential to the isoquant at the point C. If all farms face the same relative prices reflected by this line, farm C is producing at minimum cost, while the other farms are not[1]. Thus, even though farms A and D are technically efficient, they are not cost efficient because they are allocatively inefficient. That is, they do not utilise the inputs in optimal proportions, given the observed input prices, and hence do not produce at minimum possible cost. Farm B is both technically inefficient and allocatively inefficient. Its allocative efficiency can be measured by the ratio 0B′′/0B′, and its cost efficiency by the ratio 0B′′/0B. Then, cost efficiency is equal to the product of the technical and allocative efficiency scores (0B′′/0B = 0B′/0B×0B′′/0B′).

The cost and allocative efficiencies are obtained by solving the following additional cost minimisation DEA problem:

$$\begin{aligned} & min_{\lambda,x_i*}\ \ w_i'X_i^*, \\ st\quad & -Y_i + Y\lambda \geq 0, \\ & X_i^* - X\lambda \geq 0, \\ & N1'\lambda = 1 \\ & \lambda \geq 0, \end{aligned} \qquad (3.4)$$

In algebraic form, the above set of equation for a single farmer (i.e., farmer 1 from the total sample of 315 farmers) can be expressed as:

Allocative efficiency for farmer 1

$$Min\ \lambda\ ,\ x_i^* + w_1x_1^* + w_2x_{2*},\ w_3x_3^* + w_4x_4^* + w_5x_5^*$$

$$s.t.\ -y_1 + y_1\,\lambda_1 + y_2\,\lambda_2 + y_3\lambda_3 + \ldots\ldots + y_{315}\,\lambda_{315} \geq 0$$

$$x_1^* - x_{11}\,\lambda_1 - x_{21}\,\lambda_2 - x_{31}\lambda_3 - \ldots\ldots\ldots - x_{315}\,\lambda_{315} \geq 0$$

$$x_2^* - x_{12}\,\lambda_1 - x_{22}\,\lambda_2 - x_{32}\lambda_3 - \ldots\ldots\ldots - x_{315}\,\lambda_{315} \geq 0$$

$$x_3^* - x_{13}\,\lambda_1 - x_{23}\,\lambda_2 - x_{33}\lambda_3 - \ldots\ldots\ldots - x_{315}\,\lambda_{315} \geq 0$$

$$x_4^* - x_{14}\,\lambda_1 - x_{24}\,\lambda_2 - x_{34}\lambda_3 - \ldots\ldots\ldots - x_{315}\,\lambda_{315} \geq 0$$

[1] The farms can also face different price vectors, as is the case in the empirical analysis in this study.

$x_5^* - x_{15}\lambda_1 - x_{25}\lambda_2 - x_{35}\lambda_3 - \ldots\ldots\ldots - x_{315}\lambda_{315} \geq 0$

$\lambda_1 \geq 0, \lambda_2 \geq 0, \lambda_3 \geq 0, \ldots\ldots\ldots, \lambda_{315} \geq 0$

θ_0 *is unrestricted sign*

Where w_i is a vector of input prices for the i-th farm and X_i* (which is calculated by the model) is the cost-minimising vector of input quantities for the i-th farm, given the input prices w_i and the output levels Y_i. The total cost efficiency (CE) of the i-th farm is calculated as:

$$CE = w_i{}'X_i^*/\, w_i{}'X_i. \quad (3.5)$$

That is, CE is the ratio of minimum cost to observed cost for the i-th farm. The allocative efficiency (AE) is then calculated residually by:

AE = CE/TE.

Having generated efficiency scores for the farms, the variations in efficiency scores were regressed on the farm-level characteristics, in order to explain the differences. Because of the bounded nature of the efficiencies (between zero and unity), a Tobit model was used with the upper limit set at one; making this a second step regression model.

The justification for using Tobit regression instead of Ordinary Least Square (OLS) methods is that it is assumed that farmers in the current study area are operating under the same conditions. They operate in the same policy and institutional environment, and they face exogenous variables denoted as error (ϵ*). These conditions determine farmers' decision to choose sets of input vectors X and produce output vectors Y (Mussal et al. 2012). Lastly, the result of dependant variable is truncalated or censored between 0 and 1 (0 – 100percent). While OLS, if it is directly used will lead to biased and inconsistent parameter estimation regression coefficient (Chu et al. 2010).

3.7 Data and variables used for DEA analysis

For farmers' production performance analysis, the output is measured as kilograms of cassava harvested (Y). The inputs, for which both quantities and the corresponding prices are used, are land planted to cassava (X_1), family and hired labour (X_2), fertiliser (X_3), seed (X_4) and pesticides (X_5). The corresponding input prices are w_1, w_2, w_3, $w_{4,}$ w_5, respectively. For gari processors' performance analysis, the output is measured as kg of gari produced (Y). The inputs, for which both quantities and corresponding prices are used, are cassava root tuber used (X_1), labour used for all operations (e.g., fermenting, processing, frying, etc.) (X_2), all other materials (e.g., firewood, equipment, etc.) (X_3) and other input cost ($X_{4)}$. The corresponding prices are W_1, W_2, W_3 and W_4, respectively. The DEAP version 2.1 software developed by Coelli (1996) is used for the analysis. The firm's efficiency scores will be calculated under the CRS and VRS assuptions i.e the BCC input orientation or specification for DEA analysis

3.8 Factors explaining technical, cost, and allocative efficiencies

The study also attempted to explain efficiency differences among farms using farm-specific dependent variables that were collected specifically for this purpose. Since the efficiency scores lie between 0 and 1, a limited dependent variable modelling is appropriate. In this modelling framework, the underlying utility/production function is not observed. What is observed is a set of farm and farmer specific socio-economic characteristics that influence farmers' decision to produce a given crop using certain level of technology (Rahman, 2003). Because the computed efficiency scores are censored between 0 and 1, Tobit regression analysis is used since it uses all observations, both those at the limit, usually zero, and those above the limit, to estimate a regression line, as opposed to other techniques that use observations which are only above the limit value (McDonald and Moffit, 1980). The stochastic model underlying Tobit may be expressed as follows (McDonald and Moffit, 1980):

$$\begin{aligned} e_i &= Z_i\beta + u_i \quad && if\ Z_i\beta + u_i > 0 \\ &= 0 && if\ Z_i\beta + u_i \leq 0, \\ & && i = 1,2,......,n, \end{aligned} \tag{3.6}$$

Where: n is the number of observations, e_i is the dependent variable (efficiency scores), Z_i is a vector of independent variables representing farmer specific socio-economic characteristics, β is a vector of parameters to be estimated, and u_i is an independently distributed error term assumed to be normal with zero mean and constant variance σ^2. The model assumes that there is an underlying stochastic index equal to ($Z_i\beta + u_i$) which is observed when it is positive, and hence qualifies as an unobserved latent variable. The relationship between the expected value of all observations, E_e and the expected conditional value above the limit E_e* is given by:

$$E_e = F(z)\ E_e*$$

Where: F(z) is the cumulative density normal distribution function and $z = Z\beta/\sigma$.

For identifying factors affecting farmers' cassava production performance, the following farm-specific socio-economic characteristics were used as regressors. These are farmers' age (Z_1), experience (Z_2), family size (Z_3), education level of the head of the household (Z_4), crop variety (Z_5), gender (Z_6), extension contacts (Z_7), and farm size (Z_8).

For identifying factors affecting the production performance of processors of gari, the following farm-specific socio-economic characteristics were used as regressors. These are: training (Z_1), farmers processing experience (Z_2), credit provision (Z_3), education level of the head of the household (Z_4), number of working members in the household (Z_5), gender (Z_6), extension contacts (Z_7), farm size (Z_8), main occupation of the processor (Z_9); and accounting for regional variation using two dummy variables (Z_{10}, and Z_{11}). STATA 8 software (StataCorp, 2003) is used for the analysis of these models.

3.9 Measuring the Performance of Cassava Marketing

Marketing performance refers to the impact of the marketing structure, conduct, prices, costs, and volumes of output supplied and sold (Pomeroy and Trinidad, 1995). Marketing efficiency can be described as the degree of marketing performance. This section seeks to examine the marketing performance of cassava root tubers and gari by using cost and returns analysis, profitability, marketing margins, and marketing efficiency as used by other researchers (e.g., Akinpelu and Adenegan, 2011; Anuebunwa, 2008; Obasi and Mejeha, 2008 and Olukosi and Isitor, 1990). Finally, in order to determine the factors that affect gross margins of cassava and gari production, multiple regression analyses were conducted.

The marketing margin is defined as:

Marketing margin = ((Selling price- Purchase price)/Selling price)*100 (3.7)

The marketing efficiency is defined as:

Marketing Efficiency =Total revenue/Total costs (3.8)

The models are specified in natural double logs, hence incorporating non-linearities in the modelling structure, which is more likely to be close to the true scenario unlike many researchers shown above.

For analysing factors affecting gross margin of cassava root tuber marketing, the model is expressed as:

$$\ln R = \alpha \ln Y + \beta \ln C_1 + \beta \ln C_2 + \beta \ln C_3 + \beta \ln C_4 + \beta \ln C_5 + \gamma \ln E + \delta D_1 + \delta D_2 + \varepsilon \qquad (3.9)$$

Where: R= gross margin from cassava root tuber sold; Y = quantity of root tuber purchased; C_1= fees; C_2= utility cost; C_3= loading cost; C_4=transportation cost; C_5=rent; E= educational level of the marketer; accounting for regions by using two dummy variables (D_1 and D_2).

For analysing factors affecting gross margin of processed gari marketing, the model is expressed as:

$$\ln G = \beta \ln C_1 + \beta \ln C_2 + \beta \ln C_3 + \beta \ln C_4 + \beta \ln C_5 + \beta \ln C_6 + \beta \ln C_7 + \delta D_1 + \delta D_2 + \varepsilon \quad (3.10)$$

Where: G= gross margin from gari sold; C_1= fees; C_2= utility cost; C_3= loading cost; C_4=transportation cost; C_5=rent; C_6=storage; C_7= security; and accounting for regions by using two dummy variables (D_1 and D_2).STATA 8 software is used to analyse these models (StataCorp, 2003).

3.10 Chapter Summary

The data for this study were collected from a variety of primary as well as secondary sources for time-series information. Also a range of information collection methods were used, namely, questionnaire surveys, stakeholder interviews and field observations. The study uses a wide mix of quantitative and qualitative methods to analyse the data in order to achieve its objectives in the best possible way. Primarily these include descriptive statistics (e.g., percentages, means, and standard deviations), inferential statistics (e.g., ANOVA, t-test, and Chi-square tests), trend analysis, multiple regression analysis, non-parametric DEA analysis and Tobit analysis.

CHAPTER 4

CASSAVA PRODUCTION: INPUT AND OUTPUT ANALYSIS

4.1 Introduction

Nigeria is the largest producer of cassava in the world, producing 45 million tonnes in 2009 (Ibrahim and Onuk, 2010). It is a developing economy, where the contribution of agricultural productivity to the national GDP is second only to the oil sector. Around 70 percent of the total work force employed in agriculture.

As discussed in Chapters One and Two; productivity is defined as the quantitative relationship between output and input and embraces the concept of efficiency. The majority of agricultural production is measured in terms yield per hectare (Pingali et al. 2001) which is a partial measure of productivity. In this study, yield is used as one of the important measures of productivity, starting with measuring root tuber of cassava and later processed outputs from cassava, e.g., *gari*. As mentioned in Chapters One and Two, the factors affecting production of cassava like any other crops in the tropics are grouped as socio-economic factors, technology factors, natural factors and political factors (Nweke, 2003; Ball and Norton, 2002). It is revealed that farm level yield is lower than farm research stations yield. This variation may be due to in input use, management and socio-economic of the farmers at farm level (Rahman and Hasan, 2009; Kibaara, 2005).

This chapter is aimed at discussing the production performance of cassava farms in the case study areas of Delta state, Nigeria. One method of assessing the production performance of cassava at the farm level is to determine the level of efficiency in the use of inputs to produce maximum possible output. Also, it is important to see the effects each input and combination of the inputs have on the output. Therefore, this chapter is aimed at evaluating the effects of the various socio-economic, technological, natural and political factors on the yield of cassava root tubers. This chapter presents the results to satisfy one of the key aims of the study, that is, to evaluate productivity performance of the cassava farmers. Specifically, the following issues are presented in this chapter: the socio-economic characteristics of the farm/farmers, factors of production used at the farm-level and the effects of inputs on the productivity of cassava output.

Descriptive statistics are used to discuss the socio-economic characteristics of the farm/farmers their effect on output at the farm level. An ANOVA test is used to determine whether these socio-economic factors are significantly different across regions or farm size categories. Lastly, production performance of the farmers' cassava will be further analysed using Data Envelopment Analysis (DEA), to determine the technical, cost and allocative efficiencies and identify their socio-economic determinants by applying Tobit regression procedure on the efficiency at farm levels. This exercise is presented in Chapter 6. It is necessary to examine productivity of resource use in cassava-based farms as this will help to highlight the variables that could be better managed to improve productivity of cassava farms. The socio-economic characteristics and results of the physical productivity are discussed below.

4.2 Socio-Economic Characteristics of Farmers

This section mainly discusses some of the basic characteristics of the farm respondents. The characteristics are gender, age, farming experiences, education level, household size, farmer extension contacts and land types, types of labour used in farming, sources of capital. Choice of these characteristics for comparison is based on critical literature on analysis of production inputs and outputs (Oluwatusin, 2011; Onyebinama and Onyejelem, 2010; Monlouzzaman et al., 2009; Bamidele, 2007; Rahman, 1998). Table 4.1 presents the basic descriptive statistics for farm variables characteristics of the study sample as a whole and this was used to examine their effects on production of cassava.

Table 4.1 Descriptive Statistics of Farm Characteristics

Variable	Mean	STD Dev.	Minimum	Maximum
Gender (proporson on male)	0.51	.501	0	1
Education level (years)	7.124	4.8749	0	25.0
Farm size (ha)	2.0547	11.5826	.08	12.00
Cassava (ha)	1.6806	1.30671	.08	10.00
Crop variety (dummy)	0.73	.446	0	0
Family size (numbers)	5.80	3.205	0	18
Ext. contacts (dummy)	0.35	.476	0	1
Farmers age (years)	41.69	12.406	17	80
Credits (Naira)	1746.03	13147.003	0	150000
Farm Capital(Tl)(N)	74658.264	155736.1262	0	5000000
Distance to inputs markets/ KM	9.52	6.218	0	45
Distance to market (FPM)/KM	4.975	12.8815	0	160

Source: Field Survey, 2008

4.2.1 Age of the Farmers

The age of farmers plays an important role in crop production and also helps in proper management of the farming activities. Age reflects experience in farming and is used as a proxy in most studies, including those cited above. The average age of cassava producing farmers in the study area is 42 years, with a standard deviation of 12.41 with a minimum age of 17 years and a maximum of 80 years. Table 4.4 indicates that the majority of farmers (52.1%) were within the age bracket of 40 to 59 years. This was closely followed by the age bracket 17-39years (41.0%). Farmers that were in the minority were the age above 65years which represent (7.0%). This indicates that about 93percent of the farmers were in their most active economically active age bracket (17-59) years. However, there is a wide spread of farmers among all the age groups, implying that cassava farming was embraced by all age groups. The average mean of farmers slightly varies in each geographical region; with Delta Central having a mean age of 35 years only, Delta South at 44 years and the Delta North at 46 years as shown in Table 4.2.

4.2.2 Gender

Traditional or cultural practices and beliefs in Nigeria, as in many regions of the world, demand that the roles and activities of men and women are different. In most cases, the ordering of these roles is influenced by the ability of the head of the household to have access to farm inputs/resources (Olagunju et al 2013).

The gender of cassava farmers also plays an important role in how cassava is cultivated, and also shows who plays a major economic role in the household since most of the cassava farmers cultivate the crop for household consumption and only the surplus is sold for the market. According to Mafimisebi (2007), cassava is mainly described as a women's crop, but this research shows that men are also involved in the cultivation of cassava. Table 4.1 indicates that the proportion of male farmers is 51.1percent and women represent 48.9percent. This was supported by Agom et al. (2012) in their study on gender roles in cassava production in Cross River State in Nigeria, due to cultural setting of the area which allows males to have easy access to land especially, where a majority of them are the heads of households. However, this contradicts the assertion of Mafimisebi (2007 & 2008) that lends credence to the assertion that most African farmers are women. This study can conclude that in Delta State, cassava root tuber is grown by both sexes, with the numbers of males cultivating cassava being slightly higher than the number of females. This may be due to the rudimentary tools and heavy labour involved in the clearing, tilling of the soil, harvesting and processing of the crop.

Table 4.2 Descriptive Statistics of Characteristics of Farmers by Region

Variable	Measure	Regions			Total
		Delta Central	Delta South	Delta North	
Education	Completed year of education	6.684	6.648	8.048	7.126
Farmers Experience	(Yr)	13.210	20.143	15.119	16.157
Farmers Age	(Yr)	35.34	43.81	45.90	41.69
Extension visit	(Dummy)	.10	.84	.10	.35
Crop Variety	(Dummy)	.71	.89	.58	.73
Household size	(Number)	6.33	5.09	5.99	5.80

Source: Field Survey, 2008

4.2.3 Family Household Sizes

The average family size in the area of study area is 5.80, with a standard deviation of 10.27 and a minimum family size of 1 person and a maximum family size of 18 persons. This agrees with a similar study by Mafimissebi (2008) in Ondu State, South west Nigeria, which shows an average family size of 6. Effoing (2005) argues that a relatively large number of people in the household enhance the availability of family labour which reduces constraints of labour costs in crop production. Delta Central has the highest mean family size of 6.33 persons per household, followed by Delta North with 5.99 and Delta South with 5.09 persons per household (see Tables 4.1 and 4.2).

It may be noted here that household size is increased with the increase of farm size in all the regions except Delta North. This may suggest that there may be a positive relationship between farm size and household numbers.

4.2.4 Level of Education

Education is considered to be a very important factor influencing innovation and adoption of new technologies (Abang et al., 2001; Rahman 1998). Increased level of education is agood pointer to improved productivity, as the level of education is a tool with which an individual could be more efficient at any endeavour being undertaken (Oluyele and Usman, 2006). In addition, education – particularly literacy - assists a person to utilise updated information about modern technologies required for good farm accounting and record keeping. In this study, the education of the respondents was measured as years of completed schooling as used by Abang (2007) and Rahman (1998). The average mean years of schooling by the farm respondents was 7.13 years, with a standard deviation of 23.77, a minimum of zero and a maximum of 25 years of schooling. This shows that the majority of the farmers have primary school certificate and/or may have attended some secondary education as shown in Table 4.1. Delta North has the highest average number of years schooling with 8.05 years, followed by Delta Central with 6.65 and Delta South with least 6.08 years of schooling.

Generally, on the education level of farmers among the regions; while group 1 (i.e., illiterate) farmers makes 21.6 percent of the total farm respondents, those that attended primary schools makes up 32.4 percent and those that went to secondary school is 46.0 percent. Those that had a post-secondary education are made up a very tiny number, representing 0.3 percent of the total farm respondents.

In terms of educational levels, groups within the regions were in a particular order as shown in Table 4.2, with Delta North having the lowest percentages of illiterate farm respondents and the highest number (57) of post-primary school attendees. This region also has the highest output, which is followed by Delta Central on the total mean output. Finally, Delta South has the largest zero education level groups and the lowest mean total farm output of the regions. However, it is assumed that in smallholder farming increasing the number of years in school would lead to a decreasing rate of production of crops. Kabaara (2005) found that, 5 years of school enhanced crop production output, but more than five years in school decreased rates of productivity of maize production in Kenya at farm level. This implies that the number of years in education affects productivity.

4.2.5 Farmers' Farming Experience

Farming experience among farm respondents is an important factor to ensure agricultural productivity. Farmers with more experience in farming generally attain higher levels of technical efficiency. According to Nwaru (2004), farmers sometimes count more on their experience than education attainment in order to increase their productivity. Technical inefficiencies of farmers show significant relationship to the farming experience of farmers (Matuko, 2007; Rahman 2007; Ajibefun et al., 1996). The average farming experience of cassava farm respondents in the area of studies was found to be 16.16 years, with a standard deviation of 11.58 as shown in Table 4.1. This result implies that a good number of the farmers are experienced farmers and therefore are expected to obtain higher technical efficiency. The farming experience groups were 0-5years, 6-11 years, 12-15 years and 16 years or more. Total number of farmers falling within these groups was found to be 71; 74; 27 and 143 respectively, and this represents proportions of 22.5; 23.5; 8.6 and 45.4 percent respectively. When the data is broken down into separate regions, Delta South have the highest mean of farming experience at 20.14 years, followed by Delta North at 17 years and Delta Central, with the lowest average mean of 13.21years. According to farm sizes; medium category farmers were more experienced as compared to the other two groups, and this is similar across all regions as shown in Table 4.2. Farmers in Delta Central region are thus to have more farming experience compared with those from Delta South and Delta North, as shown in Table 4.4.

4.2.6 Extension Contacts

Extension services play an important role in technology and information, linking farmers and markets and acting as a bridge between researchers and farmers for new technology. According to Saliu and Ige 2009 (cited, Benor and Baxter, 1984) suggests that, sustained high levels of agricultural production and income are not possible without agricultural services supported by agricultural research that is relevant to farmers. Further, it is argued that extension services have a positive and considerable effect on the agricultural economy. The amount of contact between extension services and farm respondents is shown in Table 4.1. The average coverage of extension services was found to be 35 percent in all areas, which indicates that a majority of the farmers (65 %) had no contacts with extension agents to learn about cassava production. This scenario was similar for all regions except at Delta South which had 82 percent coverage. Given this situation, farmers are unlikely to receive information about the market for their produce or the use of new technology.

4.2.7 Land Types

Methods of acquiring land for farming play a significant role in determining farming success. The size of land owned and rented is being looked at in terms of the cost, which is measured as the rent paid for the land in the study areas, as shown in Table 4.3.

Total mean average amount spent for land rent was N4382.54/ha. Hired land costs the highest amount at N2933.56, representing 66.94 percent of rent paid for land while personal or owned land accounts for N1535.65 (33.06%). Most farmers do not have access to personal farm land, and rented land is insecure in that access to farming could be withdrawn by the land owner. Methods of farm land acquisition In the Delta South region, rented land represents 88.5 percent of the total land used in cassava production while the imputed cost for owned land makes up 11.5 percent. The comparable figures for Delta Central are 62 percent for hired land cost and 38 percent for imputed land cost and Delta North with 45 percent for hired cost for land and 56 percent for imputed land cost. The results also show that farmers in the Delta North region owned most of their farm land (see Table 4.3).

Table 4.3 Land Types

Land Types (Value)	Currency (Naire)	Delta Central	Delta South	Delta North	Total
Imputed land cost	(Naire)	2887.05	3781.67	2131.96	2933.56
Hired land Rent cost	(Naire)	1741.50	479.76	2385.47	1535.67
Total Value cost	(Naire)	4614.29	4271.43	4261.90	4382.54

Land value estimated at current rent value per year/ha

Naire is Nigerian currency

Source: Field Survey, 2008

4.2.8 Crop Varieties

The variety of seed used for planting has an important impact on the yield expected, all other things being equal. Farmers in the study area used various types of cassava cuttings for planting. Some used improved varieties, some used local varieties and majority of the farmers

Table 4.4 Socio-economic Characteristics of Farmer (Groups)

Variable	**Frequency**	**Percentage**
Gender		
Female	154	48.9
Male	161	51.1
Crop Variety		
0 (Local)	86	27.3
1 (Improved)	229	72.7
Extension Contact		
0 (no contact)	206	65.4
1 (contacted)	109	34.6
Marital Status		
Married (1)	242	76.8
Single (2)	50	15.9

Variable	Frequency	Percentage
Widow (3)	19	6.0
Divorce(4)	4	1.3
Farm Size Group		
0 – 2.5ha (1)	241	76.5
2.6 – 4.6ha (2)	55	17.5
4.6ha+ (3)	19	6.0
Farmers Experience Group		
0 – 5 years (1)	71	22.5
6 – 11 years (2)	74	23.5
12 – 15years (3)	27	8.6
16years + (4)	143	45.4
Farmers Years Group		
17 -39years (1)	129	41.0
40 – 59years (2)	164	52.1
60 above (3)	22	7.0
Occupation		
Farming (1)	256	81.3
Trading(2)	47	14.9
Civil Service(3)	9	2.9
Retired/Student/others(4)	3	1
Source of Income		
Farming(1)	264	83.8
Trade (2)	42	13.3
Retired/Student/Others	9	2.9
Secondary Source of Income		
Farming (1)	72	22.9
Trading(2)	192	61.0
Civil Service(3)	34	10.8
Retired/Student/others(4)	9	2.9
Missing	8	2.4

Source: Field Survey, 2008

used both local and improved cassava cuttings. 72.7 percent of the farmers used improved seeds. Table 4.4 indicates that 89 percent of the famers in Delta South region use the improved varieties and 21 percent use local variety cuttings, followed by Delta Central with 71 percent and 29 percent respectively, and Delta North region with 58 percent and 42 percent of improved and local varieties cassava cuttings, respectively.

4.2.9 Marital Status

The marital status of the farmers could also determine the productivity of the farming activities. For example, a married person with children could put more effort and cultivate a larger area than a single person. The marital status is measured with descriptive statistics of frequency counts and percentages with married respondents making up 241 (76.8 percent) of the sample, followed by 50 single farmers (15.9 percent) and with widowers and divorcees making up 19 (6.0 percent) and 4 (1.3 percent), respectively in the study area. These figures are indicated in Table 4.4.

4.2.10 Training/Programmes received by farmers

Training is an important tool for acquiring knowledge about any technology, farming practices, marketing, farming accounting/record keeping etc. Training could be used to increase the farmer's level of skill with regards to cultivation and production practices, or processing and marketing aspects. Agricultural training and programmes received by farmers are presented in Table 4.5. The mean percentage cassava farmers who received farm training in the areas under investigation were 10.2 percent, while 89.8 percent of farmers have no institutional training with regards to agriculture. It will be very difficult to increase yield and productivity without any proper training or awareness for the farmers. Delta Central region had the highest number of cassava farmers who had received training with 22 farmers (21 percent), followed by Delta North region where 7 farmers (6.7 percent) had attended and Delta South region where only 2 (1.9 percent) farmers had received training. During the period of the field survey, the state governor was from the Delta Central region, and Delta North is where the capital and the headquarters of the Ministry of Agriculture are located. These factors could explain the trends noted to some extent.

Table 4.5 Training Received by Farmers

Training received	Regions			Total
	Delta Central	Delta South	Delta North	
0	83	103	98	248
1	22	2	7	31
Total	105	105	105	315

Chi Square test

	Value	Df	Sig
Pearson on Chi Square	23.256	2	.002
Likelihood Ratio	23.556	2	.000

Source: Field Survey, 2008

4.3 Input and Output of Cassava Production

The descriptive statistics of the production variables obtained from cassava farmers in the study area are summarized as shown in table 4.6 and discussed below. The aim of this sub-section is to estimate the level of inputs used and cassava yield at the farm-level in Delta State.

4.3.1 Farm Size

Land is the most important asset for the farmers since a farming family's income/livelihood depends mainly on land. The average farm size of cassava farmers in the area was 1.6806 ha, with a range of 0.08 to 12 ha in all (Table 4.6). This agrees with a similar result found by Mafemisebi (2008) that indicates an average farm size of 1,66ha in Ondo State, Nigeria. However, this is slightly higher than the figure of 0.77 ha recorded in Ogun State in South west region of Nigeria (Adeyemo et al. 2010) or 1ha in Ogori-Magongo in Kogi State (middle belt region of Nigeria) reported by Mohammed et al. (2010). As the farm size found in this study correlates with other farms throughout Nigeria, the conclusions drawn in this study may be broadly applicable across the country.

4.3.2 Farm Size groups

Farm sizes were grouped into three categories as indicated by Table 4.7. The average sizes of holdings for Group 1 (small), Group 2 (medium) and Ground 3 (large) farmers were 1.36 ha, 3.26 ha and 7.29 ha respectively. Small group holding category (up to 2.50 ha) had the highest number of farmers at 76.5 percent, group 2 or the medium category had 17.5 percent and group 3, or the large farm category, had 6 percent. The highest frequency of small scale farmers were observed at Delta South (36.9 percent) and the lowest at Delta Central (29 percent), with a median found in the Delta North region (34.1 percent). Medium size farms (in group 2, with the farm size range of 2.81-4.80ha) make up 36.4 percent of the total number of farms in Delta Central and Delta North regions while in Delta South this size of farm makes up 27.2 percent of the total. For the large farm size (group 3, with land range of 4.81-12.0 ha), Delta Central have the highest share at 78.9 percent, while Delta North has 15 percent and Delta South has 5.3 percent. It was observed from Table 4.7 that the average cassava cultivated area was 1.6806, with a standard deviation of 1.7115 in all areas. This

Table 4.6 Input and Output of Cassava Production

Items	Measure	Regions			Total
		Central	South	North	
Cassava output	(kg/ha)	15059.62	9275.43	12079.00	12137.35
INPUTS					
Labour	(man-days)	166.05	110.37	110.39	128.39
Land	(ha/ha)	2.0753	1.6376	1.3288	1.6806
Seed	(kg/ha)	1354.15	248.12	445.12	683.69
Fertilizer	(kg/ha)	106.071	52.143	65.952	74.722
Pesticide	(L/ha)	1.139	.057	.907	.701
Education	Year of completion	6.684	6.648	8.048	7.126
Farmers Exp.	(Yr)	13.210	20.143	15.119	16.157
Farmers Age	(Yr)	35.34	43.81	45.90	41.69
Extension visit	(Dummy)	.10	.84	.10	.35
Crop Variety	(Dummy)	.71	.89	.58	.73
Household size	(Number)	6.33	5.09	5.99	5.80

Source: Field Survey, 2008

implies that most farmers in developing countries like Nigeria are small-scale farm holders. Most studies argue that most small-scale farm-holder are characterized by limited used of farm inputs, poor management, inability of farmers to fully exploit the available technologies, resulting in low yield outputs, lower efficiency, low-incomes earnings among other factors which are associated with low agricultural productivity (Oluwasola, 2010; Dia et al 2010; Murthy et al 2009; Ajibefun et al 2002).

Table 4.7 Farm Size and Farm Size Categories

Cassava cultivated area (ha)	Regions			Total
	Delta Central	Delta South	Delta North	
	2.0753	1.6376	1.3288	1.6806

Farm Size Categories		
Farm Size Group (ha)	Frequency	Percentage
0-2.5 (Group 1)	241	76.5
2.6-4.6 (Group 2)	55	17.5
4.6+ (Group 3)	19	6.0

Source: Field Survey, 2008

4.4. Input Utilization of Farms

The use of labour, fertilizers, pesticides, farm machinery, irrigation and other facilities can go a long way to enhance output levels of farmers when used efficiently (Odoemenem and Obinne, 2010; Ball and Norton, 2002). The aim of this sub-section is to measure the inputs used by farmers for cassava cultivation in the study areas.

Table 4.8 Input and Output Rate for Cassava per hectare

INPUT	Measure	REGIONS			Mean	Significant
		Central	South	North		
Fertilizer	(kg)	34.64	26.86	25.82	29.11	.361
Labour	(Man-day per day)	82.804	68.254	166.073	105.710	.000
Seed	(kg)	82.428	67.886	188.695	113.006	.000
Land	(ha)	2.0753	1.6376	1.3288	1.6806	.000
Pesticide	(L)	0.46	0.03	0.75	0.41	.000
Output	(kg)	7396.16	5980.50	9782.99	7719.89	.000

Source: Field Survey, 2008

4.4.1 Labour

Labour is one of the most important factors of crop production. This could be in the form of family supplied labour and/or hired labour, even management of the farm is referred to as labour input in this study, with the farmers household considered as the most important source of labour for smallholder farmers (Echibiri and Mbanasor, 2003). Household size is used as proxy for labour because individuals in the household are a potential source of labour (Muhammad-Lawal et al. 2012). Labour is measured in this study in terms of man-hours per day, and as costs in monetary terms in Naira (N). For the purpose of analysis, labour is grouped into owned/family and hired labour.

The average mean use of labour in the study area was 128.93 man-days with a minimum labour man-day of 9.2 and maximum of 832.6 man-days per farm. According to the data, Delta Central has the highest range of 25.0 to 832.0 man-days followed by Delta South with a range of 24.4 to 230.4, and Delta North with a range of 9.2-241.0 man-days per farm. However, labour use per hectare is as follows; Delta North has the highest mean number of man-days, with minimum man-days of 19.7 to maximum of 183.13 and a mean average of 166.073 man-days. Delta Central has a mean average of 82.804 (minimum of 20.000 and maximum of 416.000) man-days per ha, and Delta South has the lowest average mean of 68.258 man-days (with minimum of 32.4 and maximum of 139.7) as shown in Table 4.8. The labour use per hectare differs significantly across regions ($p<0.01$).

Onoja et al. (2010) argued that an increase in a unit use of family labour could lead to an output rise of 8.7 percent, while a unit of hired labour would contribute negatively to yield, dropping yield by 32 percent. This study suggests that this impact may be due to the high cost of hired labour in the study area. Anyaegbunam et al (2010) argue that hired labour tends to be more productive than family labour because of the incentive of wages and proper supervision. Okoye and Okoha (2008) reported a mean of labour man-days in Easter, Nigeria as 149.13. Okon et al. (2010) and Etim et al. (2011) reported 218.86 man-days for labour used in garden egg production and 49 man-days for cassava respectively in Akwa Ibom State. Okoye et al. (2008) reported a mean labour usage of 252.06 man-days for cocoyam production. Anyaegbunam et al (2012) reported mean labour man-days of 303.57 for cassava producer in South-east Nigeria, while Bamiro et al (2012) and Ogundari and Ojo (2006) recorded 244.32 and 281.42 man-days respectively for cassava cultivation in South-west Nigeria. All the studies agree that farming is labour intensive and depends heavily on human labour, and that more labour input would increase productivity. An indication from the studies above implies that labour input use by cassava farmers in Delta State is low when compared with other areas.

4.4.2 Seed Sowing Rate

The quality of seeds is paramount to higher quality and quantity of yields. Respondents in the study area plant cassava cuttings using the line method, with spacing of 20cm x 20cm and with the cuttings having 3-5 nodes depth beneath the earth's surface. The farmers use cuttings from owned farms, neighbour farms, ADP and from the local markets. Table 4.9 shows that the average rate of cassava cuttings used by the farm respondents was 1354.14, 248.12 and 445.12 kg respectively for Delta Central, South and North regions with an average of 683.69kg (62 bundles). Delta North has the highest sowing rate of 188.605kg and the lowest of 8.0kg per hectare, follow by Delta Central with highest of 32kg and the lowest of 19.5kg. Delta South has the highest minimum of 19.5kg and the lowest maximum of 120kg/ha. Other studies, for example, Okoye et al. (2009) and Okoye and Okoha (2008) reported 70 and 68 bundles of cassava cuttings respectively in South-east Nigeria, while Ogundari and Ojo (2006) reported 29 bundles as an average in South-west Nigeria. This implies, when compared with other regions, the cutting sowing rate within the area of study falls within a similar range to that observed in other parts of Nigeria.

4.4.3 Fertilizer

Fertilizer plays an important role in increasing the soil nutrient level which is essential for optimum productivity. In the study area, most of the farm respondents believe that applying fertilizer will boost yield per hectare, but in many cases farmers reported that they do not have a clear idea about the kind and quantity to apply. The mean quantity of fertilizer (including all brands of inorganic fertilizer) used in the study area was 74.72kg, with the Delta Central region having the highest mean usage of 106 kg, followed by Delta North with 65.95 kg and Delta South with the lowest level of 52.0 kg, as shown in Table 4.6. The average per hectare use was 29.11 kg across the regions, with Delta Central at the highest level of 34.64 kg, followed by Delta North and Delta South with 26.86 and 25.82 kg respectively as indicated in Table 4.8 The amount of fertilizer usage in the area of study is low when compared to other studies, for example those by Okoye and Okoha (2008), Udoh et al. (2007) and Chukwaji and Ogisi (2006) which found totals of 275kg, 105 kg and 284kg respectively. The fertilizer usage rate is affected by fluctuating prices and levels of availability, and is low when compared to the FAO recommendation of 200kg/ha for SSA countries (Akpan et al. 2012). The intensity dropped from 11.8kg in 1995 to 8.9kg/ha in 1996, 9.0kg/ha in 2003 and then increases to 13.0kg/ha in 2009 (Akpan et al. 2012). Low fertilizer usage, flooding and soil erosion in the area of study may lead to low crop productivity.

The high cost of fertilizer was the major reason that farmers do not use it, other reasons put forward by farmers were that fertilizer usage increased the rate of deterioration of fresh and harvested cassava root tuber, and they complained of a non-availability of fertilizer when needed.

Manure also contributes to increase organic matter in the soil. Use of manure and its distribution in the study area was very insignificant in all regions and represented less than 0.1 percent of the total fertilizer applied. Given the insignificance of manure application in the study area, this variable was discounted from the study.

4.4.4 Weeding

All farmers in the study regions kept their cassava plot free from weeds. For this purpose, they use manual labour, chemical sprays and biological controls on the weeds. They carried out such tasks two or three times before the harvest of crops.

4.4.5 Pesticides

Farmers in the study areas use pesticides to protect their crop from the attack of pests and diseases. The total quantity of pesticides use is very small in terms of volume and cost compared with other inputs used. The total mean quantity was 0.7 litres, with Delta Central applying the highest quantity of 1.1 litres followed by Delta North and Delta South regions with 0.9 and 0.1 litres respectively. Use rates per hectare for the regions in the study area were 0.75, 0.46 and 0.03 for Delta North, Delta Central and Delta South, respectively, with the overall average use rate of 0.41 litre per ha. The pesticide use rates are significantly different across regions ($p<0.01$).

4.4.6 Yield

The average yield of cassava in the study area was found to be 7719.89 kg/ha with standard deviation of 4079 overall. The average mean yields of cassava are 7.40 t/ha, 6.0 t/ha and 9.78 t/ha for Delta Central, Delta South and Delta North, respectively. Farmers in group 3 (large farm size group) obtained a yield of 7.8 t/ha followed by group 1 (small group) category with 7.7 t/ha and group 2 category (medium size) with 7.6 t/ha (see Table 4.10).

Table 4.9 Yield of cassava/ha According to Farm Size Categories

Farm Size (ha)	Mean	Std. Deviation	Minimum	Maximum
Lowest -2.5	7723.44	4143.00	2250	25000
2.6- 4.5	7653.45	4161.50	3714	24000
>4.6	7867.11	3071.99	2500	11917
Total	7719.89	4079.30	2250	25000

Source: Field Survey, 2008

Table 4.10 Regional Total Yield per ha According to Farm Size Groups

Region	Farm Size Group	Average Yield kg/ha	Frequency of Farmers	Percentage (%)
Delta Central	Small	7631.94	70	66.67
	Medium	6398.60	20	19.04
	Large	7626.07	15	14.29
	total	7396.16	105	100
Delta South	Small	6084.49	89	84.76
	Medium	5095.47	15	14.29
	Large	10000.00	1	.95
	total	5980.50	105	100
Delta North	Small	9580.42	82	78.10
	Medium	1082.86	20	19.05
	Large	8361.33	3	2.86
	total	9782.99	105	100
Total	Small	7723.44	241	76.51
	Medium	7653.45	53	16.83
	Large	7867.11	19	6.03
	total	7719.89	315	100

Source: Field Survey, 2008

The yield of cassava from the study area is 7.7tonnes per ha, which is considerably less than the 15tonnes per ha stated by Liverpool et al (2006), but only slightly below 10.83tonnes per ha found by Nweke et al. (2004). It is also below the COSCA (Collaborative Study on Cassava in Africa) yield measurement of 14.7tonnes per ha for Nigeria and 13.1tonnes per ha found in Ghana. In Code D'Ivore, Tanzania and Uganda yields of around 10 tonnes per ha have been reported by IFAD and FAO (2005). It is noted that the average yield in East Lampung, Indonesia is 21.8 tonnes per ha (Sugino and Mayrowani, 2009), implying that there is still room to increase cassava yields in the study area in particular, and Nigeria in general.

4.5 Interrelationships of Factors Affecting Yields

Crop production success mainly depends on the crop yield per hectare and on the form that the produce takes to get to the final consumers, because in the tropical countries much of the final yields are lost due to spoilage. Higher productivity depends on many factors that encompasses environmental, biological and management factors. The successes of cassava production mainly depend on the yield of its root tubers. Higher production rates of cassava depend on many factors. Other factors affecting yields of cassava production are discussed in the following section.

4.5.1 Relationship of Seed Variety to Yield

As shown in Table 4.11, there is a non-significant ($p<0.142$) difference in yield performance between improved and local varieties of seed. For the Delta Central region, the yield rate for local and improved varieties is 7.3 tonnes per ha and 7.4 tonnes per ha respectively. For the Delta South region both yield levels were lower, with local variety yield at 5.6 tonnes per ha and improved variety yield at 6.0 tonnes per ha. Delta North region has a highest average yields for both varieties of 9.7tonnes per ha for local and 9.8 tonnes per ha for improved cassava cuttings. Apart from other factors that may have effects on the yield, close inter-planting between local varieties and improved varieties may have resulted in cross-breeding to reduce or improve on the performances.

Table 4.11 Yield per ha by Seed Variety

Region	Crop Variety	Mean	Std Div	Minimum	Maximum
Delta Central	Local	7290.29	2666.84	3000	13000
	Improved	7438.29	3878.52	2250	25000
Delta South	Local	5585.08	1880.25	3930	10000
	Improved	6031.52	2137.15	3571	10000
Delta North	Local	9671.75	4780.11	2500	10667
	Improved	9863.23	5299.39	2250	24000
Total	Local	8270.23	4100.77	2250	22000
	Improved	7512.93	4060.86	2250	25000

Source: Field survey, 2008

The low performances of the improved varieties when compared to outputs of local cuttings in the study area may due to low input usages like fertilizer and pesticides, good management of spacing, weeding and irrigation control, among other factors that influence outputs of improved seeds (Sugino and Mayrowani, 2009, Rahman 1998).

4.5.2 Relationship of Seed Sowing Rate to Yield

Table 4.12 presents the relationship between seed sowing rates and yield of cassava. Overall, the highest seed sowing rate (121 bundles) produces the highest yield of 9.3 t/ha, but the small seed rate (0-40 bundles) produces the next highest level of yield of 8.3 t/ha. The yield rates are very dissimilar across regions by seed rate categories. The lowest yield for any seed sowing rate is in the Delta South region. The variation in yield rate may be due to large areas of space left in between crops causing competition for, or depletion of, available soil nutrient by weeds.

Table 4.12 Yield per ha in Relation to Seed Rate Application (Bundles)

Region	Seed Rate	Mean	Std Div	Minimum	Maximum
Delta Central	0-40 bundles	6713.87	3030.32	2250	14117
	41-80 bundles	7716.68	3889.49	2333	25000
	81-120 bundles	6307.65	3475.52	3000	16000
	121+ bundles	9022.91	2363.35	4100	11916
Delta South	0-40 bundles	6158.03	2433.68	3660	10000
	41-80 bundles	6273.98	1996.57	3571	10000
	81-120 bundles	5227.00	1747.02	3920	10000
	121+ bundles	-	-	-	-
Delta North	0-40 bundles	10315.22	6060.64	2250	22000
	41-80 bundles	9246.68	4005.73	3750	24000
	81-160 bundles	9763.33	3115.34	5000	16667
	161+ bundles	10117.25	5456.28	2500	15385
Total	0-40 bundles	8264.70	5001.23	2250	22000
	41-80 bundles	7670.77	3584.28	2333	25000
	81-120 bundles	6365.42	3083.41	3000	16667
	121+ bundles	9314.73	3258.84	2500	25000

Source: Field Survey, 2008

Table 4.13 Yield per ha in Relation to Family Labour Value (N)

Region	Family Labour Value (N)	Mean	Std Div	Minimum	Maximum
Delta Central	0-8000 (Group 1)	6833.33	6211.55	3000	14000
	8001-16000 (Group 2)	11541.67	11776.79	3135	25000
	16001-32000 (Group 3)	6909.90	4775.18	2250	18750
	>32001 (Group 4)	7330.06	2830.14	3000	17500
Delta South	0-8000 (Group 1)	8333.00	-	8333	8333
	8001-16000 (Group 2)	6666.00	-	6666	6666
	16001-32000 (Group 3)	5007.00	1340.09	3600	6400
	>32001 (Group 4)	5986.39	2134.59	3571	10000
Delta North	0-8000 (Group 1)	10121.79	6145.74	2500	25000
	8001-16000 (Group 2)	7300.00	2980.09	2500	10667
	16001-32000 (Group 3)	7416.67	4474.47	2250	10000
	>32001 (Group 4)	9891.62	4402.67	3750	24000
Total	0-8000 (Group 1)	9850.77	6064	2500	22000
	8001-16000 (Group 2)	8643.44	6624.22	2500	25000
	16001-32000 (Group 3)	6567.59	4053.52	2250	18750
	>32001 (Group 4)	7393.26	3389.40	3000	24000

Significant at.002

Source: Field Survey, 2008

4.5.3 Relationship of Fertilizer Application to Yield

Due to low use of fertilizer usage in the study area, it will be very difficult to assess the true effects of its application, as even when fertilizer is applied; it is below the FAO recommended level and below the level used in other areas of Nigeria. There were no significant differences in fertilizer usages between regions and farm sizes groups in the area of study.

4.5.4 Relationship of Owned Labour to Yield

It is observed from Table 4.13 that the yield had a positive relationship with family/imputed labour. The small farm group had the highest yield from using own labour effectively as indicated in total mean group 1 (N 0-8000). This was a similar trend in all regions, except Delta Central which had very few large own labour farms with highest yields. This was significant at .002 for all groups, between Group 1 and 2 at .001 and non- significant with large size farm group.

4.5.5 Relationship of Hired Labour Value to Yield

As shown in Table 4.14, there was a reverse relationship between hired labour use and yield level. Large farms make more efficient use of hired labour than small farms, which use the least amount of hired labour in all the regions. This may be due to the economies of scale (i.e., it cost less per unit labour cost when operation size increases) are easier to obtain by large scale farmers, or that the use of large units of labour in small farms may mean higher costs per operation size. But results show efficiency in the use of hired labour increases the yield of cassava production. Similar results are shown to that of the imputed labour. The lowest amount of spending on hired labour, Group 1 (N0-8000), produced the highest yields showing 8.4t/ha compared with Group 4 (>32000) which obtained 7.8t/ha. However, the yield varies in all the locations in the area of study.

Table 4.14 Yield by Hired Labour Cost

Region	Hired Labour Value (N)	Mean	Std Div	Minimum	Maximum
Delta Central	0-8000 (Group 1)	7224.00	1755.60	5000	10000
	8001-16000 (Group 2)	6775.00	1306.24	5000	8125
	16001-32000 (Group 3)	7461.10	1983.24	4375	11111
	>32001 (Group 4)	7442.94	3934.21	2250	25000
Delta South	0-8000 (Group 1)	6233.20	2446.26	4050	10000
	8001-16000 (Group 2)	6875.00	-	6875	6875
	16001-32000 (Group 3)	5247.37	2045.15	3600	10000
	>32001 (Group 4)	6127.64	2101.60	3571	10000
Delta North	0-8000 (Group 1)	10445.80	6649.93	3750	22000
	8001-16000 (Group 2)	-	-	-	-
	16001-32000 (Group 3)	9612.38	3367.80	4200	15000
	>32001 (Group 4)	9722.49	5041.85	2250	24000
Total	0-8000 (Group 1)	8409.30	4861.17	3750	22000
	8001-16000 (Group 2)	6791.67	1169.05	5000	8125
	16001-32000 (Group 3)	6789.46	2903.67	3600	15000
	>32001 (Group 4)	7816.82	4185.45	2250	25000

Source: Field Survey, 2008

According to Anyaegbunam et al (2010), hired labour is more productive than family labour but this is not supported by the findings in this study. However, Onoja et al. (2012) make a similar finding arguing that family labour is more productive and has a positive coefficient, while hired labour productivity has a negative coefficient and makes a negative contribution to cassava yield.

Table 4.15 Yield per ha Relation to Total Labour Quantity (Man-days)

Region	Labour (Man-days)	Mean	Std Div	Minimum	Maximum
Delta Central	1 (0-60)	6875.00	883.88	6250	7500
	2 (61-90)	8697.83	7177.96	2250	25000
	3 (91-120)	8405.00	3718.57	3750	17500
	4 (121+)	7041.15	2654.24	2333	16000
Delta South	1 (0-60)	5183.25	1291.84	3600	6666
	2 (61-90)	9166.50	11178.75	8333	10000
	3 (91-120)	5569.57	2288.40	3600	10000
	4 (121+)	6111.85	2063.83	3571	10000
Delta North	1 (0-60)	12204.77	6781.22	3000	22000
	2 (61-90)	6715.25	5751.41	2250	22000
	3 (91-120)	8595.36	3044.61	4260	15000
	4 (121+)	9782.99	5065.41	2250	24000
Total	1 (0-60)	10116.28	6450.30	3000	22600
	2 (61-90)	7818.85	6195.25	2250	25000
	3 (91-120)	7062.00	3211.28	3600	17500
	4 (121+)	7489.21	3307.23	2333	24000

Source: Field Survey, 2008

4.5.6 Relationship of Yield to Quantity of Labour

Table 4.15 indicates that there is a positive relationship between yields and total number of man-days of labour. Labour group 2 had the highest yield, and as more labour is used the research shows that the yield is diminished as shown by group 4 in Delta Central region. Delta South region shows that the impact of labour on yields is more effective in small amounts than with large increases. Delta North region shows similar results to Delta Central region, where yield increases as labour increases until it reaches a critical point, after which further increases in labour do not necessarily improve on outputs as stated with the law of diminishing marginal returns. With the overall total average mean; labour group 1(small) had

Table 4.16 Yield per ha Relation to Total Labour Value (Naire)

Region	Total Labour Value (N)	Mean	Std Div	Minimum	Maximum
Delta Central	0-8000 (Group 1)	6250.00	-	6250	6250
	8001-16000 (Group 2)	8605.69	6880.40	2250	25000
	16001-32000 (Group 3)	7699.68	3170.23	2333	17500
	>32001 (Group 4)	7029.90	2691.45	3000	16000
Delta South	0-8000 (Group 1)	6666.00	-	6666	6666
	8001-16000 (Group 2)	5903.67	2177.57	3600	10000
	16001-32000 (Group 3)	6060.79	2020.90	3571	10000
	>32001 (Group 4)	5902.00	2232.67	3420	10000
Delta North	0-8000 (Group 1)	6000.00	2738.61	3000	10000
	8001-16000 (Group 2)	11181.71	7183.75	2250	22000
	16001-32000 (Group 3)	8460.71	2542.91	4200	15000
	>32001 (Group 4)	9894.33	4262.83	2500	24000
Total	0-8000 (Group 1)	6114.50	2326.90	3000	10000
	8001-16000 (Group 2)	9561.90	6708.47	2250	25000
	16001-32000 (Group 3)	7003.04	2681.01	2333	17500
	>32001 (Group 4)	7639.24	3569.33	2500	24000

Significant at .002 for all groups; .012 for Group 1 and 2; .000 for Group 2 and 3; .005 for Group 3 and 4

Source: Field Survey, 2008

6.1 t/ha, group 2 (medium) with the highest output of 9.6 t/ha, while groups 3 and 4 have 7.0 t/ha and 7.6 t/ha respectively. All groups have significant differences of .002, and .012 between Groups 1 and 2, indicating 0.000 significant difference between all groups and similar results are also shown by the relationship of total labour value to yield as indicated in Table 4.16.

4.5.7 Relationship of Yield to Pesticide use

Table 4.17 shows that there is an insignificant relationship between yield and use of pesticides in the study area. In Delta Central region, Group 1 had yields of 7.4 t/ha; Group 2, 5.8 t/ha and Group 3, 7.9 t/ha. In Delta South region, Table 4.17 shows a positive relationship between pesticide usage and output; group 1 (5.9 t/ha), group 2 (7.0 t/ha), but Delta North region indicates the reverse with group 1(10 t/ha) followed by group 2 (8.4 t/ha) and group 3 (8.2t/ha). The overall mean yield for pesticide use is group 1 at 7.7t/ha, with groups 2 and 3 at8.0t/ha each. The difference across use group is insignificant at ($p<0.175$).

Table 4.17 Yield per ha Relation to Pesticide Value (Naire)

Region	Pesticides Value (N)	Mean	Std Dev	Minimum	Maximum
Delta Central	1 (lowest-2500)	7381.19	3621.92	2250	25000
	2 (2501-5000)	5833.33	2466.41	3000	7500
	3 (5001+)	7946.45	3411.62	3500	13000
Delta South	1 (lowest-2500)	5970.69	2113.66	3571	10000
	2 (2501-5000)	7000.00	-	7000	7000
	3 (5001+)	-	-	-	-
Delta North	1 (lowest-2500)	10239.86	5328.09	2250	24000
	2 (2501-5000)	8493.59	4719.59	2500	15386
	3 (5001+)	8268.22	1959.21	4375	12000
Total	1 (lowest-2500)	7670.03	4142.49	2250	25000
	2 (2501-5000)	8042.43	4403.10	2500	15385
	3 (5001+)	8064.25	2785.67	3500	13000

Non-significant at .175

Source: Field Survey, 2008.

4.5.8 Relationship of Yield to Land Rent Value (N)

Table 4.18 shows that there is no positive relationship between the value of land rented and the yield of cassava produced, by region. The yield rates with group 1 (7.4t/ha), group 2 at 7.7t/ha, group 3 at 8.2 t/ha and group 4 at 7.7t/ha. The groups 1 and 4 have above average yields and groups 2 and 3 are below the overall mean yield of 7.7 t/ha. The differences are non-significant ($p<0.388$).

Table 4.18 Yield per ha in Relation to Land Rent (N)

Region	Land Rented	Mean	Std Div	Minimum	Maximum
Delta Central	1(<4000)	8094.03	4806.10	2250	25000
	2 (4001-5000)	6871.34	2818.19	3000	175000
	3 (5001-6000)	6645.06	2494.52	3000	12625
	4 (>6001)	8289.87	3326.66	4100	16000
Delta South	1(<4000)	5487.97	5227.11	2250	22000
	2 (4001-5000)	6385.15	1916.99	3571	10000
	3 (5001-6000)	6475.39	2383.31	4000	10000
	4 (>6001)	5380.86	2235.30	4100	10000
Delta North	1(<4000)	8548.29	5227.11	2250	22000
	2 (4001-5000)	10576.64	5711.00	2250	22000
	3 (5001-6000)	10843.23	4228.39	2500	24000
	4 (>6001)	9372.13	4538.59	2500	22000
Total	1(<4000)	7366.96	4418.44	2250	25000
	2 (4001-5000)	7718.12	4607.56	2250	22000
	3 (5001-6000)	8215.96	3836.22	3000	24000
	4 (>6001)	7719.89	4079	2250	25000

Not Significant at .388

Source: Field Survey, 2008

4.5.9 Yield Relation to Land Owned

As shown in Table 4.19, increasing yields result from increased value of land owned in Delta South and Delta North, but not in Delta Central. Overall, the trend is even in reverse that is yield is reduced as the value of owned land increases. However, overall there is a significant difference in yield from owned land across the different regions of the study ($p<0.002$).

Table 4.19 Yield per ha in Relation to Land owned (N)

Region	Land Owned	Mean	Std Div	Minimum	Maximum
Delta Central	1(<4000)	7514.00	5873.32	2250	25000
	2 (4001-5000)	7599.59	2990.50	3125	17500
	3 (5001-6000)	7094.61	2923.34	3000	16000
	4 (>6001)	7344.00	2388.67	41000	1111
Delta South	1(<4000)	5957.00	1572.89	3600	8333
	2 (4001-5000)	5738.83	2188.40	3600	10000
	3 (5001-6000)	6054.74	2084.25	3571	10000
	4 (>6001)	10000.00	-	10000	10000
Delta North	1(<4000)	9642.86	5705.68	2250	22000

Region	Land Owned	Mean	Std Div	Minimum	Maximum
	2 (4001-5000)	9703.89	5303.89	3750	22000
	3 (5001-6000)	10009.19	4071.19	3750	24000
	4 (>6001)	-	-	-	-
Total	1(<4000)	8759.53	5600.54	2250	25000
	2 (4001-5000)	7334.91	3610.63	3125	22000
	3 (5001-6000)	7423.15	3386.34	3000	24000
	4 (>6001)	7548.31	2479.30	2250	25000

Significant at .002
Source: Field Survey, 2008
Where there is no, there were no respondents in this category (-)

4.5.10 Relationship of Yield to Farmers Age

Table 4.20 indicates that there is a positive relationship between the yield produced and the age of the farmers. Older farmer age group 3 had the highest yield, above the total mean average of 7.7 t/ha with 9.0 t/ha, followed by the middle age group (8.1 t/ha) and lower group age had the least yield (6.9 tonnes per ha) although this varies with location. There are significant differences between age group and yield levels. The main effects of farmers' age on productivity will be examined more closely in Chapter 6.

Table 4.20 Relationship of Yield to Farmers' Ages

Region	Farmers Age	Mean	Std Div	Minimum	Maximum
Delta Central	17-39 years(1)	7397.99	3622.14	2250	25000
	40-59years (2)	8060.71	3547.58	3125	17500
	>60year (3)	4720.00	1432.60	2333	6500
Delta South	17-39 years(1)	5812.41	2277.10	3600	10000
	40-59years (2)	6060.99	2030.75	3571	1000
	>60year (3)	-	-	-	-
Delta North	17-39 years(1)	7243.64	4507.89	2250	20000
	40-59years (2)	10474.98	5282.92	3000	24000
	>60year (3)	11016.60	4195.21	2250	24000
Total	17-39 years(1)	6950.17	3562.27	2250	25000
	40-59years (2)	8151.85	4296.61	3000	24000
	>60year (3)	9013.14	4618.43	2333	22000

Significant at .013 in all groups
Significant at .041 between group 1 and group 3 only
Source: Field Survey 2008

4.5.11 Relationship of Yield to Educational Attainment

It is observed from Table 4.21 that illiterate farmers obtained the least yield of 7.1 tonnes per ha, follow by respondents who had attended primary school with 7.6 tonnes per ha. Those with more than primary level education obtained the highest yield of 8.0 tonnes per ha. The primary schooling level farmers' yield is almost equal to the overall mean of 7.7tonnes per ha, while the higher educational group 3 is above total mean average for the study area. On the regional levels, the results are similar. The influence of years in education to determine farmers' yields of cassava will be further examined in Chapter 6.

Table 4.21 Yield in Relation to Education Level

Region	Education Level	Mean	Std Div	Minimum	Maximum
Delta Central	0 years (1)	7493.04	2882.26	3714	16000
	7-12 years (2)	6756.51	3119.03	2250	17500
	>13years (3)	7872.62	4157.61	3000	25000
Delta South	0 years (1)	5453.23	1891.52	3571	10000
	7-12 years (2)	6072.00	1778.25	4100	9000
	>13years (3)	6294.65	2419.59	3600	10000
Delta North	0 years (1)	10461.79	4065.35	4200	20000
	7-12 years (2)	10028.09	6032.25	2250	24000
	>13years (3)	9470.07	4703.40	2500	24000
Total	0 years (1)	7174.34	3348.38	3571	20000
	7-12 years (2)	7639.00	4388.11	2250	24000
	>13years (3)	8032.63	4161.75	2500	25000

Not Significant at .901
Source: Field Survey, 2008.

4.5.12 Relationship of Yield to Farming Experience

As shown in Table 4.22, younger farmers tend to gain higher yields than older farmers with more experience. This is quite interesting to observe. The table shows that farmers in group 1, with lower levels of farming experience, were observed to have the highest levels of yield. The highest yield was observed in farming experience less than 17 years (8.9 tonnes per ha), followed by group 3 (20-45 years' experience) with 7.5 tonnes per ha and for farmers with more than 45 years experience, the yield fell to7.3 tonnes per ha. The negative relationship between experience and yield may be that younger farmers are more likely to be adapting to modern technologies or new ideas. Although they have less farming experience they look more innovative than older farmers and are likely to be significantly stronger physically.

Table 4.22 Yield per ha in Relation to Farming Experience

Region	Farming Exp. (yrs)	Mean	Std Div	Minimum	Maximum
Delta Central	0-5years (Group 1)	8031.44	4758.13	2250	25000
	6-11 years (Group 2)	6610.04	2504.19	3666	13000
	12-15years(Group 3)	8789.82	1948.67	6592	12625
	16+ (Group 4)	6856.60	2984.66	2333	11000
Delta South	0-5years (Group 1)	9291.60	972.80	8125	10000
	6-11 years (Group 2)	6504.74	2572.74	4050	10000
	12-15years(Group 3)	5160.00	2235.71	3600	9000
	16+ (Group 4)	5668.31	1719.05	3571	10000
Delta North	0-5years (Group 1)	10011.67	6331.89	2250	22000
	6-11 years (Group 2)	8739.11	3556.24	4000	16667
	12-15years(Group 3)	8738.00	3231.60	2500	12000
	16+ (Group 4)	10326.62	5039.88	3000	24000
Total	0-5years (Group 1)	8956.90	5376.33	2250	25000
	6-11 years (Group 2)	7239.05	3025.92	3666	16667
	12-15years(Group 3)	7566.44	2901.25	2560	12625
	16+ (Group 4)	7383.50	3910.99	2333	24000

Source: Field Survey, 2008

4.5.13 Relationship of Yield to Family Size

It is observed from Table 4.23 that farm respondents with lower household sizes obtained the highest yield levels and this relationship was found to be significant at $p<0.089$. Group 1 (1-5 members of household) obtained 7.6t/ha in Delta Central, 6.0 t/ha in Delta South and 10.45 t/ha in Delta North, but it varied significantly within these regions.

Table 4.23 Yield per ha in Relation to Household Numbers

Region	Family Size (No.)	Mean	Std Div	Minimum	Maximum
Delta Central	1-5	7664.32	4056.99	3125	2500
	6-10	7376.20	2774.49	3000	17500
	11+	6904.84	3594.21	2250	16000
Delta South	1-5	6006.63	2204.48	3571	10000
	6-10	6170.19	2086.05	3600	10000
	11+	4939.67	1319.54	4100	7143
Delta North	1-5	10450.63	5112.38	2500	22000
	6-10	9683.45	5108.36	2500	24000
	11+	6489.50	3412.82	2250	10000
Total	1-5	7816.58	4213.71	2500	25000
	6-10	7966.83	4071.50	2500	24000
	11+	6319.14	3170.30	2250	16000

Significant at .089 in all groups and between regions
Source: Field Survey, 2008

4.5.14 Relationship of Yield to Farm Size

Table 4.24 reveals that farm sizes have significant effects on the yield of cassava, with small size farms giving an average yield of 7.7tonnes per ha and this makes up more than 70 percent of cassava farming in all the case study areas of Delta State compared with 7.8t/ha on large farms, but with very few farms in the sample. Yield in relation to farm size varies with location and is significant ($p<0.02$).

Table 4.24 Yield per ha in Relation to Farm Size

Region	Farm Size (ha)	Mean	Std Div	Minimum	Maximum
Delta Central	0-2.5 (1)	7331.94	3872.36	2250	25000
	2.6-4.5 (2)	6398.60	2802.55	3714	16000
	4.6+ (3)	7626.07	2820.85	3000	11916
Delta South	0-2.5 (1)	6084.49	2093.50	3571	10000
	2.6-4.5 (2)	5095.47	1825.60	4100	10000
	4.6+ (3)	10000	-	10000	10000
Delta North	0-2.5 (1)	9580.41	5183.91	2250	22000
	2.6-4.5 (2)	10826.80	4635.32	5000	25000
	4.6+ (3)	8361.33	5114.40	2500	11917
Total	0-2.5 (1)	7723.44	4143.00	2250	25000
	2.6-4.5 (2)	7653.45	4146.50	3714	24000
	4.6+ (3)	7867.11	307.99	2500	11917

Significant at .023 in all groups and between regions
Source: Field Survey, 2008

4.5.15 Yield in Relation to Marital Status

It is observed from Table 4.25 that marital status of the farm respondents does not have any significant effect on the production of cassava root tubers. This is observed from the various yields in no particular order in all the areas of study.

Table 4.25 Yield in Relation to Marital Status

Region	Marital Status	Mean	Std Div	Minimum	Maximum
Delta Central	Divorce	6562.50	3287.46	3750	11250
	Married	7587.84	3490.87	2333	25000
	Single	6617.48	3622.88	7000	16000
	Widow	10333.33	4932.88	7000	16000
Delta South	Divorce	4896.33	1524.27	4100	8400
	Married	6089.28	2147.10	3571	10000

Region	Marital Status	Mean	Std Div	Minimum	Maximum
	Single	5982.87	2147.10	3600	9000
	Widow	7000	-	7000	7000
Delta North	Divorce	18146.64	6252.45	7300	22000
	Married	9702.26	4486.03	2500	24000
	Single	5483.20	3281.23	2250	10000
	Widow	-	-	-	-
Total	Divorce	9430.42	7150.45	3750	22000
	Married	7870.06	3849.25	2333	25000
	Single	6200.25	3155.35	2250	18750
	Widow	9500	4358.90	7000	16000

Source: Field Survey, 2008

4.5.16 Relationship of Yield to Extension Contacts

Table 4.26 shows that farmers with linkages to extension personnel did not gain higher yields in any of the study areas. This may be due to the inefficient use, or unavailability, of farm inputs including new technologies or training, leaving extension services unable to make a significant impact on yield Further studies would need to be carried out to determine the specific factors that contribute to these trends.

Table 4.26 Yield per ha in Relation to Extension Contact

Region	Extension Rceived	Mean	Std Div	Minimum	Maximum
Delta Central	No Contact	7378.02	3656.27	2250	25000
	Contact	7551.38	2762.95	3666	11250
Delta South	No Contact	7022.33	2361.05	3020	10000
	Contact	5339.37	1647.28	3571	10000
Delta North	No Contact	10003.83	5134.27	2250	24000

Region	Extension Rceived	Mean	Std Div	Minimum	Maximum
	Contact	7685.00	3970.93	2500	16667
Total	No Contact	8404.20	4371.47	2250	25000
	Contact	7685.00	2361.98	2500	16667

Significant differences exist between mean yield per ha in regions of extension conctacts by region based on ANOVA ($p<0.01$)

Source: Field Survey, 2008

4.5.17 Relationship of Yield to Gender

Table 4.27 indicates that the gender of the farm respondents affects the yield of cassava root tubers in the study areas only slightly, and this varies in different areas. Male farmers produced a higher yield of 7.7 tonnes per ha compared with female farmers at 7.5 tonnes per ha. This is supported by the findings of Nweke et al. (2002) which suggested that men have a higher labour input in cassava producing areas. However, this is contrary to other studies, such as that of Ogunleye et al. (2008) which finds that female producers are more productive than male producers who have more land, and it has also been recorded that female heads of households are more efficient with the use of land (Akinsanmi et al. 2005).

Table 4.27 Yield in Relation to Gender

Region	Gender	Mean	Std Div	Minimum	Maximum
Delta Central	Female	7495.67	3356.06	2333	18750
	Male	7258.25	3865.94	2250	25000
	Total	7396.18	3562.48	2250	25000
Delta South	Female	6219.98	2296.70	3571	10000
	Male	5661.18	1796.23	3600	10000
	Total	5980.50	1796.23	3571	10000
Delta North	Female	10038.91	5317.41	2500	24000

Region	Gender	Mean	Std Div	Minimum	Maximum
	Male	9665.69	4979.58	2250	22000
	Total	9782.99	5065.41	2250	24000
Total	Female	7543.63	3794.16	2333	24000
	Male	7888.48	4339.70	2250	25000
	Total	7719.89	4079.30	2250	25000

There is no significant differences in yield by gender in each region based on ANOVA ($p<0.293$).

Source: Field Survey, 2008

4.5.18 Relationship of Yield to Training Provision

Training provision is taken as a dummy with farmers that received any farm training, and those with no training specific to cassava production. Table 4.28 shows that farmers without training provision had higher yield compared with the few that had received training. Training programmes for farmers in the study area are seen as an exercise by agricultural officials or extension agents to make quick money, and this may explain why the training is insufficient to promote higher yields. Farmers that received such training were not observed to have backed it up with the competent use improved technologies, meaning that training could not achieve its objectives.

Table 4.28 Yield in Relation to Training Received

Region	Training RCVD	Mean	Std Div	Minimum	Maximum
Delta Central	No Training	7579.53	3540.80	2250	25000
	RCVD Training	6704.45	3641.79	2333	18750
Delta South	No Training	5979.15	2108.79	3571	10000
	RCVD Training	6050.00	2757.72	4100	8000
Delta North	No Training	9861.45	5194.55	2250	24000

Region	Training RCVD	Mean	Std Div	Minimum	Maximum
	RCVD Training	8684.99	5194.87	4375	12500
Total	No Training	7786.53	4144.47	2250	25000
	RCVD Training	7109.35	3422.36	2333	18750

ANOVA test; Not significant at (<0 .508).

Source: Field Survey, 2008

4.6 Chapter Summary

This chapter has discussed the socio-economical characteristics of farmers and farming households, and investigated other factors that affect the productivity of cassava root tubers in the case study region of Delta State, Nigeria. Key findings of the study reveal that: the average age of farmers in the area is 42 years and this is close to average age at the national level (FAOSTAT, 2010; CBN various issues); average household size was 5.8 which is significantly above the national level of 4.2 (FAOSTAT, 2010; FOS various issues); average farm size was 2.1 ha and the majority of farmers had primary level education. Results indicate that the majority of farmers use agricultural inputs which are below the recommended levels, and this is in accordance with other studies (Oni et al., 2009; Lawenbergs- DeBoar and Ibro, 2008; Chukwaji and Ogasi, 2006; Abang et al. 2006; Nweke, 2004). The extension services, training provision and access to credit facilities are low. ANOVAs test results indicate that farm size, family size, farmers' age and extension contacts and quantity of farm inputs significantly influence cassava yield, and this pattern is supported by the findings of other scholars (Mohammed et al., 2010); Asogwa et al., 2009; Monirruzzaman et al., 2009).

In addition, other factors may have influence on the yield performances in the area of study, apart from the use of inputs and determinants of efficiency was the geography of the region, flooding and the effects of oil pollution, low soil fertility (Okubor, 2011; Inoni et al. 2006; Efole, 2004). The lowest yield in Delta South may have resulted mostly from the above factors, since this area lies in the low land plain and is subject to frequent annual flooding and oil pollution.

However, the discussion of physical inputs may be insufficient to explain some of the processes involved in performance measurement of cassava production. For this it is necessary to also discuss the economic implications of these factors and this is the subject of the next chapter.

CHAPTER 5

CASSAVA PRODUCTION COST AND RETURN ANALYSIS

5.1 Introduction

Chapter four discussed the production of cassava root tuber in relation to physical attributes and socio-economic characteristics of farmers' and input use. Results showed that there are significant relationships between some socio-economic factors and yield levels, such as, farm size, farmer's age, farming experience, education level, seed variety, and extension contacts among others. This chapter discusses other attributes of productivity as mentioned in the literature review (Chapter two). This study analyses the economics of cassava production where productivity is measured in term of yield and its value/return. Productivity of output is measured in Naira which is the Nigerian currency in which farmers sell their produce. Most farmers in the study area grow crops for home consumption and only the surplus is left over for sale. Whether crops are grown for farmers' household use or for market, they need to produce benefits which outweigh the inputs made by the household. In commercial situations, one of the major criteria for crop production is economic profitability. The economic performance of crops has important implications and could be used as a tool for better management and planning of farming enterprises.

The aim of this chapter is to analyse the data to estimate the production costs and returns from cassava production which were computed at actual prices paid and received by the farmers at the farm level. Per hectare costs and returns of cassava root tuber production were estimated for each of the three regions under study. Production costs can be divided into fixed and variable costs. Returns could be described as the value of outputs that are generated from agricultural activity. The valid measure is in terms of yield and the monetary value attached to yield per hectare is used for cross-comparisons.

This study also conducts some sensitivity analysis on the effect of increasing yield per ha, technological changes and on price changes, especially as Nigeria is a country where price structures have frequently affected production. The sensitivity analysis is a test to see the effects of fluctuating yields and price changes on production, and the resulting effect on the gross margin.

The gross margin and cost-benefit analysis has been used for the cost and revenue data. This analysis uses total revenue (TR), total variable cost (TVC), total fixed cost (TFC). This model has been used for the estimation of gross margin by many scholars (e.g., Emam and Hassan, 2011; Ebukiba, 2010; Emam, 2010; Awoyinka, 2009; Haji, 2008; Rahman, 1998).

Gross Margin (GM) = Total Revenue (TR) – Total Variable Cost (TVC) (5.1)

NET Profit Margin (NP) = TR—(TVC + TFC) (5.2)

Benefit Cost Ratio (BCR) =TR/TC (5.3)

5.2 Cost of Production

5.2.1 Imputed (Own) Labour Cost

It is observed from Table 5.1 that imputed (own or family) labour was N17, 923.72/ha for all regions which is 30.8 percent of total production cost and 49.7 percent for total cassava labour cost. The family labour cost was highest in Delta South region (N19, 729.24/ha) followed by Delta Central (N19, 693.25/ha) and Delta North region (N14, 348.68/ha). It can be inferred from the above values that cassava production is labour intensive since this accounts for a high proportion of the cost of production.

5.2.2 Hired Labour

The hired labour cost overall is N18, 192.02 per ha (see Table 5.1). This accounts for 31.3 percent of the total cost of cassava production and about 51.3 percent of total cassava labour cost. The Delta North region has the highest hired labour cost (N23, 767.11/ha) followed by Delta South (N16, 015.69/ha) and Delta Central (N14, 793.06/ha).

Table 5.1 Analysis of cost and returns of cassava production per hectare

Variables	Measure	Region Central	Region South	Region North	Total Mean	Sign
Cassava root	kg/ha	7396.18	5980.50	9782.09	9782.99	.000
Cassava Root cost	kg/N	16.73	17.29	16.48	16.83	.000
Total Revenue	N	123738.09	103402.85	161208.84	164647.72	
Variable input cost N/ha						
Impute labour cost	N	19693.25	19729.24	14348.68	17923.72	.000
Hired Labour cost	N	14793.06	16015.69	23767.11	18192.02	.000
Total labour cost	N	34567.77	35621.43	37829.19	36009.19	.000
Fertilizer cost	kg/N	4700.53	3636.25	3519.01	3951.93	.362
Pesticide cost	L/N	761.90	37.14	1130.38	643.17	.000
Imputed seed cost	N	10525.15	6853.61	7353.07	8243.94	.000
Seed purchased cost	N	2786.78	4251.66	6411.88	4483.44	.000
Total seeds cost	N	13364.78	12383.17	13754.45	13167.53	.324
Total Variable cost	N	53395.16	51677.99	56232.75	53771.82	
Fixed Variable Cost (Rent)						
Imputed land cost	N	2887.05	3781.67	2131.96	2933.56	.000
Hired land Rent cost	N	1741.50	479.76	2385.47	1535.67	.000
Total Fixed cost	N	4614.29	4271.43	4261.90	4382.54	.000
Gross Margin (GM) = Total Revenue – Total Variable Cost (TVC)						
GM	N	70342.93	51724.86	104976.09	110884.09	
Net Profit Margin (NP) = TR – (TVC + TFC)						
NP	N	65728.64	47453.43	100714.19	106496.55	
Benefit Cost Ratio (BCR) = TR/TC						
BCR		2.1	1.85	2.66	2.83	
Return to Labour	N	850	757.82	652.11	863.7	
Returns to Family Lab.	N	1496.65	1361.18	1666.29	2491	

1 Bundle cassava sticks cuttings = 11 -13kg
Exchange rate US 1dollar = 116 naira and British pound 1= 200 naira
SOURCE: Computed from Field Survey, 2008

The total cost of labour in cassava production amounted to N36, 009.19/ha which represents 62 percent of the total cost of cassava production in the area of study as shown in Tables 5.1 and 5.2. A similar study carried out by Yakasai (2010) reported 55.8 percent in Abuja, Northern Nigeria, with a total cost of N73, 1011.30. According to Bemidele et al. (2008), the total labour cost for cassava based production systems in the Guinea Savannah area of Kwara State for cassava/maize/guinea corn, cassava/maize, cassava/cowpea and cassava/mellow were N60, 280.39, N45, 940.68, N48, 350.24 and N55, 569.82/ha, respectively. Lastly, Adeyemo et al. (2010) reported that the cost of labour is 68.24percent of the total cost of cassava production in the study that was carried out in in Ogun State, South-West Nigeria. Oyinbo et al. (2013) reported that labour accounts for 75.9 percent of the total costs of production in Edo state, South-south Nigeria. While, Chukwuji's (2008) study, focussing on a combination of enterprise of cassava, yam and maize, reported a 79 percent share of total production cost for labour. It could be implied that the proportion of labour costs in cassava production in Delta State is low when compared to other states and forms of farm enterprise.

5.2.3 Seed

Farmers in the study areas used both home supplied (imputed) seed and purchased seeds. Imputed seed equated to a cost of N8, 243.94/ha for all areas and this accounts for 14.2 percent of the total costs, as shown in Table 5.1, and it accounts for 62 percent of the total cassava cuttings used for cultivation. Seed purchases represent 37 percent of the total with a cost of N4, 483.44/ha. The cost of seeds was highest in Delta North region (N13, 754.54/ha), followed by Delta Central (N13, 364.78/ha) and Delta South had the lowest value (N12, 383.17/ha). Seed costs make up 22.6 percent of total cassava production costs in the study areas. With respect to farm size categories, the seed costs are highest for large farms (N15, 658.37/ha) followed by small farms (N13, 424.38/ha) and medium size farms (N11, 181.56/ha) (see Table 5.2).

5.2.4 Fertilizers

Fertilizers include all nutrient types and organic manures. It is observed from Table 5.1 that the average cost of fertilizer application is N3, 951.93 per ha which accounts for 6.7 percent of the total cost of production. Fertilizer utilization in the area of study is generally low, either because of the farmers' beliefs, costs involved or availability during the planting season. It is observed that the Delta Central has the highest cost (N4, 700.53 per ha) followed by Delta South (N3, 636.26 per ha) and the lowest cost was from Delta North region (N3, 551.93/ha). With respect to farm size categories (see Table 5.2), large farms have the highest cost (N6, 698.50 per ha), followed by medium farms (N4, 441.60 per ha) and the lowest costs are observed in the smallest scale farms (N3, 692.15 per ha). This may be due to the fact that large owners have more capital to buy fertilizers and have contacts in the government supplying agencies to aid their purchase than small farmers.

5.2.5 Pesticides

The average cost of pesticides was observed to be N643.17 per ha which accounts for about 1.1 percent of the total cost of production. Delta North region has the highest amount (N1, 130.38 per ha) followed by Delta Central (N761.90 per ha) and the lowest in Delta South (N37.14 per ha). The figures for farm size categories show that the large farms use the highest level of pesticides, followed by small farms and medium farms (Table 5.2). But overall use rates are very large for large farms, almost four times that of the lowest user, the medium farms.

Table 5.2 Farm Sizes, Production Cost and Return Analysis per hectare

Variable	Measure	Farm Size Category			Total
		Small	Medium	Large	
Fertilizer	Kg/ha(N)	3692.15	4141.60	6698.50	3951.93(6.7%)
Imputed Labour	N/ha	19335.78	13994.44	11387.11	17923.72
Purchase labour	N/ha	17549.57	20803.67	18780	18192.02
Total Labour	N/ha	36775.10	34649.42	30179.74	36006.13(62%)
Seeds	N/ha	13424.38	11181.56	15658.37	13167.53(23%)
Pesticides	Naire	554.36	494.18	2198.47	643.17(1.1%)
Total Variable Cost	Naire	54445.02	50470.76	54726.08	53768.76
Imputed land Cost	N/ha	2807.45	3306.45	3453.75	2933.56
Rented Land	N/ha	1594.13	1211.67	1730.42	1535.57
Total Land Rent Cost	N/ha	4304.98	4445.45	5184.21	4382.54(7.5%)
Total Fixed Cost	Naire	4304.98	4445.45	5184.21	4382.54
Total Cost	Naire	58750	54916.21	59910.29	58151.30
Root tuber output	Kg/ha	7723.44	7653.44	7867.11	7719.89
Value of output	Naire	131232.91	127145.98	130288.16	130462.33
Gross Margin (GM)	Naire	76787.89	76675.22	75562.08	76693.57
Gross Revenue (GR or NET Revenue (NR)	Naire	72482	72229.77	70377.87	72311.03
Benefit Cost Ratio (BCR)		2.23	2.32	2.17	2.24
Total quantity of labour Return	Man-day/ha	172.39	175.76	144.304	171.287
Total qty labour/ha	Man-day/ha	106.918	105.53	90.92	105.71
Returns to Labour	Naire	718	726	831.08	725

Source: Field Survey, 2008

This table uses the following equations to calculate terms:

Gross Margin (GM) = Total Revenue (TR) – Total Variable Cost (TVC)

NET Profit Margin (NP) = TR—(TVC + TFC)

Benefit Cost Ratio (BCR) =TR/TC

5.2.6 Land Rent

Land rent cost was considered as total fixed cost. The average land rent cost in all areas of production was N4, 382.54 which represents 7.5 percent of the total cost of production. Land rent was highest in Delta Central (4, 614.29/ha) followed by Delta South (N4, 271.43/ha) and

Delta North (N4, 261.90/ha). The land rent for large size farmers was the highest (N5184.21/ha) followed by medium (N4, 445.45/ha) and small (N4, 304.98/ha) farmers in the study area.

5.2.7 Total Production Cost:

Total cost (TC) consists of total variable cost (TVC) and total fixed cost (TFC). Total cost by region is shown in Table 5.1 and by farm size is shown in Table 5.2. The mean production cost for all areas and farm categories was N58,154.36 and this was made up of Variable cost (N53, 771.82) which represents 92.5 percent and total fixed cost (N4, 382.44 per ha) account for 7.5 percent of cassava cultivation cost. Farmers from Delta North region incurred the highest production cost (N60, 494.09 per ha) followed by Delta Central region (N58, 009.45 per ha) and Delta South (N55, 949.42 per ha) farmers. With respect to the farm size categories, the production cost for farmers with large scale land size was the highest (N59, 910.29 per ha) followed by small size (N58, 750 per ha) and was lowest for medium size farmers (N54, 916.21 per ha) (see Table 5.2). This result will be further analysed in Chapter 6.

The total variable cost consists of all imputed and cash purchased variable inputs. On average, the total variable cost for cassava cultivation was N53, 771.82 per ha for all areas, which makes up 92.5 percent of the total cost of production. The highest variable cost was observed at Delta North region (N56, 232.74 per ha) followed by Delta Central region (N53, 395.16 per ha) and Delta South (N51, 677.99 per ha). According to farm categories, the cost for large size farms (N54, 726.08 per ha) was the highest followed by that of small (N54, 445.02 per ha) and finally medium farmers (N50, 470.76 per ha).

In the study area, only land was used as fixed cost. Total fixed cost includes interest on operating capital and land use costs (see section above for how land costs are calculated.

5.3 PROFITABILITY

5.3.1 Gross Return

This is defined as the sum of returns from crop productions. Therefore, gross return from cassava cultivation is the sum of return from the sales of: leaves as vegetables, stem cuttings for planting, for fire wood and the root tuber yield. However, only the value generated from root tuber was used for this study, as it was difficult to accurately value the other components of cassava production. The gross return for all the areas was N16, 464.72/ha. The highest was DN region (N16, 1208.84/ha) followed by DC (N12, 3738.09/ha) and DS (N10, 3402.82/ha) (Table 5.1). With respect to the farm size categories, the gross return for small farmers was highest at N72, 482.91/ha, followed by medium (N72, 229.77/ha) and large (N70, 377.87/ha) (Table 5.2). It could be suggested that the amount of inputs used by small and medium size farms is less, and is easier to improvise using non-financial resources, than that of large farms where such alternative approaches may not be possible. This can mean that small farms have greater potential to enjoy higher profitability margins. However, large farms may have enjoyed economies of scale by the use of more inputs and supervision of hired labour (Eastwood et al. 2006).

5.3.2 Gross Margins:

A gross margin for farming enterprise is its financial output minus its variable costs i.e. the differences between the gross return and total variable costs. Generally, farmers want optimum return over variable cost of production and using gross margin analysis this can be achieved. Gross margin was usually computed on TVC basis. The average gross margin for all areas on the basis of TVC for cassava cultivation was N11, 0884.09/ha. The gross margin was higher in DN region (N10, 4976.09/ha) compared to other regions of DC and DS with N70, 342.93/ha and N51, 724.43/ha, respectively. Table 5.2 shows that the gross margin was maximum in small farm sizes (N76, 787.89/ha) followed by medium (N76, 675.22/ha) and lowest for large farm (N7, 556.08/ha).

5.3.3 NET Returns

Net return is calculated by deducting total costs (both TVC+TFC) from the total revenue or gross return. This is defined as the sum of returns from crop production. The net return from all avenues of cassava cultivation for all areas was N106, 496.55/ha. DN region had the highest net return (N100, 714.19/ha) as compared to DC and DS with net returns of N65, 728.64/ha and N47, 453.43/ha respectively (Table 5.1). With respect to farm size categories, the net return gained by small size farmers was maximum (N76, 787.89/ha), followed by medium (N76, 675.52/ha) and large (N75, 562.08) was the lowest (Table 5.2). In other regions of Nigeria, studies have also shown these patterns. Adeyemo eta l. (2010) reported GM of N105, 775 and profit of N95, 738/ha. Mafimisebi (2008) findings indicate that the GR, GM and NFI/ha were N97, 500.00, N90, 133.20 and N88, 319.81, respectively. According to Chukwuji's (2008) study of combined farm enterprise (cassava, yam, maize and vegetable), profit is higher than sole cassava cultivation with profit of about N21, 514/ha in 2004/2005 and 2005/2006 planting seasons in Delta state. Onu and Edon (2009) reported a gross margin and net returns for improved varieties of N26, 384.62 and N21, 908.87, respectively, and N19, 399.72 and N15, 515.75 respectively for local varieties.

According to Odemenem and Otanwa (2011) in an economic analysis of cassava production in Benue State, Northern Nigeria, of total sample of 116 small scale cassava farmers was used which indicated that 21.55 percent of farmers earned N10,000-N50,000 per year, ; 41.40 percent of farmers earned N50, 000-N100, 000 ; 31.90 percent earned N100,000-N200,000; 0.86 percent earned N200,000-N300,000 and 0.86 percent earned N300,000-N400,000 . These studies seem to demonstrate that farmers in these areas are generally low-income earners, with daily incomes of about N200 (less than USD 2) on average. Cassava production can hereby be considered profitable in all geographical regions of Nigeria, in any enterprise combination but it can also be concluded that Nigerian cassava farmers are low-income earners.

5.3.4 Benefit Cost Ratio

This is the average return to each Naira spent on the cultivation of cassava and is an important criterion for measuring profitability. It is estimated as ratio of gross return or total revenue to total cost per hectare. Table 5.1 shows the undiscounted cost benefit ratio BCR for all areas was 2.83. This implies that every one Naira spent in cassava production will create a return of N2.83. For all the regions, the BCR was highest at DN (2.66) compared to DC (2.1) and DS with the lowest (1.85) (Table 5.1). According to farm sizes; medium farms have the highest BCR of 2.32, compared to 2.23 for small farms and 2.17 for large farms (Table 5.2). It can thus be seen that cassava production is profitable in all areas of Delta State, Nigeria. This finding is supported by other studies (Adeyomu et al. 2010; Ebukiba, 2010) where the research found BCR's of 1.9 and 1.8, respectively. According to Ologunju et al. (2007, cited in Abu et al., 2010:5) as a rule of thumb, any enterprise with benefit cost ratios greater than one, equal to one or less than one indicate profit, break-even or loss respectively. . According to Adegeye and Dittoh (1982), this ratio is one of the concepts of discount method of project evaluation.

Table 5.3 Returns and Profitability of Cassava Production in the area of study

Variable	Region			ALL
	Delta Central	Delta South	Delta North	
Yield (t/ha)	7.39	5.98	9.78	9.78
Cost (kg/N)	16.73	17 .29	16.48	16.83
Total Revenue (TR or GR)(N/ha)	123738.09	103402.85	161208.84	164647.72
Total or Gross Cost (N/ha)				
Total Variable Cost	53395.16	51677.99	56232.75	53771.82
Total Fixed Cost	4614.29	4271.43	4261.90	4382.54
Total Cost of Production	58009.45	55949.42	60494.65	58154.36
Total Average Cost(t/ha)	7849.72	9355.44	6185.55	5946.25
Gross Margin (N/ha)	70342.93	51724.86	104976.09	110884.09
Gross Margin (N/t)	9518.58	8649.64	10733.75	11337.84
Net Return (N/ha)	65728.64	47453.43	100719.19	106496.55
Average Net Return (N/t)	8894.27	7935.36	10298.49	10889.22
Benefit Cost Ratio:				
Total Cost basis	2.1	1.85	2.66	2.83
Total Variable Cost	2.31	2.0	2.87	3.06
Return to Labour (N/Man-day) on Total Profit basis	850	757.82	632.11	863.7
Return to family labour (Profit/ TL Family N/ Man-days/ha)	1496.65	1361.18	1666.29	2491

Source: Field Survey, 2008

5.3.5 Return to Labour:

This is total profit over labour used in production. This is the value of the opportunity cost which could have been used in another production. The average value of the return to labour for all areas of study was N863.6; which is higher than the average wages at between N500-N600. The low rate of wages may be due to the high availability of labour in the area. The highest return to labour was from DC (N850) followed by DS and DN with N757.82 and

N632.11, respectively. According to farm sizes, DN had a significantly higher return to labour figure with N850, while there was little difference between DC and DN - N718 and N726 respectively. Returns to labour are not considered only in financial terms but also as recognition of broader mental and physical benefits of agricultural activities.

The gross margins, profitability and benefit cost ratio are very important in economic analysis, and are used to measure most aspects of cassava production performance. However, these measurements cannot be used to determine the effect of socio-economic, technological, political policy and other factors on agricultural productivity. The efficiency and growth rate measurement would be useful to assess and compliment the economic analysis over time.

5.4 Sensitivity Analysis of Cassava Production

The profitability analysis by region and by farm sizes was presented in Tables 5.1 and 5.2. In this sub-section, a sensitivity analysis is carried out to see how profitability changes with changes in some parameters of inputs and price. The result is presented in Table 5.4, which can be judged as a measure of cassava production efficiency. This measure generates static information with regards to comparative advantages of one alternative to another which policy makers can use. Static analysis fails to show or provide information in regards to the limiting variable inputs. The sensitivity analysis is important in this case since it's a dynamic measure to show changes in resource endowments, market forces, production technology, and government policies, and this is calculated under a set of base line assumptions which are likely to be affected by changes in the values of the key parameters (Baksh, 2003). Assumptions might change or sometimes be unrealistic due to vulnerable market price and variation in the weather pattern, which could lead to a change in the profitability of cassava production. Therefore, it is important to know the degree to which the empirical results are sensitive to any change in the assumed conditions.

As justification for the sensitivity analysis used in this study, Nigeria is a country where prices and price structures change frequently. The changes may have resulted from; differences in the accessibility of areas of production; seasonality; technological changes (improved cassava varieties), among others. Any or all of these factors may affect cassava production. The sensitivity analysis is to test the effects on production as regards to price changes.

The following section will show how technological changes which would have effects on cassava yield and/or market price change would have an effect on the static situation of cassava production which is expected during the production period. It is observed from Table 5.4 that technological change, for example, is proxy to improved cassava cuttings which are assumed to influence output yields, when other variables are held constant. The prices observed during the field survey ranged from about N15.00 per kg to about N30.00 per kg of CRT. Table 5.4 indicates the change of net return considering the original return range from -52 to 1113 percent in cassava production in study areas, if the prices and technology varies within a given period in Nigeria. The maximum positive (1113%) and negative (-52%) change were found with the provision that yield increases by 360 percent and decreases by -25 percent, respectively. The indication is that if yield decreases by 25 percent (i.e. from the average output of 9.78 tonnes per ha to about 7.3 tonnes per ha in Central and North regions) the NR percentage will be negative at N15.00, N16.83 and N20.00, respectively. However, at the highest price of N30.00 CRT per kg, the NR percentage will be positive. Furthermore, when the yield is held constant, the NR percentage will only be negative at the least cost.

Table 5.4 Sensitivity Analysis for Cassava production on Yield, Price and Return

Yield (t/ha)	% Change in Yield	Price (N) Change and % NET Compared											
		15			16.83			20			30		
		TR	NET	%NR	TR	NET	%NR	TR	NET	%NR	TR	NET	%NR
7.3	-25%	109.5	51.3	-51.8	122.9	64.5	-39.2	146.0	87.8	-17.5	182.5	124.3	16.8
9.78	00	146.7	88.6	-16.8	164.6	106.5	00.0	195.6	137.4	29.1	293.4	235.2	120
15	53	225	166.9	56.7	252.5	194.3	82.5	300	241.8	127.0	450.0	391.8	267.9
30	209	450.0	391.9	267.9	504.9	446.7	319.5	600	541.8	408.8	900.0	841.9	690
45	360	675.0	616.8	479.2	757.4	699.2	556.5	900.0	841.9	690.5	1350.0	1291.8	1113

Assumption that total production cost is held constant (N58153.36)
Source: Computed from field survey, 2008

With improved cuttings and assumed high demand creating increases in price, it is reasonable to assume that there will be corresponding increases in NR percentage. Therefore, any measures that will improve on the technology of production like improving varieties of cuttings, increasing the application of fertilizer or pesticides, and the provision of machine planters, harvesters and processing machines would boost the productivity per hectare and lead to increases in the net returns for cassava production. Similar sensitivity analyses was conducted by Nweke (2004), Phillips et al. (2004) who argued that under improved agronomical practices the yield could increase from 7.7tonnes per ha in the Delta State to a national average of 10-15tonnes per ha, which is an increase of 20 percent, (FAOSTAT, 2010; Arhabor et al. 2007). This may suggest that as technology improves in terms of yield, profitability increases and as demand increases, with a favourable price, cassava farmers will increase their profitability per hectare and this may attract more people to farming. Revenue from cassava enterprises may be used in other areas of the economy to boost growth and economic development.

5.5 Chapter Summary

This chapter was designed to assess the economic performance of cassava farms in Delta State, Nigeria. The gross margin, net returns and profitability methods were used to determine the economics of cassava production at farm level, classified by three regional areas and farm sizes.

Results revealed that the major cost for production for cassava is the cost of labour (62 percent) followed by seeds (23 percent), while the cost of land rent, fertilizer and pesticide are 7.5; 6.7; and 1.1 percent respectively. The total gross margin in all areas is N110, 884.09. Cassava production is profitable in all the regions of case study areas with BCR for DC (2.1); DS (1.82) and DN (2.66) with an average BCR for all areas of 2.83). The gross margins for farm size categories are N76, 787.89, N76, 675.22 and N75, 562.08 for small, medium and large farms, respectively. For the small farm category BCR is (2.23); medium farms (2.32) and large farms (2.17). The main conclusion from this analysis is that cassava production is profitable in all regions and farm size categories, based on the net return and undiscounted BCR. Sensitivity analysis suggested that there is great opportunity for expansion and to increase the yield and net return if provided with improved technology, markets and better agricultural policy environments.

No major study has before been carried out to determine the productivity of cassava in the regions of the study area. It seems it is not the large farms that are the most profitable but the small size farms are which is contrary to expectations. The next chapter will now address the issue of productivity performance more formally by applying Data Envelopment Analysis to estimate technical, cost and allocative efficiencies and identifying their determinants.

CHAPTER 6

Productivity and Economic Efficiency Analysis of Cassava Production

6.1 Introduction

The previous Chapters 4 and 5 have discussed the physical production and economics of cassava production in the study areas of Delta State, Nigeria. The main conclusions that emerged from the previous two chapters are that yields of cassava root tuber are quite low in general in the area; several socio-economic and physical attributes significantly affect productivity; and producing cassava is profitable for all farm size categories as well as in all the regions. Yield could be increased and profits could be improved through efficient use of inputs. Determination of the factors that affect cassava productivity and efficiency could be one of the most important steps to increase agricultural productivity.

As discussed in Chapter 2, efficiency is one of the most important aspects of productivity and growth especially in developing agricultural economies, where farm inputs and resources are limited and opportunity for adopting and applying technology is being hampered by education level, lack of access to markets and credit provisions and so on.

The performance of cassava production was evaluated in terms of the productivity and efficiency of farmers. Production efficiency means attainment of a production goal with minimal or no waste (Ajibefun and Daramola, 2003). Efficiency is viewed as the relative performance of processes used in transforming given inputs into outputs (Asogwa et al., 2011; Javed, 2009; Khai et al., 2008; Ohajianya and Onyeweaku, 2001). According to Khai et al (2008), efficiency could increase output without requiring additional conventional inputs or the use of new technology. Gains could be obtained by improving performance in cassava production using present technologies. An important policy implication that arises from significant levels of inefficiency is that it might be more cost effective to achieve short-term improvements in cassava output, and thus income, by concentrating on improving efficiency rather than introducing new technology (Belbase and Grabowski, 1985; Shapiro and Muller, 1977). Estimation of efficiency is important. Firstly, it is a success indicator or performance measure by which production units are evaluated, and the measurement of causes of inefficiency makes it possible to explore the sources of efficiency and remove those causes, help to improve productivity through input reallocation or cost minimization. Furthermore, identification of sources of inefficiency is essential for the government and private sector to formulate policies. Lastly, the aim here is to investigate levels of productivity and efficiency in relation to farm size, as well as the relationship of profitability to these factors in Nigerian cassava production. This chapter will also consider strategies designed to improve performance.

The chapter entertains the hypothesis that productivity, efficiency and profitability may vary among farm size groups. This would be of interest to policy makers so as to assess how to improve efficiency. This chapter focuses on the presentation and discussion of the results obtained through applying DEA analysis on efficiency levels of farmers. Next, Tobit's regression analysis was conducted to identify the determinants of efficiency.

6.2 Data used for DEA analysis

Data was collected from 315 cassava farmers in three geo-political zones with distinct ecological zones of Delta state, Nigeria: tropical rainforest in the Central area, mangrove forest to the South and the range from rainforest to guinea savannah in the North. The annual rainfall ranges between 1500 and 2000mm. Other inputs used in the analysis are detailed in Section 3.9.

The DEA input-output oriented model of Coelli et al. (2002) was used for the analysis as shown in Equation 3.2 in Chapter 3, and was explained in Chapter 2. Output in this study is aggregated into one variable using five inputs and their relative prices, namely, farm size, fertilizer, cuttings (seeds), labour, pesticides, land rent, fertilizer price, pesticide price, seed price, labour wage and cassava price. Table 6.1 indicates a summary of the input and output, as described below.

For TE specification: variables used

Output (Y) represents mean total CRT/kg

Farm size (X_1) represents mean of farm size/ha

Labour (X_2) represents total mean labour/man-days

Fertilizer (X_3) represents mean total of fertilizer

Seed (X_4) represents total mean of cassava cuttings/kg

Pesticides (X_5) represents total mean of pesticides litre/ha

For allocative efficiency specification: prices of input variables are added as well:

Land rent (w_1) represents mean rent per ha in Naira (N)

Labour wage (w_2) represent mean labour wage per day

Fertilizer Price (w_3) represents mean price of fertilizer per kg (N/kg)

Seed Prices (w_4) represents mean price of seed per kg (N/kg)

Pesticides price (w_5) represents mean price of pesticides per litre (N)

Cassava price (P_1) represents mean price of CRT per kg (N/man-days)

e_i = efficiency scores

Specification of socio-economic variables affecting efficiency:

Farmers years is represented by (Z_1)

Farmer Farming experience is represented by (Z_2)

Household numbers is represented by (Z_3)

Education is represented by (Z_4)

Cassava crop variety (dummy) is represented by (Z_5)

Gender is represented by (Z_6)

Extension contacts (dummy) is represented by (Z_7)

Farm size is represented by farm size (Z_8)

E_z = efficiency scores

$E_{z'}$ = error term limiting production

The numerical form of the Eq (chapter 3) for farmer 1 in actual values is given by:

Technical efficiency of each Farming DMUs are given below in Table 6.1 for solving a numerical examples each farmer.

Table 6.1 Cassava farmer inputs and output efficiency numerical Table

DMU	X_1	X_2	X_3	X_4	X_5	W_1	W_2	W_3	W_4	W_5	Y
1	2.4	183.54	300	80	0	3500	580	120	250	1616	20000
2	1.6	97.77	350	70	0	3500	500	120	350	1616	20000
3	1.6	146.95	0	50	0	4000	580	143	350	1616	3500
4	2.0	189.09	0	80	0	3500	580	143	350	1616	18000
315	10.0	884.72	500	200	0	3500	600	150	300	1616	64000

$$Min_{\theta,\lambda} \quad \theta = \theta_0 = 2000kg$$

$$s.t. \ -20000 + 20000\lambda_1 + 20000\lambda_2 + 3500\lambda_{3,} + \ldots\ldots.. + 64000\lambda_{315} \geq 0$$

$$2.4\theta_0 - 2.4\lambda_1 - 1.6\lambda_2 - 1.6\lambda_3 - \ldots\ldots.. - 10\lambda_{315} \geq 0$$

$$300\theta_0 - 300\lambda_1 - 350\lambda_2 - 0\lambda_3 - \ldots\ldots.. - 10\lambda_{315} \geq 0$$

$$183.54\theta_0 - 183.54\lambda_1 - 97.7\lambda_2 - 196.9\lambda_3 - \ldots\ldots.. - 884.7\lambda_{315} \geq 0$$

$$80\theta_0 - 80\lambda_1 - 70\lambda_2 - 50\lambda_3 - \ldots\ldots.. - 200\lambda_{315} \geq 0$$

$$0\theta_0 - 0\lambda_1 - 0\lambda_2 - 0\lambda_3 - \ldots\ldots.. - 12\lambda_{315} \geq 0$$

$$\lambda_1 \geq 0, \lambda_2 \geq 0, \lambda_3 \geq 0, - \ldots\ldots.. -, \lambda_{315} \geq 0$$

The solving for the allocative efficiency of each farmesrs are numeriacally expressed as follows:

$$Min \ \lambda, x_i^* \ \ 3500x_1^* + 120x_2^* + 580x_3^* + 250x_4^* + 1616x_5^*$$

$$s.t. \ -20000 + 20000\lambda_1 + 20000\lambda_2 + 3500\lambda_{3,} + \ldots\ldots\ldots + 64000\lambda_{315} \geq 0$$

$$x_1^* - 2.4\lambda_1 - 1.6\lambda_2 - 1.6\lambda_3 - \ldots\ldots\ldots. - 10\lambda_{315} \geq 0$$

$$x_2^* - 300\lambda_1 - 350\lambda_2 - 0\lambda_3 - \ldots\ldots\ldots. - 500\lambda_{315} \geq 0$$

$$x_3^* - 183.54\lambda_1 - 97.7\lambda_2 - 146.9\lambda_3 - \ldots\ldots\ldots. - 884.7\lambda_{315} \geq 0$$

$$x_4^* - 80\lambda_1 - 70\lambda_2 - 50\lambda_3 - \ldots\ldots\ldots. - 200\lambda_{315} \geq 0$$

$x_5^* - 0\ \lambda_1 - 0\ \lambda_2 - 0\ \lambda_3\ - ……….\ - 0\ \lambda_{315} \geq 0$

$\lambda_1 \geq 0,\ \lambda_2 \geq 0,\ \lambda_3 \geq 0,\ …………,\ \lambda_{315} \geq 0$

This is also standard LP calculations that can be solved for nth times (Khezrimotlagh et al., 2012; Cooper et al., 2011; O'Donnell, 2011; Gavirneni, 2006). This was solved by using LP computer software DEAP version 2.1 deveoped by Coelli (1996).

The input quantities are similar across the regions, with the exception of labour which varies slightly and fertiliser, which is very low in all the regions. Input prices are also similar across the regions and were regressed using Equation 3.2 to determine the technical efficiency, allocative efficiency and cost efficiency of DMU of each farm, which were all incorporated into BBC model (for dual LP for cassava farmers) using computer programming of DEAP 2.1 in the first stage regression.

Farm specific estimates of the technical efficiency, allocative efficiency and cost efficiency are used as a dependent variable and are regressed on the explanatory variables which includes education level, farming experience, gender, actual cassava area cultivated, number in household, farmers age and extension contacts. Dummy variables are used for numbers of extension contacts. The Tobit regression used to estimate the general form is given in Equation 3.4, Section 3.10.

The results of the DEA method described above used the inputs and outputs reported in Table 6.2, to measure technical, allocative and cost efficiencies. The mean cassava output of farmers in study area is 7710.89kg, mean age is about 42, average numbers of years of formal education among farmers was 7 years. The mean farm size was 2.1ha, with a range between 0.8 ha and 12 ha. The average mean amount of fertilizer used by cassava farmers was 40kg/ha and the mean quantity of cassava cuttings was 39kg/ha. Labour was shown to have a mean of 171 man-days. The prices of land rent, fertilizer, pesticides, seeds and cassava are N4, 382.54/ha, N5, 271.63/ha, N643.17, N13,

Table 6.2 Descriptive Statistics of Farm Variables

Variables	Cassava			
	Mean	STD Deviation	Min	Max
Outputs and Inputs:				
Cassava output(kg)	7719.89	4079.30	2250.00	25000.00
Farm Size (ha)	2.0547	11.58	.08	12.00
Fertilizer (kg)	39.67	60.00	0.00	300.00
Seeds (bundles)	39.16	24.88	4.38	312.50
Labour (man-days)	171.29	279.75	30.0	2746.00
Pesticides (Litres/N)	.41	1.20	0.00	4.00
Land Rent (N)	4382.54	760.60	0.00	7500.00
Fertilizer price(N)	5271.63	8402.87	0.00	48000.00
Pesticides price	643.17	1734.82	0.00	10400.00
Seeds Price	13167.53	6806.74	0.00	7500.00
Cassava price (N)	130462.33	74883.12	9000.00	672000.00
Farm-specific variables:				
Education (years)	7.124	4.88	0 .00	25.00
Farm experience(years)	2.05	1.71	0.08	12.00
Gender	0.51	.50	0.00	1.00
Actual Cassava Area (ha)	1.68	1.31	0.08	10.00
Crop Varieties (dummy)	0.73	0.45	0.00	1.00
Household members (numbers)	5.80	3.21	0.00	18.00
Extension Services (dummy)	0.35	0.48	0.00	1.00
Farmer Age (years)	41.69	12.41	17.00	80.00
Credits Provisions (Naira)	1746.03	13147.00	0.00	150000.00

Source: Field Survey, 2008

167.53 and N13, 90462.33, respectively. The mean age of farmers was 42, and the mean number of persons in a household was 6. The dummy for seed variety (improve seed=1 and local variety=0), access to credit=1, no access=0. Gender, female=0 and male=1 and for extension (farmers with contact=1, no contact=0) as indicated in Chapter 4.

Table 6.3 shows the results of the input oriented DEA analysis of cassava farmers in Delta State. The key results indicate that mean technical efficient (TE) score is very low, estimated at 0.40 for cassava root tuber production. This suggests that the average farm is producing only about two thirds of the potential output level, which is seriously

Table 6.3 Ranges of Technical, Allocative, and Cost Efficiency

Level	TE		AE		CE	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
<50%	252	80.0	31	9.8	289	91.7
50-59%	21	6.7	37	11.7	10	3.2
60-69%	17	5.4	50	15.9	7	2.2
70-79%	7	2.2	72	22.9	1	0.3
80-89%	1	0.3	85	27.0	1	0.3
90-100%	17	5.4	40	9.8	7	2.2
Total DMUs	315	100	315	100	315	100
Mean	0.40		0.73		.29	
Std. Dev.	0.20		0.17		0.16	
Minimum	.08		0.3		0.01	
Maximum	1.00		1.00		1.00	

Source: Author’s calculation, 2013

discouraging. And about 5.4 percent of the samples of cassava farms were technically efficient while the remaining cassava farms were technically inefficient, with only 17 farms at TE frontier. In addition, the allocative efficiency (AE) was calculated to have an average of 0.73, meaning that about only 9.8 percent of the cassava farmers were fully efficient. 40 farms were at the frontier and the rest were seen to be operating below the allocative efficiency frontier as shown in Table 6.2. The mean AE score indicates that these farmers could reduce cost by about 23 percent, by taking more notice of relative input prices when selecting input quantities. Furthermore, if technical and allocative efficiencies are combined to form costs efficiency measures, DEA output further revealed that about 2.2 percent of the farms were both technically and allocatively efficient, with seven farms defining the cost frontier. The causes of inefficiency may be due to the inefficient use of farm inputs or may result from farms not taking advantages of economies of scale. Cost efficiency was about 0.29, which means a huge 71 percent of the costs can be eliminated by removing inefficiency in resource allocation and producing at the lowest possible cost combinations. Sources of inefficiency are mainly due to improper use of input, lack of appropriate use of technology and bad management practices.

Table 6.3 also shows the frequency distribution of technical, allocative and economic efficiency of cassava farmers. There are variations in the level of efficiency among the farmers ranging from .20 - 1.00, with a mean of 0.40. However, 20 percent of the farmers had technical efficiency of 40 percent and above and only very few farmers; less than 6 percent, were operating close to and/or at the efficiency frontiers. This implies that efficiency is very low; there is scope to increase output by 60 percent through better management and technical practices, and the efficient use of inputs at a reducing cost. Such changes could perhaps be made by emulating those farmers at the efficiency frontier. This distribution correlates with the findings of Javed et al. (2009); Ajibefun, (2008); and Nchare, (2007) who all conclude that small scale farmers are inefficient. More than 91.2 percent of the farmers would realize about 27 percent costs saving if they obtained a level of output equal to the most efficient farmer in the sample. The TE varied among regions and was higher in large farms than that of small and medium farms, as shown in Table 7. This correlates with the findings of Rahman (2002) and Perdomo and Mendieta (2007).

This finding may be used to make suggestions for policy formulation that will encourage farmers to cultivate large areas of land and join resource bases together in order to improve efficiency. On the basis of this analysis, policymakers may also encourage the use of machinery instead of intensive labour.

6.3 Factors Explaining Efficiencies

The analysis of determinants of inputs use, and the resulting effect on efficiency, is very useful as a basis for informing agricultural policy on what should be done in order for the inefficient farms to emulate the operative practice of the most productive and efficient farms in order to improve agricultural productivity (Eyitayo et al. 2011). In order to identify the key determinants of inefficiency in input use, technical, allocative and costs efficiency scores are regressed against a set of farm specific demographic and socio-economic variables as shown in Table 6.2.

The results thus far indicate that efficiency scores vary substantially across farms and that the average level of inefficiency is significant. To explain some of these variations, the efficiency scores were regressed on the farm-level characteristics, using a Tobit model, since the efficiencies vary from zero to unity. The Tobit results are listed in Table 6.3.

The results of the determinants of the technical efficiency estimation indicate that farming experience and extension contacts have significant negative effects on technical efficiency. This suggests that with long years of farming experience, farmers may find it difficult to adjust to the use and application of new technology which new farmers may adopt easily. It is notable that those farming in the study area with many years of farming experience use the most traditional, and in some cases obsolete, methods of farming and species of livestock or crops which do not encourage high output. However, this is contrary to the prior expectation that increasing farming experience would increase output. Or it could be said that, the coefficient of farming experience variable was

Tables 6.4 Factors Explaining Efficiency: A Tobit regression

	TE	**AE**	**CE**
Constant	**5**.3148 (0.000)***	7.0195 (0.000)***	3.3493 (0.000)***
Education	-0.0035 (0.110)	-0.0079 (0.680)	-0.0021 (0.294)
Family size	-0.006 (0.764)	0.0064 (0.698)	-0.0003 (0.854)
Age	0.0016 (0.213)	0.0010 (0.344)	0.0025 (0.027)**
Experience	-0.0035 (0.070)*	-0.0022 (0.055)**	-0.0039 (0.001)***
Extension contact	-0.5248 (0.059)*	0.0862 (0.000)***	-0.001 (0.996)
Crop variety	-0.2435 (0.306)	-0.0197 (0.337)	-0.0439 (0.056)*
Gender	-0.0107 (0.607)	0.0093 (0.605)	-0.0078 (0.672)
Farm size	-0.0065 (0.297)	-0.0272 (0.000)***	-0.0075 (0.177)
Log-likelihood	99.0434	145.256	136.981

Note * = significant at 10per cent level ($p<0.10$); ** = significant at 5 per cent level ($p<0.05$); ***= significant at 1 per cent level ($p<0.01$)

negative was both surprising and significant ($P<0.05$). This suggests that cassava farmers with more year of farming experience tend to be less efficient in cassava production, and this is supported by the study of Chukwuji et al. (2006). However, this conclusion is contrary to the findings of Amaza and Maurice (2005) for rice production in Northern Nigeria and that the findings of Shehu et al. (2007) in their study of the efficiency of small-scale rainfed upland rice production in Nigeria. Extension contacts or visit will not result in increases in productivity if farmers only partially applied their suggestions, as they often either lacks capital to purchase improved inputs or ignore the advice. This result is similar to those of Ejibefun (2008) and Seyoum et al., (1998). According to Aye and Mungatana (2011) and Adebayo and Idowu (2000), extension services are provided by the Nigerian government and are supported by the World Bank. However, on withdrawal of counterpart funding by the World Bank; extension services provision becomes inefficient and not effective.

The quality of extension officer's training and the overall performances of extension services are on the decline. This has affected the efficiencies of cassava farmers, and this is similar to the findings of other studies with reference to gender and experience (Ognniyi and Oladejo, 2011); age, extension contacts and education level (Javed et al. 2009). Or it could be said that the estimated coefficient for extension visits had a negative sign for both technical and allocative efficiencies, which is significant: TE=$p<0.10$, AE=$p<0.01$. The negative sign of efficiency implies that extension visits contributed negatively to technical efficiency.

The above findings indicate that extension contacts were very important in determining the TE in the study area. This is contrary to the findings of Bifarin, (2008) and Bora-Ureta (1994). Farmers experience has a negative influence on allocative efficiency, but extension contacts have a significant positive influence on allocative efficiency. This suggests that policy makers could invest to improve the provision of managerial support and dissemination of information to smallholder cassava farmers via extension programs. Additionally, comprehensive involvement by stakeholders or the private sector could lead to alternative funding of extension services; forms of non-formal education and cheap and efficient supplies of farm inputs, which would be likely to lead to higher levels of efficiency. Farmer's age has positive influence on cost efficiency and is significant at 5 percent, i.e. the older the farmer the more effective they are in maintaining low costs of inputs. TE for age is positive, but not significant. This does not agree with a prior expectation. As for a farmer's age, there is the likelihood that productivity will decrease due to declining strength (Shehu et al. 2007). However, this finding could be attributed to the fact that most of the cassava farmers in the study area started farming at an early age. It was noted that experience and improved varieties have a negative influence on cost efficiency.

In addition, the coefficient for the years in education was negative and not significant, which implies that the higher the level of education, the less committed a person or household may be to farming activities, due to involvement in off-farm activities such as business. This may mean that such farmers rely on unsupervised, hired labour (Wage et al., 1996). This may also suggest that due to the generally small amounts of formal education observed throughout the sample, that TE should increase with higher levels of education. This is assumed since education and the adoption of new technology were expected to be positively correlated; however lack of capital may have hampered this creating in any change in practice. The coefficient of number of members of the household has a negative sign but was not significant. This implies that increases in household size may lead to a reduction in efficiency. Lastly the coefficient of farm size is negative and could be as a result of poor farm management and poor soil fertility resulting from lack of land improvement. Crop variety and gender were negative and not significant, implying that they do not affect efficiency in the study area.

The figures in Table 6.4 cannot reveal the actual magnitude of these effects. Therefore this study presents the marginal effects of the factors on efficiency scores in Table 6.5.

6.3.1 Marginal effects of TE, AE and CE of Cassava Production

Marginal effects often provide a good approximation to the amount of change in Y that will be produced by a unit change in $X_{k.}$ Marginal effects can also be called, partial effect, and this often measure, the effect on the conditional mean of Y of a change in one of the regressors $X_{k.}$ In linear regression model, the marginal effect equals the relevant slope (Hristovska et al 2013). The marginal effects measure the expected instantaneous change in the dependent variable as a function in certain explanatory variable in cassava production firm while keeping all other covariates constant. The marginal effect could also be said to measure the relative impact of an estimated parameter. This similar to elasticity except instead of estimating the effect of a proportional change of independent variable X_k on the dependent variable Y, it measure the effect of 'one unit' change in X_k on the dependant variable Y. STATA V 10 software is used for this regression.

The results are largely similar for level variables but changes for the dummy variables. It is clear from the results that less experienced farmers are more efficient which is very surprising. However, on the other hand, older farmers are more cost efficient. Extension contacts have a negative effect on technical efficiency but a positive influence on allocative efficiency. The marginal effects are generally small for all the significant variables. As indicated from Table 6.5, coefficient of farm size was 0.007 and thus was non–significant, indicating that an increase in farm size of 0.7 percent would produce and increase in yield of 1 percent. In addition, farming experience was -0.00035 significant at 10 percent. This implies that the longer the years in farming output would decrease in output by .004 percent unless training compliments experience with the appropriate technology, output will decline. Similarly, extension contacts had a coefficient of -0.0525

Table 6.5 Tobit Elasticity (Maginal Effects) of Determinants of Efficiency in Cassava

Variables	TE	AE	CE
Education	-0.0035	-0.0008	-0.0021
Family size	-0.0006	0.0006	-0.0003
Age	0.0016	0.0010	0.0025**
Experience	-0.0035*	-0.0022**	-0.0039***
Extension contacts	-0.0525*	0.0861***	-0.0012
Crop variety	-0.0243	-0.0197	-0.0439*
Farm size	0.007	-00272***	-0.0075
Gender	-0.0107	0.0093	0.0078

Note: The significance of the elasticity is based on the standard error of the Tobit regression coefficients. *** = significant at 1 percent level (p<0.01); ** = significant at 5 percent level (p<0.05); * = significant at 10 percent level (p<0.10) Marginal effects is dy/dx is for discrete change of dummy variable from 0 to 1
Source: Author's calculation, 2013

which was significant at 5 percent level, implying that further extension contacts without easy access to capital and thereby improve the use of inputs; output will decline by 5.3

percent. Farm size, education level, family size, crop variety and gender are not significant, so they cannot influence the marginal effects of cassava output in the study area.

6.4 Regional variation in efficiency levels

Table 6.5 presents the efficiency estimates by regions. The mean efficiencies vary significantly among all the regions. The technical efficiency level is highest in Delta North (0.50) followed by Delta Central (0.38) and Delta South (0.31). On the other hand, allocative efficiency is highest in Delta South (0.79) followed by Delta Central (0.73) and Delta North (0.67). Cost efficiencies were highest in Delta North (0.33) followed by Delta Central (0.29) and Delta South (0.25). This suggests the over use of some farming inputs like family labour, but the underutilization of fertilizer, pesticides and other inputs (see Chapter 4).

Region and Farm Size Efficiency

Table 6.6 Cross-sectional region Efficiency

	Delta Central			Delta South			Delta North			Total Mean		
	TE	AE	CE	TE	AE	CE	TE	AE	CE	TE	AE	CE
Mean	0.3859	0.7291	0.2885	0.3117	0.7877	0.2454	0.5007	0.6700	0.3261	0.3994	0.7289	0.2866
Std Dev.	0.1859	0.1387	0.1831	0.1027	0.1301	0.9551	0.2333	0.2103	0.1901	0.1976	0.1701	0.1649
Minimum	0.145	0.450	0.096	0.1720	0.1360	0.057	0.077	0.033	0.110	0.077	0.033	0.110
Maximum	1.000	1.000	1.000	0.707	0.981	0.646	1.000	1.000	1.000	1.000	1.000	1.000

Note: ANOVAs test for Cross Region-wise efficiency.
Significant: TE = .000; AE = .000; CE =.002

Table 6.7 Farm Size Efficiency

	Small			Medium			Large			Total Mean		
	TE	AE	CE	TE	AE	CE	TE	AE	CE	TE	AE	CE
Mean	0.4026	0.7563	0.2980	0.3476	0.6319	0.2186	0.5090	0.6630	0.3452	0.3994	0.7289	0.2866
Std Dev	0.1837	0.1608	0.1487	0.1665	0.1331	0.1353	0.3565	0.2521	0.3233	0.1976	0.1010	0.1645
Minimum	0.143	0.033	0.110	0.172	0.172	0.113	0.077	0.110	0.057	0.077	0.033	0.110
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Note: ANOVAs test for Farm size efficiency,
Significant: TE = .000; AE = .000; CE = .001

6.5 Efficiency Levels by Farm Size Groups

Table 6.7 shows the estimated empirical results of efficiency scores by farm size categories. These are estimated separately for each of the farm size categories. That means small farms for all three regions were estimated in one program and similar for the other two categories. The mean technical efficiency levels of large farms are highest (0.50) followed by small farms (0.40) and medium farms (0.35). The allocative efficiency also vary across farm size categories (Small farm: 0.76; Medium farm: 0.64 and Large farm: 0.73). Small farmers were more allocatively efficient when compared to large and medium farms, supporting the findings of Monirruzzaman et al (2009); (2007); Perdomo and Medieta (2007); and Murthy et al. (2009). The mean level of economic or cost efficiency is also varied. The highest is for large farms (0.32) followed by small farms (0.30) and medium farms (0.22). Large scale farmers are more economically efficient when compared to small and medium farmers

In order to comprehensively examine the hypothesis that large scale farms are more efficient overall, this section will determine if there is a significant relationship between farm size and productivity efficiency according to technical, allocative and cost efficiency categories in Table 6.7. Farm sizes are group into three categories as follows:

<2.5 = small farm size

2.6- 4.6= medium size

>4.6 = large size

The relationship between farm sizes categories and efficiency as hypothezied, in Chapter one, were analysed using ANOVA test in SPSS. This is to determine if there is any significant difference in cassava production efficiency increases with farm size. Result of ANOVA test is given in Table 6.8 below.

Table 6.8 Farm Category Anova Table

	Sum of squares	df	Mean square	F	Sig
TE estimate					
Between groups	0.379	2	0.189	4.970	0.008
Within groups	11.881	312	0.038		
Total	12.258	314			
AE estimate					
Between groups	0.781	2	0.391	14.674	.000
Within groups	8.304	312	0.0227		
Total	9.085	314			
CE estimate					
Between groups	0.364	2	0.182	0.946	.001
Within groups	8.173	312	0.026		
Total	8.537	314			

Table 6.8 confirms that there is a significant difference in efficiency scores by farm size categories. In case of TE, there is a positive relationship between farm size and TE (Table 6.7). In case of AE, there is a negative relationship between farm size and AE, as small farms are more allocatively efficient (Table 6.7). With respect to CE, there is a positive relationship between farm size and CE, as large farms are more cost efficient (Table 6.7). This means that large farmers can derive economies of scale because they are more technically efficient as they can use all necessary inputs required at the right time. But small farmers are allocatively efficient because they are able to use inputs at minimal costs, but may be using too much of some. However, the overall results from the ANOVA test above support the hypothesized positive farm size-efficiency relationship in Chapter one.

6.7 Chapter Summary

The present chapter was designed to assess the production performance of cassava farmers in Delta state of Nigeria. One of the methods of assessing efficiency is to determine the productivity and its determinants at the farm levels. This was done by computing technical, allocative and economic efficiency and also by investigating factors explaining variations in technical, allocative and economic inefficiency of cassava production. Using detailed data from the field survey in 2008, the DEA method has been used to estimate technical, allocative and economic efficiency of cassava farmers. Technical, allocative and economic efficiency scores were regressed on the socio-economic and farm specific variables to identify sources of efficiency by the Tobit regression model.

Results indicate a mean technical efficiency of 40 percent, mean allocative efficiency of 72 percent and 29 percent for economic efficiency. Findings of the study show that the sample farms operated at a very low efficiency level. They could reduce their inputs by 60 percent and cost of production by 28 percent without reducing the level of output, but using the same technology and management practices. Results indicate that large farms were more technically efficient than small and medium farms, while small farms are more allocatively efficient than medium and large farms. Large farms are also cost efficient as compared with small and medium farms. On the other hand economic efficiency varies slightly among the different farm size categories and also between regions. When considering regions, Delta North is more technically efficient than Delta Central and Delta South. Delta South is more allocatively efficient than Delta Central and Delta North.

Second-stage regression attempted to explain variations in efficiencies between farms and revealed that the impact of the number of contacts with extension agents and experience was negative. Farmers with more farming years of experience and farm size were found to have a negative coefficient. Increases in farming years and farm size without improving or adapting to new technology will reduce allocative efficiency, whereas extension contacts has a positive influence on allocative efficiency of cassava farms.

The farm specific technical efficiency distributing range level reveals that only very few of the farms reached the frontier thresholds. This concluded that within the context of efficient agricultural production, production could be increased by 60 percent using available inputs and technology; i.e. farmers with more contacts with extension agents, without an accompanying increase in the use of inputs, will have negative influence on the output. Farmers with long years of farming experience tend not to adopt new technologies and stick to usage traditional methods of farming, and it is noted that this reduces farm efficiency while new farmers are adapt easily to new technology which will improve efficiency. The obvious policy implication from these conclusions is to increase funding to extension services and encourage large scale farming. This could be achieved by land reform policies aimed at providing easy access to land, so that small farmers are able to expand their enterprises and eventually increase their levels of technical efficiency.

CHAPTER 7

PROCESSING OF CASSAVA ROOT TUBER INTO GARI

7.1 Introduction

The previous chapter examined the economic efficiency of cassava production in Delta state, Nigeria. Analysis from the results indicates that farms in the study areas are operating at a very low efficiency level and that there is room for improvements in the productivity of cassava. This chapter seeks to explore ways in which productivity of cassava could be improved.

The productivity of cassava root tuber is greatly affected by seasonal price changes and this defines the prospect of production in the next planting season. The short shelf life of cassava root, which starts to deteriorate two or three days after harvest, also affects the price and the potential of productive capacity. Chukwuji et al. (2007) claimed that proper processing and preservation of harvested produce reduces post-harvest losses and thus helps to increase the shelf life and offset shortages in food supplies. The processing of cassava roots prior to consumption is also necessary, not only due to the problems of storage, but also because of its cyanide content. Some authors (see for example, Ndaliman, 2008; IITA, 2005 and Nweke, 2003) assert that there is a need to process cassava roots within 24 - 48 hours after harvesting due to its toxicity and perishability.

As discussed in Chapter Two, there is therefore a need to add value to and diversify the usage of cassava, increase the storage periods, stabilise price of cassava root tubers and to use processing as a link between production and market. This chapter presents the ways in which cassava production in the study area could be more effective and more efficiently used to encourage production through a value added process. It will be argued that cassava root tuber can be processed into various forms which can then be used as food, industrial raw material and livestock feeds (Kaine, 2011; Wilhemina et al, 2009; Nweke, 2003).

Some of the major products in which cassava root tuber is used in the study area are *gari*, starch, *fufu*, fresh tapioca and dried tapioca. Other uses are cassava chips, cassava crumbs, pellets and cassava flour. Among these, *gari* processing was done by 94 percent of the total farm respondents as a means to add value to cassava. *Gari* is a roasted granule, widely accepted in both rural and urban areas and is the most important cassava derivative in Nigeria and most parts of Africa (Odebode, 2008; Phillips and Taylor, 2008; and Asogwa, 2006).

This chapter section seeks to examine the costs and returns of processing cassava root tuber into *gari* in the Delta State, Nigeria. The total numbers of 278 farm processors were interviewed using structured questionnaires in the same study areas as the main respondents of this study. Analysis of variance as used in Section 6.5 was used to show the relationship between input and output as significant or not, and in some cases between or within the groups of input variables that show the sources of difference in output.

7.2 Inputs and Output in *Gari* Processing

This section discusses the level of inputs used and outputs produced from processing cassava root tubers into *gari*. The section also examines the *gari* output in relation to some socio-economic attributes of the farmers.

7.2.1 Farm Size

It is asserted that access to farm land, provisions of improved technology, availability of labour and other inputs would improve the processing of cassava root tubers, as discussed in

Chapter 2. Land is an important factor used in the processing of cassava to gari and other associated products. The land is used for the cultivation of raw materials (root tubers), processing site, office building and accommodation for workers and provision for storage facilities. The total mean land size of the average gari processors is 2.06 ha, with a standard deviation of 1.72 where size ranges from 0.08 ha to 12 ha. Table 7.1 below, is the summary of descriptive statistic of the inputs and output in gari processing.

Table 7.1 Inputs use rate and output produced per ha in *Gari* processing

Variables	Measure	Mean	Standard Div
OUTPUTS			
Gari	kg/ha	4671.49	6564.26
Roots	kg/ha	12137.35	11498.98
INPUTS			
Farm Size	ha	2.06	1.72
Washing	Man-days/ha	14.55	22.06
Peelings	Man-days/ha	26.40	38.58
Grating	Man-days/ha	23.21	38.66
Fermentation	Man-days/ha	2.73	12.08
Drying	Man-days/ha	13.62	22.70
Frying	Man-days/ha	25.74	36.50
Firewood	Naire/kg	2810.16	1492.200
Others	Naire/kg	4419.68	1953.200

Source: Field Survey, 2008

7.2.2 Raw Materials (Root Tubers)

One of the most important inputs that need to be considered for *gari* processing is the availability of cassava root tubers. Most cassava processors in the area of study are either farmers or marketers of root tubers. Processing of *gari* is generally performed close to sources of cassava root tubers, in order to reduce or avoid the high transportation costs for a bulky product like cassava root tuber. The average quantity of root tuber from one hectare of land is 12,137.35 kg per ha, with a mean standard deviation of 11,498.98 as shown in Table 7.1. The quantity of *gari* processed is estimated at 4,671.49 kg/ha with a standard deviation of 6,564.26, so there is a conversion ratio of 2.6kg of CRT to 1kg of *gari*. There is large variation between individual farms, which varies according to the amount and availability of CRT, market conditions, financial situation of processors and across regions and sizes of *gari* processors.

7.2.3 Labour

Processing of *gari* involves very tedious and complex processes that are carried out both manually and semi-manually. These processing activities may be grouped as peeling, washing, grating, fermentation, drying of the pulp paste, sieving and frying or roasting the pulp into fine yellow or white granules. The total mean labour used to process 4,671.49 kg per ha of *gari* in the study area was 106.25 man-days. The breakdown of total labour man-days used in *gari* processing activities shows that peeling and frying have the highest demands on labour, and these operations were carried out manually, while grating, fermentation and drying were done semi-manually (with the aid of a petrol or electric power machine for grating) (Table 7.1). The quantity of gari produced and the amount of labour required depends on the availability of cassava root tubers, family labour and hired labour, and these vary by farm sizes and regions within the study area.

7.2.4 Firewood (Fuel)

The fuel used in cassava processing is petrol for semi-manual grater or electric for grating, fermentation, drying and few cases for frying. Firewood fuel is the most used source of energy for roasting the dried grain of cassava. The total mean cost of firewood for frying 4671.49 kg of *gari* was N2810.16 in the study area and the maximum amount could be up to N5, 000.00. The cost varies with individual processing styles, by quality and by region. The other inputs used in processing are transport, management, packaging, etc. Drying/frying with firewood to process *gari* is not very efficient and contributes to deforestation. It may also result in air pollution, with most of the heat energy lost due to lack of a control mechanism. This may give a low product yield and one which is also low in quality. Firewood is therefore not only inconvenient to use but is increasingly a scarce resource.

7.3 Cost and Returns Analysis of *Gari* Processing

Most cassava processors process *gari* either from the root tuber which is produced within their farm or bought from other farms and/or the markets. The economic performance of processing could be used as a criterion for processing enterprise management. This section's aim is to compare the estimation of *gari* processing costs and returns analysis among the three regions in Delta State, as has been done in Chapter 5 in respect of cassava root tuber. Production cost is made of both fixed and variable costs while return is represented by the revenue from sales of processed *gari*. The gross margin analysis will be used to evaluate the cost and revenue data.

7.3.1 Gari Processing Costs This sub-section will discuss all the major costs of processing gari such as rent, labour, fuel cost and other associated costs. The gross margin, total fixed cost, total variable cost, total revenue, and benefit cost ratios are calculated and presented below.

Labour Cost

Apart from the cost of raw material, which has the highest cost at N204, 466.49, the cost of labour represents a sizeable proportion of costs at an average of N56, 896.77. Labour is required for washing, peeling, grating, fermentation, drying, frying and packaging. The labour cost in Delta Central was the highest (N91, 535.23), followed by Delta North (N48, 043.75) and with the lowest cost in Delta South (N45, 773.49). The total mean labour cost was N56, 896.77 as shown in Table 7.2.

Table 7.2 *Gari* Processing Costs per Hectare

Items	Measure	Region			Total Mean
		Delta Central	Delta South	Delta North	
Output					
Gari	Naira	393236.16	228792.94	379554.44	334339.79
Inputs					
Root	Naira	247885.71	168703.63	196544.95	204466.49(74.9%)
Rent	Naira	4614.29	4271.43	4261.90	4382.54(1.6%)
Labour					
Washing	Naira	11634.63	5958.60	6494.60	8123.72
Peeling	Naira	19961.13	11083.33	11322.60	14051.40
Grate	Naira	18831.90	8511.49	10950.00	12692.62
Fermentation	Naira	1586.23	1794.41	889.50	1330.50
Drying	Naira	8889.13	5362.30	6195.86	6195.86
Frying	Naira	22763.64	13063.36	12191.19	14502.67
Total labour	Naira	83666.66	45773.49	48043.75	56896.77(20.8%)
Firewood(Fuel)	Naira	3085.71	3028.85	2322.64	2810.16(1.0%)
Others	Naira	4782.86	4703.85	3781.13	4419.68(1.6%)
Total Costs Processing	Naira	91535.23	53506.19	54147.52	64126.61
TVC	Naira	339420.94	222209.82	250692.47	268593.16
TFC	Naira	4614.71	4271.43	4261.90	4382.54
Items	Measure	Region			Total Mean
		Delta Central	Delta South	Delta North	
Items	Measure	Region			Total Mean
		Delta Central	Delta South	Delta North	
TC	Naira	344035.65	226481.25	254954.37	272975.64
Gross Margin	Naira	53815.22	6583.12	128861.97	65746.63
NET Profit	Naira	49200.51	2311.69	124600.00	61364.09
BCR		1.10	1.03	1.49	1.22

Items	Measure	Region			Total Mean
		Delta Central	Delta South	Delta North	
Return to Labour Ratio		4.7	5.00	7.9	5.88
Return to Labour (TR/TMDYS	Naira	-	-	-	3709.78

Source: Field Survey, 2008.
Exchange rate: £1=N200

Amoa et al. (2007), in their economic analysis of cassava processing into gari in South west Nigeria, asserted that cassava root tubers make 60 percent and labour 40 percent of variable cost in gari processing. However, the study of Ibekwe et al. (2012) suggests labour costs represent about 22.8 percent of the total variable cost and 21.3 percent of the total cost of gari processing in Imo State, South East Nigeria. Table 7.2 indicates the labour share of total cost at about 20.8 percent in the study areas. This implies that labour represents a very high proportion of the total cost and is about the same in all regions of cassava production in Nigeria.

Fuel Cost

Fuel cost includes electricity, petrol and firewood costs. Among these, firewood is mostly used as the main source of fuel for frying gari, while electricity and petrol are used for grating, drying and sometimes frying. Delta Central has the highest cost for firewood (N3, 085.71) followed by Delta North (N3, 028.85) and Delta South (N2, 322.64).

Land Rent

Land rent is considered as a fixed cost in this study and is the annual cost of renting land Land is taken to be the processing site, administration/office space and also includes rent for the land area used for cultivation of cassava. Land rent is highest in Delta Central (N4, 614.29) followed by Delta North and Delta South with N4, 271.43 and N4, 261.90 respectively, with the total mean of N4, 382.54.

Root Tuber Costs

The main raw material cost is the cost of fresh root tuber. The average cost of fresh root tuber from one hectare is estimated at N204, 466.49 which produces an output value of N334, 339.99 of *gari*. Delta Central is associated with the highest cost of root tuber followed by Delta North and Delta South respectively as shown in Table 7.3. Other costs incurred in *gari* processing include transportation of raw materials like palm oil, turning sticks and so on. Ibekewe et al. (2012) reported that CRT accounted for 44 percent for total production cost and 48 percent for total variable cost. The study of Ibekwe et al. (2012) also calculated that cost of transportation represented 19.5 percent of the total cost of gari production.

The main difference in the computation of costs of production between this study and that of Ibekwe is that transportation cost was not included in this study. In a similar study on groundnut processing in Nigeria by Saingbe et al. (2010), research indicated that the cost of raw materials accounted for 79.59 percent of the total variable cost of production. This implies that CRT and other raw material inputs account for the highest percentage of cost in cassava processing in Nigeria.

7.3.2 *Gari* Processing Profitability Analysis

Table 7.3 Return and Profitability of Gari Processing in Delta State

Variable	Region			Total Mean
	Delta Central	Delta South	Delta North	
Total Revenue (N/ha)	393236.16	228792.92	379554.44	334339.79
Total Cost				
Total Variable Cost	339420.94	222209.82	250692.47	268593.16
Total Fixed Cost	4614.71	4271.43	4261.90	4382.54
Total Processing Cost(N/ha)	344035.65	226481.25	254954.37	272975.64

Variable	Region			Total Mean
	Delta Central	Delta South	Delta North	
Gross Margin (N/ha)	53815.22	6583.12	128861.97	65746.63
Gross Margin (N/t)	8679.88	1910.04	28635.99	13697.21
Net Returns (N/ha)	49200.51	2311.69	124600.00	61364.09
Net Returns (N/t)	7935.57	653.74	27638.90	12784.19
Benefit Cost Ratio				
Total Cost Bases	1.10	1.01	1.49	1.22
Total Variable Cost Bases	1.16	1.03	1.51	1.25
Return to labour Ratio	4.7	5.0	5.9	5.88
Return to labour (N/ha)	541.29	85.9	1376.28	619

Source: Field Survey, 2008

***Gross Return/Total Revenue*:**

This is total monetary value of processing gari per tonne or per hectare, multiplied with the total revenue for all areas which was N334, 339.79/ha, with Delta Central contributing the highest amount when compared to Delta North and Delta South.

***Net Return*:**

This is the deduction of both total variable and total fixed costs from the total value of gari. The total revenue *gari* processing has a mean value of N334, 339.79/ha, with Delta Central with highest net returns N393, 236.16 compared to that of Delta South and North with N228, 792.94/ha and N379, 554.55/ha respectively, In respect of farm size categories, large farms have the highest net returns (N1189, 735.00/ha) followed by medium farms (433,152.63/ha) and small size farms (N167, 595.40/ha) have the lowest. The study of Ibekwe et al. (2012) recorded an average net return of N385, 888.00.

Benefit Cost Ratio (BCR):

Adding value to cassava root tubers will not only improve the storage life of cassava products but is profitable in the short term. BCR for all areas was 1.22. For Delta Central, BCR was calculated to be 1.10; Delta South, 1.03 and Delta North, 1.49 which was the highest value.

This indicates that *gari* processing is profitable in all regions of Delta State. Similar result s are obtained from all farm size and processing categories. Ibekwe et al. (2012) reported a 1.78 RRVC (Rate of Return on Variable Cost). Based on the findings as shown in Table 7.3 above, it can be concluded that *gari* processing is a profitable enterprise.

Return to Labour**:** This is the total labour used in the processing of *gari*, which is calculated by considering the possible other uses of that labour. The average returns to labour ratio was 5.88 in all areas, highest in Delta North (7.9) followed by Delta South and Delta Central with 5.00 and 4.7 respectively. The wage per day for labour is between N450 and N800. The value of N618 means processing *gari* will be profitable enough to pay for the labour cost as shown in Table 7.3. Table 7.4 gives the profitability from processing one kilogram of *gari*.

Table 7.4 Profitability in Processing 1kg of *Gari*

Items	Measure	Region			Total Mean
		DC	DS	DN	
Output					
Gari	N/kg	60.70	62.49	53.89	59.00
Input					
Root	N/kg	16.73	17.29	16.48	16.83
Processing Cost	N/kg	20.12	20.44	14.90	18.47
Total Processing Costs	N/kg	36.85	37.73	31.38	35.20
Gross Margin	N/kg	23.85	24.76	22.51	23.80

Source: Field Survey, 2008

7.4. Interrelationship of Yield with factors affecting *Gari* Processing

Levels of gari processing will be greatly influenced by the quantities of supply and demand for the products. The production of gari depends on the availability of root tuber, the demands for gari, the available supplies of labour, fuel materials, transportation, socio-economic factors etc. This sub-section discusses the interrelationship between the factors used for processing and the output of gari in Delta State. This analysis focuses on inputs/outputs at the farm level in order to determine input use efficiency.

7.4.1 Relationship of Output to Gender of Producers

The relationship between gender and the quantities of gari output varied across the areas of study. Table 7.5 showed the highest output of 5353.61 kg was produced by male farmers while 4192.17 kg was produced by female farmers. These varied with the regions. In Delta Central region, male processors have the highest of 8218.05 kg compared with female processors with 5227.62 kg, while in Delta South the female processors have the highest output of 3422.64kg compared to that of male output of 3261.90kg. The output in Delta North is similar to that of Delta Central. The mean difference in output of gari produced by male and female is significant at 10 percent level only ($p<0.122$) based on ANOVA analysis (see Appendix F for ANOVA Tables). This is contrary to the studies of Ogunleye et al (2008), who have asserted that primarily females are involved in gari and akpu processing, while males will be more involved in the processing of cassava flakes. This assertion is supported by Fapojuwop (2007) who stated in his study of cassava processing in South west Nigeria, that more females are involved in cassava processing than male processors. However, these studies did not state which genders are more productive.

Table 7.5 Relationship between Gender and Levels of Output

Region	Gender	Mean	Standard Div
Delta Central	Female	5227.62	5256.73
	Male	8218.05	9224.03
	Total	6167.33	6854.95
Delta South	Female	3422.64	3594.39
	Male	3261.90	2101.93
	Total	3360.81	3095.38
Delta North	Female	4192.17	3822.70
	Male	5163.11	10756.13
	Total	4475.72	8302.94
Total	Female	4192.17	4426.60
	Male	5353.61	8725.65

	Total	4671.49	6564.26
F	2.401		
p-value	0.122		

Significant difference exist between mean yield per ha by regions of gender based on ANOVA (p<0.122).
Source: Field Survey, 2008

7.4.2 Relationship of Output to Processors Age

Table 7.6 shows that there is a positive relationship between the outputs with the age of the processors. The older age group 3 (>60 years) obtained the highest quantity of *gari* followed by the age group 1 (17-39years) with 4845.02kg and group 2 (40-59years) obtained the lowest quantity (4130.25kg). , but these again varies between regions. There is a significant difference of 5 percent (p<0 .053) between the age group and the quantity of gari processed, based on ANOVA analysis. Kaine's (2012) research found a contrary view in his study of akpu processing in Delta State, asserting that the age of processors that ranges between 30 and 51 years with the a mean age of 47 years old. This age range may mean that processors are rather conservative, and therefore may be unlikely to adopt new technologies, with an adverse effect on productivity.

Table 7.6 Relationship of Output with Processors Age

Region	Years Group	Mean	Standard Div
Delta Central	Lowest-39years	5151.05	6226.81
	40-49years	9139.87	8277.02
	>60years	4439.97	1884.50
	Total	6167.33	6854.95
Delta South	Lowest-39years	3674.63	4441.16
	40-49years	3208.39	2180.55
	>60years	-	-
	Total	3360.82	3095.38
Delta North	Lowest-39years	5579.87	14394.34
	40-49years	2982.69	3656.92
	>60years	9204.83	7944.10
	Total	4475.72	8302.94
Total	Lowest-39years	4845.02	8088.74
	40-49years	4130.25	4889.06
	>60years	7688.74	6946.02

	Total	4671.44	6564.25
F	2.903		
p-value	0.053		

Significant difference exist between mean yield per ha by regions with age groups based on ANOVA (p<0.053).
Source: Field Survey, 2008

Table 7.6 shows that there is a positive relationship between the outputs with the age of the processors. The older age group 3 (>60 years) obtained the highest quantity of gari followed by the age group 1 (17-39years) with 4845.02kg and group 2 (40-59years) obtained the lowest quantity (4130.25kg). , but these again varies between regions. There is a significant difference of 5 percent (p<0 .053) between the age group and the quantity of gari processed, based on ANOVA analysis. Kaine's (2012) research found a contrary view in his study of akpu processing in Delta State, asserting that the age of processors that ranges between 30 and 51 years with the a mean age of 47 years old. This age range may mean that processors are rather conservative, and therefore may be unlikely to adopt new technologies, with an adverse effect on productivity.

7.4.3 Relationship of Output to Amount of Processing Experience

Table 7.7 indicates that processors with higher amounts of processing experience obtained the highest outputs as expected. The high level of outputs were observed in the most experienced groups, those processors with 12-15years experience and those with more than 16 years' experience, gained outputs of 6669.93 kg and 5106.41 kg respectively. This is compared with the less experienced groups, with 1-5 years' experience, and 6-11 years

Table 7.7 Relationship of Output to Processing Experience

Region	Experience	Mean	Standard Div.
Delta Central	1-5years	3988.20	6486.92
	6-11years	4368.28	4216.92
	12-15years	14467.70	7821.40
	>16years	8427.80	7135.91

Region	Experience	Mean	Standard Div.
	Total	6167.50	6854.95
Delta South	1-5years	9624.00	11502.79
	6-11years	3341.59	2187.05
	12-15years	1877.00	7821.40
	>16years	3195.00	7135.91
	Total	3360.81	3095.38
Delta North	1-5years	4047.28	13003.66
	6-11years	2670.26	3601.07
	12-15years	3920.51	4396.52
	>16years	5780.03	6039.78
	Total	4475.72	8302.94
Total	1-5years	4331.50	10043.71
	6-11years	3554.40	3580.66
	12-15years	6669.93	7505.52
	>16years	5106.41	5295.69
	Total	4671.49	6564.20
F	0.672		
p-value	0.153		

Significant difference exist between mean yield per ha by regions of processors year of experience groups based on ANOVA (p<0.153).
Source: Field Survey, 2008

experience, who obtained 4331.50 kg and 3554.40 kg, respectively. These trends varied with locations. However, the differences across processors years of experience groups is only significant at 10percent (p<0.153) based on ANOVA analysis.

7.4.4 Relationship of Output to Educational level

Table 7.8 shows that there is an insignificant relationship between the outputs of *gari* produced and the level of education of processors. The yield varied most significantly between the illiterate group and the group with the highest level of education, but such differences are evident between all the educational groups and across all the regions. The variability was limited between group 3 (7-12 years schooling) and group 4 (more than

Table 7.8 Relationship of Output to Educational Level

Region	Educational Level	Mean	Standard Div.
Delta Central	0years	6980.31	7221.90
	1-6years	4182.11	3688.87
	7-12years	7369.09	8428.81
	>13years	5443.87	3024.42
	Total	6167.33	6854.95
Delta South	0years	2203.77	1712.81
	1-6years	3478.00	1724.07
	7-12years	4034.09	5013.39
	>13years	4297.95	2519.47
	Total	3360.82	3095.38
Delta North	0years	5203.54	5740.86
	1-6years	4678.51	7665.26
	7-12years	4405.00	6740.81
	>13years	3406.37	3191.88
	Total	4475.72	8302.94
Total	0years	4704.69	5740.86
	1-6years	4132.11	7665.26
	7-12years	5319.28	6740.81
	>13years	4034.96	3191.88
	Total	4671.49	6564.26
F	0.672		
p-value	0.570		

There is no significant differences in yield by processor years in obtainting education in each region based on ANOVA ($p<0.570$).
Source: Field Survey, 2008

13years of schooling) at 0.061. This suggests that the higher the level of education, the lower the output.

7.4.5 Relationship of Output to Household Size

Table 7.9 indicates that there is no significant difference between the level of output for the various household sizes, with the exception of Delta South region where there is a clear pattern in which household sizes of more than 11 members obtained slightly higher outputs (3499.50 kg) when compared to the household sizes of 6-10 members and that of 1-5 members, with outputs of 3359.13 kg and 3357.17 kg respectively. However, the difference is not statistically significant. This indicates that there is no correlation between household sizes and the level of output.

Table 7.9 Relationship of output to Household Size

Region	Household Size	Mean	Standard Div.
Delta Central	1-5	5540.36	7079.02
	6-10	6021.99	5854.96
	>11	8676.89	8295.26
	total	6167.33	6854.94
Delta South	1-5	3357.17	3843.38
	6-10	3359.13	1954.00
	>11	3499.50	4949.04
	total	3360.81	3095.57
Delta North	1-5	5279.79	11619.01
	6-10	4221.10	5433.57
	>11	937.80	952.60
	total	4475.70	8302.94
Total	1-5	4659.71	7806.06
	6-10	4417.63	4811.87
	>11	4671.49	7669.36
	total	4671.49	6564.20
F	0.915		
p-value	0.402		

There is no significant differences in yield as a results processor household sizes in each region based on ANOVA (p<0.402).
Source: Field Survey, 2008

Several studies (Kaine, 2011; Fapojuwo, 2007; Ibekwe et al.2008) argue that high literacy levels, larger family size of working group and high years of processing experiences would enhances the output performances of cassava processors. It could be hypothesis to see if the these social economic variables have significant influence on processors output yield in *gari* production

7.4.6 Relationship of Output to Marital Status

Table 7.10 indicates that output from married couples is higher than for processors who were single or widowed, apart from divorced processors, who showed an exceptionally high output. However, these represented a tiny fraction of the sample, on four, compared to the high

Table 7.10 Relationship of Output to Marital Status

Region	Marital Status	Mean	Standard Div.
Delta Central	Married	6421.64	7298.17
	Single	3954.90	3155.35
	Widow	9562.70	11296.77
	Divorce	13888.80	6251.45
	Total	6167.33	6854.95
Delta South	Married	3516.27	3434.67
	Single	2221.37	1257.88
	Widow	3491.06	1106.44
	Divorce	6999.00	-
	Total	3390.81	3095.38
Delta North	Married	4897.12	8876.15
	Single	2624.16	3489.84
	Widow	1240.70	888.70
	Divorce	-	-
	Total	4475.72	8302.74
Total	Married	4906.22	7082.01
	Single	3168.70	2866.38
	Widow	4058.65	5619.01
	Divorce	12166.35	6158.01
	Total	4671.49	6564.26
F	2.818		
p-value	0.039		

Significant difference exist between mean yield per ha by regions with marital status based on ANOVA ($p<0.039$).
Source: Field Survey, 2008

number of married couples (242) and this may explain the unusual result. This also varied within all regions. The relationship between marital status and output produced is significant at 0.5 percent level ($p<0.039$) based on ANOVA analysis.

7.4.7 Relationship of Output to Provision of Credit Facilities

It is shown in Table 7.11 that the provision of credit facilities varied for all the regions with no clear linkages. ANOVA test showed that there is no relationship between the provision of credit facilities and the level of output ($p<0.626$).

Table 7.11 Relationship of Output to Provision of Credit Facilities

Region	Credit Provision	Mean	Standard Div.
Delta Central	No credit	6219.96	6420.96
	Credit	5943.80	8652.79
	total	6167.33	6854.95
Delta South	No credit	2912.51	2040.20
	Credit	3864.01	3922.20
	total	3360.81	3095.38
Delta North	No credit	4563.79	9088.32
	Credit	4119.24	3853.92
	total	4475.72	8302.94
Total	No credit	4785.80	7007.08
	Credit	4385.74	5322.85
	total	4671.49	6564.26
F	0.238		
p-value	0.626		

There is no significant differences in output level by provision of credit in each region based on ANOVA ($p<0.626$).
Source: Field Survey, 2008

7.4.8 Relationship of Output to the Provision of Extension Services

Table 7.12 suggests that processors with linkages to extension provisions or contacts obtained lower outputs, except in Delta Central where those with contacts obtained higher outputs. Both other regions show the opposite trend. This indicates that extension linkages had a negative impact on the output which is much unexpected. The relationship is significant at 10percent level ($p<0.102$).

Table 7.12 Relationship of Output to the Provision of Extension Services

Region	Extension Contacts	Mean	Standard Div.
Delta Central	No contact	5579.20	6302.14
	Have contact	11193.18	9396.51
	total	6167.33	6854.95
Region	Extension Contacts	Mean	Standard Div.

Region	Extension Contacts	Mean	Standard Div.
Delta South	No contact	5719.32	6129.19
	Have contact	2931.91	1912.30
	total	3360.81	3095.38
Delta North	No contact	4553.50	8653.07
	Have contact	3729.04	3639.85
	total	4475.72	8302.94
Total	No contact	5112.13	7490.94
	Have contact	3838.74	4290.15
	Total	4671.49	6564.26
F	2.697		
p-value	0.102		

Significant difference exist between mean yield per ha by regions with number of contacts with extension services based on ANOVA (p<0.102).
Source: Field Survey, 2008

7.4.9 Relationship of Output to the Provision of Training Programmes

The provision of good extension services and programmes for training of agricultural field officers, farmers and processors on the application of the most recent technology is expected to influence the efficiency of processing. Table 7.13 suggests that training provisions may have a negative influence on outputs and this is similar in all the regions, although the relationship is not significant (p<0.549). This may be due to participants receiving training without using the appropriate inputs or without access to the appropriate technology.

Table 7.13 Relationship of Output to the Provision of Training Programmes

Region	Training Programme	Mean	Standard Div.
Delta Central	No training	6805.13	7557.30
	Have training	4126.38	3151.26
	Total	6167.33	6854.94
Delta South	No training	3360.81	3095.38
	Have training	-	-
	Total		
Delta North	No training	4537.98	8503.48
	Have training	3595.26	4940.55
	Total	4475.72	8302.94
Total	No training	4746.27	6823.02
	Have training	4010.20	3530.53
	Total	4671.49	6564.20
F	0.361		
p-value	0.549		

There is no significant differences exist between in output level by numbers of training programmes received in each region based on ANOVA (p<0.549).
Source: Field Survey, 2008

7.4.10 Relationship of Output to Farm Size

It is observed from Table 7.14 that the output of *gari* is highest in all regions for the large farms followed by medium size farms, while the small-scale processors produced the lowest outputs in all regions. This indicates that the size o agricultural enterprises has a highly significant positive relationship with outputs (p<0.000). This will be further discussed in Chapter 8.

Table 7.14 Relationship of Output to Farm Size

Region	Farm Size Group	Mean	Standard Div.
Delta Central	Small	3278.41	2203.04
	Medium	6996.16	3910.47
	Large	18543.84	9877.64
	Total	6167.33	6854.94
Delta South	Small	2800.37	1931.19
	Medium	5095.20	1824.68
	Large	26664.00	-
	Total	3360.81	-
Delta North	Small	2514.02	2955.06
	Medium	9371.75	7117.33
	Large	26109.33	40970.58
	Total	4475.72	8302.94
Total	Small	2840.60	2413.34
	Medium	7341.57	5199.96
	Large	20165.49	16517.52
	Total	4671.49	6564.20
F	5.691		
P-value	0.000		

Significant diffirences exist between mean yield per ha by regions with farm size groups based on ANOVA (p<0.000).
Source: Field Survey, 2008

7.4.11 Quantity of CRT in Relation to Yield of *Gari*

The CRT total yield for each farm enterprise may be presumed to have a positive relationship to the total quantity of *gari* processed as shown in the Table 7.15.

Table 7.15 Quantity of CRT in Relation to Yield of *Gari*

Region	Root Qty	Mean	Standard Div.
Delta Central	1	2364.84	1562.96
	2	5721.54	3134.87
	3	8911.53	5688.12
	4	23879.14	7224.49
	Total	6167.33	6854.95
Delta South	1	2590.20	3298.22
	2	4630.34	1652.64
	3	9000.00	1412.80
	4	-	-
	Total	3360.81	3095.00
Delta North	1	2364.84	1562.96
	2	5721.54	3134.87
	3	8911.53	5688.10
	4	23879.14	7124.49
	Total	6167.33	6854.95
Region	Root Qty	Mean	Standard Div.
Total	1	3052.34	6325.66
	2	5291.99	3082.81
	3	6709.49	6473.72
	4	172117	11064.45
	Total	4735.34	6597.38
F	30312		
p-value	0.000		

Significant diffirences exist between mean yield per ha by regions with quantity of CRT processed based on ANOVA (p<0.000).
Source: Field Survey, 2008

As stated in Chapter 1, if there is any significant relationship between farm sizes, processing quantity groups, which also be taken as proxy for processing firm sizes and efficiency performance hypothesis. This relationship will be further discussed in Chapter 8.

7.5 Chapter Summary

This study was designed to assess and improve the production performance of cassava farmers in Delta state, Nigeria. Use gross margin, return and profitability analysis, this chapter has investigated the economics of *gari* processing at farm level.

Using detailed data for 2008, collected in the field survey for 278 farms and processors spread over 9 local government areas of Delta State, this chapter has presented the costs and returns analysis including relationships between productivity and selected socio-economic factors. The study used the gross margin and benefit-cost analysis to explore the factors affecting *gari* processing. It was found that processing of *gari* was profitable in all regions as well as for all processing size categories.

The benefit cost ratio for Delta Central, Delta South and Delta North are 1.10, 1.01 and 1.49 respectively, with mean of 1.22. In respect of farm size categories, large farms have the highest net returns (N1189735.00/ha) followed by medium (N433152.63/ha), with those in the small size processing category (N167595.40/ha) gaining the lowest result. The results of this study agree with several other studies in Nigeria (Kaine, 2011; Oluwasola, 2010; Afolabi, 2009; Ayoade and Adeola, 2009; Awoyinka, 2009; Enete, 2009; Wilhemina et al., 2009; Knischeer et al., 2007; Mafimisebi, 2007; Amao et al., 2006 and Chukwuji et al., 2006). This research finding also indicates that 88 percent of cassava root tubers produced in these areas of Delta State are used in gari processing, which is significantly higher than the 70 percent rate found at the national level (Ayoade et al., 2009; Nwokoro et al., 2007; Knipscheer et al., 2007).

A major finding in this study is that for every Kilogram of *gari* processed, the gross margin obtained is N23.30, compared to the gross margin of N16.83 for every Kilogram of cassava root tuber sold. This agrees with the empirical studies discussed in Chapter two, that note adding value will increase the gross margins of producers. Farmers and processors also highlighted the need for cassava processing. Marketing intermediaries and marketers increase their profit margins when more value is added to cassava root tubers. This study found that the provision of extension services and training programmes for agricultural extension officers, farmers and cassava processors has little or no beneficial effect in terms of outputs.

CHAPTER 8

TECHNICAL, ALLOCATIVE AND COST EFFICIENCIES IN GARI PROCESSING AND THE POTENTIAL OF VALUE ADDED MARKETS

8.1. Introduction

Cassava is processed into *gari*, starch, tapioca, *fufu*, flour, chips, and pellets among other products. These products constitute the main staples of diet in the study area in particular and in Nigeria in general. *Gari* is favoured as it has a longer shelf-life than other CRT processed products (Ellul, 2010).

The previous chapter examined the importance and profitability of processing cassava into *gari*. The conclusion is that the majority of cassava farmers use cassava root tubers for *gari* processing which is also very profitable and agrees with the findings of Knipscheer et al. (2007), Adebayo and Sangosina (2005), and Phillips et al. (2004). However, due to the ineffectiveness of traditional processing methods and the attributes of cassava root tubers; traditional processing results in inadequate supplies, price instability and upward movement in price, making Nigerian cassava products less competitive in world markets (Nweke, 2004 and Phillips et al., 2004). In addition, processing cassava for consumption is essential in order to remove the cyanide content and generally, they do not store for long period after harvest (Kaine, 2011).

The importance of adding value to cassava as a marketing strategy, to extend the shelf life and thereby increase the profit margin in developing countries cannot be overemphasised (Wilhemina et al. 2009; Phillips et al. 2004). Processing of cassava root tubers into products that increase the shelf life of cassava would help to reduce the seasonal glut effects and bridge the food gap in developing countries. It would also serve as means of job creation and provide linkages between production and marketing processes (Eboh et al. 2012; Benin et al. 2010; and Awoyinka, 2009).

This chapter tries to determine the factors that affect *gari* processing efficiencies and their determinants. The non-parametric DEA approach and Tobit regression model as explained in the Chapters 2 and 3, and as used in Chapter 6, is used here. The section is divided into three sub-sections. The first section presents the efficiency estimates of the sample farms according to their region. The second section presents the relationship between efficiency estimate levels and farm size. Sources of the inefficiencies in gari processing are explored and they demonstrate that larger cassava processors are more efficient than small and medium enterprise processors. The third section assesses the demand for cassava's added value markets. Efficiency is an important aspect in agricultural productivity. Accordingly, Kaine (2011) argues that productivity is easy to derive, given that it is the ratio of output to any given input (i.e., partial productivity measure). 'Technical efficiency' is a more elaborate concept and is a component of the broader principles of 'economic efficiency' and these scores are affected by a host of specific demographic characteristics, inputs and policy influences (Piya and Yagi, 2012; Bifarin et al. 2010; Wilhemina et al. 2009; Chukwuji et al. 2006).

The efficient use of farm inputs, which may lead to increases in productivity, is likely to generate higher income and thus provide better chances of surviving in cassava enterprises (Adeniyi, 2006; Alabi, 2003). This study applies the DEA to estimate technical, allocative and cost efficiency of *gari* processing. Results of the DEA output are then used to estimate the effects of various factors affecting efficiency. This could be used for policy formulation and management purposes. Not much study has been done to determine the degree of TE, AE and CE of *gari* processing especially in Nigeria and Delta State in particular (Chukwuji, 2007).

Descriptive statistics (e.g., frequency counts, percentages, means, and standard deviation), ANOVA tests, t-tests (to examine the difference between various variables and efficiency), and DEA non-parametric linear programme was used to estimate the technical allocative and cost efficiency gari processors. The DEA input-output oriented model of Coelli et al. (2002) and the BCC model specification mentioned in Chapter 2 was selected for use, and Equation 3.2 was used. A second stage Tobit regression model was used to determine the factors affecting efficiency. The output is aggregated into processed gari quantity and the input variables are farm size, labour, and fuel. The cost of labour, rent, fuel and the price of gari are used to determine the allocative and cost efficiency levels. Table 8.1 indicates the summary statistics of the farm specific variables.

The efficiency Equations 3.2 and 3.3 were used, where:

Y = Gari output/kg
X_1 = Root tuber quantity
X_2 = labour/man-day
X_3 = Fuel (Firewood)
X_4 = Other cost per kg
Prices
W_1 = Root tuber price/kg
W_2 = Wage
W_3 = Fuel price
W_4 = Other costs

The numerical form of the Eq (chapter 3) for farmer 1 in actual values is given by:

Table 8.1 Gari processing inputs and output efficiency numerical example table

DMU	X_1	X_2	X_3	X_4	W_1	W_2	W_3	W_4	Y
1	20000	146	100	200	20	204	2000	4000	3333
2	10800	62	100	200	20	204	2000	4000	1291
3	20000	182	150	200	16	204	3000	4000	4444
4	20000	117	150	250	15	255	3000	5000	1291
5	3500	39	200	300	16	306	4000	6000	4444
278	20000	149	200	200	16	204	4000	4000	3333

$Min_{\theta,\ \lambda}\quad \theta = \theta_0 = 3333kg$

$s.t.\ 3333 + 3333\ \lambda_1\ + 1291\lambda_2 + 4444\lambda_{3,} + \ldots\ldots.. + 3333\ \lambda_{278} \geq 0$

$20000\ \theta_0 - 20000\ \lambda_1 - 10800\lambda_2 - 20000\ \lambda_3\ - \ldots\ldots..-20000\ \lambda_{278} \geq 0$

$146\ \theta_0 - 146\ \lambda_1 - 62\lambda_2 - 182\ \lambda_3 - \ldots\ldots.. - 149\ \lambda_{278} \geq 0$

$100\ \theta_0 - 100\ \lambda_1 - 100\ \lambda_2 - 150\lambda_3 - \ldots\ldots.. - 200\ \lambda_{278} \geq 0$

$200\ \theta_0 - 200\ \lambda_1 - 200\ \lambda_2 - 200\ \lambda_3 - \ldots\ldots.. - 200\ \lambda_{278} \geq 0$

$\lambda_1 \geq 0,\ \lambda_2 \geq 0,\ \lambda_3 \geq 0,\ -\ldots\ldots..-,\ \lambda_{278} \geq 0$

The allocative efficiency of the gari processor 1 is:

$Min\ \lambda\ ,\ x_i^*\quad 40000x_1^* + 204x_2^* + 100x_3^* + 4000x_4^*$

$s.t.\ \ - 3333 - 3333\ \lambda_1\ - 1291\lambda_2 - 4444\lambda_{3,} - \ldots\ldots..-4167\ \lambda_{278} \geq 0$

$x_1^* - 20000\ \lambda_1 -\ \ 10800\lambda_2 - 20000\lambda_{3,} - \ldots\ldots\ldots - 18000\lambda_{278} \geq 0$

$x_2^*\ - 146\lambda_1 - 62\ \lambda_2\ \ 182\ \lambda_3 - \ldots\ldots\ldots.\ \ - 149\lambda_{278} \geq 0$

$x_3^* - 100\lambda_1 - 100\lambda_2\ \ 150\lambda_3 - \ldots\ldots\ldots.\ \ - 200\ \lambda_{278} \geq 0$

$x_4^* - 200\ \lambda_1 - 200\ \lambda_2 - 200\ \lambda_3\ - \ldots\ldots\ldots.\ \ - 200\ \lambda_{278} \geq 0$

$\lambda_1 \geq 0,\ \lambda_2 \geq 0,\ \lambda_3 \geq 0,\ \ldots\ldots\ldots\ldots,\ \lambda_{278} \geq 0$

This is also standard LP calculations that can be solve for nth times (Cooper et al., 2011; O'Donnell, 2011; Gavirneni, 2006). This was also solved by using LP computer software DEAP version 2.1 deveoped by Coelli (1996), as used in Chapter 6.

For second stage Tobit regression in Equation 3.4:

Z_1 = training

Z_2 = farmers experience

Z_3 = credit provision dummy (1= credit available, 0= no access to credit)

Z_4 = educational level of household head

Z_5 = number of working member of household

Z_6 = gender dummy (1= male, 0 = female)

Z_7 = Numbers of extension contacts

Z_8 = farm size

Z_9 = main occupation of processors

Accounting for regional variation for (dummy Z_{10} and Z_{11})

Table 8.2 Summary of descriptive Statistics of inputs and output variables

Variables	Measure	Mean	Standard Div.
OUTPUT AND INPUTS			
OUTPUT			
Gari	kg	4671.49	6564.260
Roots	kg	12137.35	11498.980
INPUTS			
Farm Size	ha	2.06	1.720
Washing	Mandays/ha	14.55	22.06
Peelings	Mandays/ha	26.40	38.58
Grating	Mandays/ha	23.21	38.66
Fermentation	Mandays/ha	2.73	12.08
Drying	Mandays/ha	13.62	22.70
Frying	Mandays/ha	25.74	36.50
Firewood	N	2810.16	1492.200
Others	N	4419.68	1953.200
FARM-SPECIFIC VARIABLES			
Years	yrs	42	12.406
Household No	No	5	3.000
Education Level	Yrs	7	4.980
Variables	Measure	Mean	Standard Div.
Processing Experience	Yrs	16.14	11.592
Farm Size	Ha	2.01	1.711
Extension Contact	Dummy	0.35	0.476
Credit Provision	Dummy	0.29	0.452
Training	Dummy	0.10	0.303

Source: Field Survey, 2008

8.2. Data and Variables

The data used in this study comes from the field survey and involves 278 respondents that were involved in gari processing. The output is measured as kilograms of gari processed. The inputs, for which both quantity and the corresponding prices are used, are sizes of land, labour, root tubers, firewood (fuel) and others. The study also attempts to discuss the efficiency among farms using farm-specific variables that were collected from the field survey for this purpose. These are farm size, household size, educational level of head of household, years of processing experience, and dummy for provision of credit facilities, extension contacts and training programmes for gari/farming activities. These are similar variables to those selected by other scholars in similar studies (Falayan and Bifarin 2011; Javed 2009; Olagunju 2008; and Rahman 1998).

8.3 Results and Discussion

Descriptive statistics for all the data are reported in Table 8.2 above. The input quantities are similar across the regions and seasons and input prices are also similar across the regions, with the exception of Delta South where prices are lower by about 25 percent. The processor-specific variable provides a brief summary of the socio-economic characteristics of the processors. The average age of gari processor is 42 years; average household numbers is 6; the average level of education is 7 years; 35 percent of the processors have contacts with extension personnel and 10 percent have had training in the past five years.

8.3.1 Efficiency Estimates

The DEA results are reported in Table 8.2 which shows the summary statistics of measures of technical, allocative and cost efficiencies. Table 8.3 provides the distribution of these efficiency scores. The average processors technical efficiency score is 0.55 for *gari*

Table 8.3 TE, AE and CE Estimates for Gari Processing in Delta State by Region

	Delta Central			Delta South			Delta North			Total Mean		
	TE	AE	CE	TE	AE	CE	TE	AE	CE	TE	AE	CE
Mean	0.557	0.027	0.025	0.481	0.023	0.181	0.623	0.516	0.344	0.549	0.171	0.117
Std Div.	0.174	0.140	0.148	0.125	0.132	0.116	0.516	0.248	0.248	0.165	0.287	0.224
Minimum	0.357	0.001	0.001	0.360	0.001	0.001	0.422	0.086	0.044	0.357	0.001	0.001
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Anova test: All Significant at .000

Table 8.4 Frequency of Efficiency Distribution

	Technical Efficiency		Allocative Efficiency		Costs Efficiency	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
<50%	155	55.8	234	84.2	254	91.4
51 – 60%	65	23.4	7	2.5	6	2.2
61 – 70%	14	5.0	10	3.6	7	2.5
71 – 80%	14	5.0	10	3.6	4	1.4
81 – 90%	12	4.3	10	3.6	1	0.4
91 – 100%	18	6.5	7	2.5	6	2.2
Total	278	100	278	100	278	100

Table 8.5 TE, AE and CE Estimate for *Gari* processor by Firm processing Size

	Small			Medium			Large			Total Mean		
	TE	AE	CE	TE	AE	CE	TE	AE	CE	TE	AE	CE
Mean	0.539	0.143	0.094	0.538	0.136	0.096	0.585	0.285	0.196	0.549	0.171	0.117
Std Div.	0.171	0.265	0.203	0.148	0.148	0.312	0.228	0.192	0.319	0.165	0.287	0.224
Minimum	0.357	0.001	0.001	0.390	0.390	0.002	0.001	0.467	0.002	0.357	0.001	0.001
Maximum	1.000	1.000	1.000	0.945	0.931	0.776	1.000	1.000	1.000	1.000	1.000	1.000

Anova test: All Significant at .000

Source: Field Survey, 2008

processors, with a range between 0.36 and 1.0. These results suggest that if sample gari processors are operating at a full efficiency levels they could reduce their input use by 45 percent and still produce the same level of output.

The mean allocative efficiency scores are 0.17 for *gari*. These scores imply that these farmers could reduce cost by 83 percent, by taking more notice of relative input prices when selecting input quantities. Thus, allocative inefficiency adds to the degree to which costs could be reduced in this industry. The cost efficiency scores are 0.12, when technical and allocative efficiencies are combined to form cost efficiency. Table 8.4 indicates that technical efficiency of the majority of the sample of processors lies at less than 50 percent, with only 6.0% producing at a technical efficiency of above 90%. The results of allocative and cost efficiency distribution are similar, where 84.2% and 91.4% of the processors are operating below 50% levels of efficiency, respectively.

8.3.2 Relationship between Efficiency Estimates and Processor Firm Size

This section considers the hypothesis that processor firm size is positively correlated with increased efficiency. ANOVA test was carried out using SPSS computer program to determine the efficiency estimate level of TE, AE and CE. Processors are grouped into the following categories: with small size processing firm (0–1500 kg), medium size (1501-3000kg) and large size processors (greater than 3001kg).

The TE, AE and CE for processing firm categories are as follows: TE is 0.54, 0.54 and 0.59, for the small, medium and large-scale processor, respectively. The AE for processor categorises for small (0.14), medium (0.14) and large-scale processors (0.29). And lastly for CE, results indicate that small and medium-scale processors have similar levels of CE at .095

and .096 respectively, while large-scale processors are significantly more efficient in terms of cost, at 0.27. The results as indicated in Table 8.5 suggest that large-scale processors are more efficient in terms of technical, allocative and cost efficiency measures than small and medium size processors.

Table 8.5 suggests that large processors are more efficient than the small and medium processors. In regards to total mean allocative efficiency, large processors have greater AE followed by small and medium processors. Large processors are also more cost efficient and enjoy greater economies of scale. Therefore, this finding supports the hypothesized relationship of positive size-efficiency relationship.

8.3.3 Factors Explaining Efficiencies

In order to examine socio-economic and processing specific factors influencing the level of technical, allocative and cost efficiency of the processors, this study makes an attempt to determine the sources of technical, allocative and cost efficiency of gari processing enterprises in Delta State, Nigeria. The results thus far suggest that the efficiency scores vary across farms and the average level of efficiency is low. To explain some of these variations, the efficiency scores were regressed with the socio-economic characteristics at the farm-level using a Tobit model, since the efficiency varies from zero to unity. Also, the coefficients of the explanatory variables in Tobit regression model are of particular interest in terms of understanding the inefficiency differentials among processors and for making policy options. A positive sign means that the variable increases efficiency and a negative sign vice versa. Tobit results are listed in Table 8.6 and the marginal effects or elasticity estimates derived from the regression results (evaluated from the sample means) are reported on Table 8.8.

Table 8.6 shows that farm size and contact with extension agents have a significant positive relationship with technical efficiency. The farm size is positively correlated with technical efficiency, whereas the level of extension contact has a negative effect which is in contrast with general expectations. The results of the study are also in contrast to the findings of Ali (1997) and Hassan (2004). It is surprising to see no influence of any other variables used in the models. Technical efficiency is lower in Central and Northern Delta regions implying that Delta South is relatively more efficient.

Tables 8.6 Factors Explaining Efficiency

Variables	TE	AE	CE
Constant	5.7521***	0.3302	0.3392
Delta Central	-0.0925 (0.000)***	-0.0961 (0.000) ***	-0.0801 (0.002) ***
Delta North	-0.0115 (0.000) ***	-0.1199 (0.004) ***	-0.1012 (0.002) ***
Education	0.0005 (0.780)	0.0029 (0.286)	0.0036 (0.865)
Farmer Processing Experience	-0.0006 (0.490)	0.0127 (0.286)	0.0001 (0.951)
Farm Size	0.0323 (0.000)***	0.1098 (0.000)***	0.0889 (0.000) ***
Extension Contacts	-0.0569 (0.041)**	-0.0976 (0.014)***	-0.0597 (0.051)**
Training	-0.0290 (0.361)	-0.0629 (0.169)	-0.0458 (0.191)
Credit Provision	0.2827 (0.169)	0.0051 (0.860)	0.0139 (0.540)
Gender	0.0442 (0.180)	-0.0079 (0.761)	0.0060 (0.761)
Household Members Working Numbers	0.0174 (0.813)	-0.0079 (0.482)	-0.0007 (0.813)
Occupation	-0.0008 (0.490)	-0.0218 (0.526)	-0.0210 (0.840)
Log Likelihood	148.543	51.644	121.316

Note ** = significant at 5per cent level (p<0.05), *** = significant at 1 per cent level (p<0.01)

The coefficient for large-scale processors is positive and significant. This implies that larger processors are more technically efficient than small processors. This is consistent with the findings of Rahman (2002); Rahman et al. (2000); Sharma et al. (1999); Coelli and Battese (1996). But it is at contrast with the findings of Ajibefun et al. (2002); Rahman et al. (1999) and Tadesse and Krishamoorthy (1997). These results suggest that larger processors are more efficient in processing gari than small processors.

Table 8.6 shows that farm size and contact with extension agents have a significant relationship with allocative efficiency. The farm size is positively associated with allocative efficiency whereas extension contact has a negative effect. This is contrary with the general expectation. The results of the study are at contrast with the findings of Ali (1997) and Hassan (2004). It is also surprising to see no influence of any other variables used in the models. Allocative efficiency is also lower in Central and Northern Delta regions implying that Delta South is relatively more efficient.

The coefficient for farm size is positive and significant. This implies that larger processors are more cost efficient than small processors. This is consistent with the findings of Rahman (2002); Rahman et al. (2000); Sharma et al. (1999); Coelli and Battese (1996). But it is in contrast with the findings of Ajibefun et al. (2002); Rahman et al. (1999) and Tadesse and Krishamoorthy (1997). The implication is that larger processors are more efficient at processing at a cheaper cost than smaller processors.

The estimated coefficient for farmers processing experience is negatively related to technical efficiency but not to a significant degree. This implies that the longer a processor is involved in the processing of gari, the more the processor would increase technical efficiency. The estimated coefficient for the number of working members of the household is positive to technical efficient but not significant. This implies those large households, where family members constitute a greater pool of resources for the processors, can lead to increased input uses and thus result in increases in efficiency. Although this factor makes labour easily available, it also increases household consumption of the CRT products.

To test the hypothesis that gari processing efficiencies increased with the processor size, and examine if there are any significant differences, the TE, AE and CE of the processing estimate are ‘bootstrapped’, as discussed by Latrutte (2010), to the variable of processor firm categories with SPSS computer program. The ANOVA test results, as shown in Table 8.6, suggest that there are significant differences at 1 percent for TE, AE and CE. The major finding in this chapter suggests that large-scale processing firms are more efficient than small and medium scale processors, thereby, reinforcing the hypothesized positive size-efficiency relationship. This may indicate the effect of firm size (farm size), education and influence of scale economies enjoyed by large processors. This supports the findings of Addy et al. (2004) in their study of the potential of small, medium-scale *gari* processing. The study suggests that medium scale (large-scale) is more efficient.

Table 8.7 Processing Firms ANOVA Analysis

	Sum of Square	df	Mean Square	f	
TE					
Between Groups	1.980	11	0.180	8.611	.000
Within Groups	5.559	266	0.021		
Total	7.538	277			
AE					
Between Groups	11.071	11	1.006	22.684	.000
Within Groups	11.802	266	0.044		
Total	22.873	277			
CE					
Between Groups	7.315	11	0.665	26.621	.000
Within Groups	6.644	266	0.025		
Total	13.959	277			

8.3.4 Marginal effects of TE, AE and CE of *Gari* Processing

The figures in Table 8.6 show only the direction of the effects of socio-economic factors but cannot reveal the actual magnitude of these effects. Therefore, this subsection presents the marginal effects of the factors on efficiency scores.

Table 8.8 Tobit marginal effects

Variables	TE	AE	CE
Delta Central	-0.0925***	-0.0960***	-0.08071***
Delta North	-0.1149***	0.1199***	-0.1012***
Education	0.0054	-0.0291	0.0004
Farmer Processing Experience	-0.0057	0.0013	0.0005
Farm Size	0.0323***	0.1098***	0.0889***
Extension Contacts	-0.5670**	-0.0976**	-0.0578**
Training	-0.0290	-0.0621	-0.6458
Credit Provision	0.0282	0.0051	0.0138
Gender	0.0244	-0.0218	0.0059
Household Members Working Numbers	-0.0170	0.0218	0.0209
Occupation	-0.0076	0.0016	0.0007

Note: The significance of the elasticities is based on the standard error of the Tobit regression coefficients. *** = significant at 1 percent level ($p<0.01$); ** = significant at 5 percent level ($p<0.05$); Marginal effects is dy/dx is for discrete change of dummy variable from 0 to 1
Source: Calculated from Field Survey, 2008

The marginal effects of the determinants of technical, cost and allocative efficiency are presented in Table 8.8. These results suggest that an increase in farm size, extension contact visits and the regions will cause TE, AE and CE to change. It shows that one percent increase in farm size of processors will increase technical efficiency by 0.03 percent, allocative efficiency by 0.11 percent and cost efficiency by 0.09 percent. The effect of extention contact, however, has a negative relationship with TE, AE and CE which is quite contradictory to expectation. It means that those who had extension contacts are performing poorly . But, the negative effects of poor extension services provisions are supported by Aye and Munganta (2011) and Adebayo and Idowu (2000). However, other variables such as increase in education level, farmer processing year of experience, training provision, credit provision facilities, gender, household working numbers and precessors occupation do not have any significant effect on TE, AE and CE of gari firm processing. The marginal effects of the dummy variables should be taken with caution because they represent marginal effects on the efficiency scores, for a change from 0 to 1.

8.4 Potential of Adding Value CRT Production

A recent surge of interest in cassava, not only for its use as traditional forms as staple foods and animal feeds stuffs, but also for production of important industrial products (starch, alcohol, glucose, flour and others products) has been noticed in recent years. Processing of cassava into various value added products such as starch, breads, biscuits, cassava flour, chips and animal feeds through the development of small and medium scale industries have the potential to increase incomes of cassava producers and escalate agricultural growth (Benin et al. 2010; Nweke, 2004; Shams-Ud-Din, 2000). Also, this would lead to greater price stability, increases in production and marketing of cassava root tubers, increased storage and shelf life of cassava root tubers (Awoyinka, 2010; Shama-Ud-Din and Taluker, 2007; Nweke, 2003).

The purpose of this section is to identify the potential for value added products and alternative modes of utilization. According to Afolabi (2009), Nweke (2004) and Nyerhovwo (2004), cassava starch staples give carbohydrate output which is about 40 percent higher than rice and 25 percent more than maize. This means that cassava is the cheapest source of calories for both human nutrition and animal feeding. Cassava root marketing and processing is profitable as indicated by Table 7.3.

8.4.1 Sources of Value Added Potential of Cassava

According to Samuel et al. (2010), Nweke (2004) and Okoh, (1998), cassava has competitive advantages over other crops in terms of favourable growing conditions and could do well in all type of soils even where nutrients are depleted. There are large domestic and regional markets, relatively low costs of labour and unique opportunities to massively re-invest oil revenues for rapid agricultural transformation. Table 8.8 indicates the uses of value added products and relative potential market demand in Nigeria. Table 8.9 shows potential sources and substitution options for cassava root tubers, apart from the use and export potential of dried cassava chips and pellets.

Table 8.9 Cassava Demand Estimates by Presidential Initiatives by 2007 (MT)

Item	Domestic	Export	Total
Food	5700000	1825000	7525000
Starch	1700000	3200000	4970000
Livestock	15622000	75621248	91243248
Ethanol	900000	2700000	3600000
Total	23992000	83346248	107338248

Source: Philips et al. (2004)

Table 7.3 indicated that cassava processing is profitable with gross margin of N13, 697.21 per tonne and BCR of 1.22. Thus, there are still opportunities to increase the efficiency of cassava production and processing, by reducing the costs of production and processing as examined in the TE, AE and CE calculations.

Table 8.10 Cassava Conservative Estimates of Demand (Tonnes)

Sector	Current Alternative Product Use	Substitution (%)	Equivalent in Cassava roots (MT)
Animal Feeds	1200000 (cereals)	20	1000000
Starch	67100 (corn starch)	100	350000
Livestock (Flour)	1180000 (wheat)	20	1000000
Ethanol	20900 (imports)	100	2000000
Total			4500000

Sources: Adapted from FOS (2001); Philips et al. (2004); Knipscheer et al. (2007)

8.4.2 Constraints to Adding Value by Processing

Apart from the constraints to processing cassava root tubers , as shown in Table 10.3, Sanni et al. (2009), Azih (2008) and Eboh et al. (2004) have suggested that the economic and market potential to add value have been undermined by inappropriate and unstable macroeconomic and structural policies. These are often comprised of inconsistent and poorly implemented sector strategies and programmes, a poor technology and services delivery environment and an absence of credit facilities (Ohimain, 2014; Manyong et al. 2005).

8.5. Chapter Summary

This chapter provides the estimates of the technical, allocative and cost efficiencies of *gari* processing, as well as identifying the underlying socio-economic determinants. DEA is used to estimate technical, allocative and cost efficiency levels of cassava farmers in Delta State. These scores were then separately regressed on the socio-economic and farm specific variables to identify sources of efficiency using a Tobit regression model.

The study found out that 34, 44 and 22 percent of *gari* processors in the study area are small, medium and large scale processors, respectively. Results indicate a mean technical efficiency of 55 percent; mean allocative efficiency of 17 percent and a mean of 11 percent for cost efficiency. The results show that the sample of processors operated at a low level of efficiency. They could reduce their inputs by 45 percent and thereby reduce the cost of production by 73 percent, without reducing the level of output and using only the same technology and management practises. Results indicate that amongst the regions DN is more technically efficient than DC and DS. DN also has a higher allocative efficiency rate than DC and DS and quantity of CRT used in processing as means scale measure of size categories, results indicate that the TE, AE and CE is higher with Large-scale processors with TE (58 percent) while small and medium-scale processors with TE (54 percent).

Second-stage regression attempts to explain variations in efficiencies between farms. Findings of the study revealed positive impacts of farm size on efficiency and negative impacts of extension agents on all types of efficiency. The farm specific technical efficiency distributing range reveals that 35 percent is minimum level 100 percent is the maximum frontier thresholds. This allows the conclusion that within the context of efficient agricultural processing, processing output could be increased by 45 percent using available inputs and technology. The ranges of efficiency score obtained for *gari* processing are quite low, implying that there is significant scope to increase processing efficiency by a very large margin, especially for allocative and cost efficiencies. Thus, in order to increase the production efficiency of *gari* processors, small and medium processors should be encouraged to combine their resources in other to increase efficiency. Also policy should be made to encourage large scale processing by provision of land for expansion and credit facilities. In addition, undertaking policy reforms for the promotion of small and medium scale processors to be completed by large-scale farming and/or processing enterprises will improve accessibility to production inputs. Reduced labour costs and extension service provisions should be supported by policy to make such farm inputs easily available for the operators of *gari* production. In addition, encourage innovation that could improve on processing technology. This will reduce labour costs and also improve the efficiency processing, raise quality and enhance CRT's products martability and the promotion of industrial uses of cassava and its diversification through processing options, in order to encourage increases CRT production and enhance household income.

This study finding suggest, that cassava farmer have higher efficiency in the processing of cassava than in the cultivation of cassava. The study also found out that there is great potential to add value to cassava by processing into different forms for the domestic markets, ECOWAS regional markets and the global markets. The findings indicate that with provision of better extension services, training programmes accompanied by the adoption of improved technologies and increased efficiency in the uses of inputs, inefficiency would be reduced and would lead to the increases in productivity of cassava through processing.

CHAPTER 9

MARKETING OF CASSAVA AND MARKETING STRATEGIES IN DELTA STATE

9.1 Introduction

Among the major constraints to increasing productivity of cassava are the effects of low prices, poor storage condition and inefficiencies in processing (Afolabi, 2009; Awoyinka, 2009; Ayoade et al., 2009; Enete, 2009; Knipscheer et al., 2007; and Adekanye, 1988). Chapter 8 examined the sources of cassava processing inefficiencies in order to provide further insights into the nature and causes of such inefficiency. This also highlighted the view of cassava processing as an important link between cassava production and marketing. An improvement in efficiency is essential for enhancing cassava enterprise profitability and can be extrapolated to determine the potential marketing demands of cassava root tubers in Nigeria. The aim of this chapter is to describe and analyse the various forms by which cassava is being marketed in the study areas. The purpose is to identify the unexploited markets for cassava which are needed to foster agricultural development and growth in Delta State, Nigeria.

Descriptive statistics are used to describe the socio-economic characteristics of marketers of cassava. Also, a marketing margin analysis is conducted to analyse the level of gross margin and profitability of cassava marketing. Finally regression analysis was applied to determine the factors affecting performance of cassava marketing in the Delta State of Nigeria. The specific purpose of this section is to:

Describe the socio-economic characteristics of the sampled cassava marketer respondents

1) Determine the various ways by which cassava is being sold in the markets

2) Examine current marketing chains and channels
3) Examine current market structures, conducts and performances
4) Determine the factors affecting the marketing revenue (or gross margin) of cassava in the study areas

9.2 Socio-economic Characteristics of Market Respondents

This section is confined to the discussion of some basic descriptive statistics of the market survey respondents. The characteristics of age, education level, credit provision, marketing experiences, marketing frequency, marketing distance, gender and family size etc as used in marketing study by (Keerthi, 2008; Adetunji and Adesiyan, 2008; Mafimisebi, 2007; Aniola and Fawole, 2007).

Table 9.1 Socio-economic characteristic of the marketers

Variables	Means	Std Division	Minimum	Maximum
Years	42.12	12.852	17	76
Education(yrs)	6.12	4.224	0	14
Credit (Dummy)	0.42	0.496	0	1
Experience(yrs)	13.32	8.556	2	39
Mrkt Frequency(Days)	4.23	.258	1	8
Mrkt Distance(Km)	2.93	3.129	0	15
Family Size	5.82	2.254	1	13

Source: Field Survey, 2008

9.2.1 Age of the Marketer Respondents

The average marketers' age is 42 years with a standard deviation of 12.85 in all areas. This is slightly higher than the national average of 38 years (Mafimisebi, 2007). The majority of the marketers fell within the age group of 40-59 years (54.3 percent); with the next most popular being the age group 17-39 years (34.3 percent) and the smallest proportion of marketers were over 60 year (11.4 percent) as shown in Tables 9.1 and 9.2. Further, analysis shows that 88.6 percent of the respondents belong to an active segment of the population, while 14.4 percent represent an aged group. This implies that age has a positive impact on the level of marketing activity undertaken by marketers.

9.2.2 Educational Level

The educational level is measured in terms of total numbers of years in school. The total mean education level is 6.12 years with standard deviation of 4.22, and a maximum of 14 years of completed schooling. The majority of market respondents had between 1 and 6 years of schooling, with a low level of education (43.8 percent); followed by 7-12 years schooling (35.2 percent); 17.1 percent of the respondents had no schooling and those with over 13 years at school constituted 3.8 percent of the sample. Education may have a positive effect on marketing activities and is generally accepted to increase marketing efficiency, as the ability to process information increases with education.

9.2.3 Provision of Credit Facilities

The provision of credit facility is examined as a dummy variable with Yes/No answers. We see that the total number of respondents that have access to credit provision is 42 percent, as shown in Table 9.1 Access to credit provision comes from personal thrift contribution, co-operatives, banks or money lenders.

9.2.4 Marketing Experience

Table 9.1 indicates that the mean marketing experience is 13.32 years with standard deviation of 8.56, and a minimum of 2 years, maximum of 39 years. The largest group of respondents

(37.1 percent) had a high level of marketing experience, in excess of 16 years. The next largest group were those with 6-10 years' experience (31.4 percent). The years in marketing may have an effect on marketing efficiency and also on the quantities and choices marketers make available during seasonal variations.

Table 9.2 Frequency of Socio-Economic Characteristics of Marketers

Variables	**Frequency**	**Percentage**
Gender		
Female	65	61.9
Male	40	38.1
Total	105	100
Marital Status		
Married	95	90.5
Single	7	6.7
Widow	1	1.0
Divorce	2	1.9
Total	105	100
Credit Provision (Dummy)		
Not Available	61	58.1
Available	44	41.9
Total	105	100
Age		
0-39yrs	36	34.3
40-59yrs	57	54.3
>60yrs	12	11.4
Total	105	100
Education Level (Years)		
0	36	17.1
1-6yrs	46	43.8
7-12yrs	37	35.2
>13yrs	4	3.8
Total	105	100
Marketing Experience(Years)		
Variables cont.	Frequency	Percentage
0-5	21	20
6-10	33	31.4
11-15	12	14.4
>16	39	37.1
Total	105	100

9.2.5 Gender Distribution of Marketers

The market for cassava is dominated by female marketers, who consittiute 62 percent of the total, whereas males account for 38 percent. This is similar to the study of Afolabi (2009) in South West Nigeria which found 68.7 percent of marketers were female and 31.3 percent male. As noted earlier, cassava is generally considered a women's crop in Nigeria. Although Chapter 4 showed that the number of male farmers producing cassava root tuber is slightly higher than the number of female producers, the marketers of cassava products seem to be mostly women as expected. The prevalence of females in cassava marketing activity may be due to the small amounts of capital required to start these enterprises (Afolabi, 2009).

9.2.6 Marital Status

A significant majority of the marketers (90.5 percent) were married and only 6.7 percent were single. The general idea is that a married household will have access to more working members, including wife/husband and/or children, to be involved in the business whereas a single person will have to do by him/herself. Since cassava marketing is not a formal big business; recruiting hired workers is not the norm. Rather, the use of family labour in cassava production and processing is more likely to be the preferred choice. This may have a positive effect on family labour. Marital commitment and obligation to the traditional family set up may have an effect on the efficiency of farming.

9.2.7 Frequency of Market Days/ Marketing Days Interval

A majority of the marketing activities for cassava takes place in rural areas, where there is a low population density and where many marketers come from towns and central towns to the villages on market day. The mean frequency of marketing days is 4 days (so every 5th day is a marketing day), with a minimum interval of one day, so everyday marketing, in towns and cities and a maximum of 8 days interval in remote areas. Even in towns and cities, most markets have a fixed day on which farmers bring their produce to the market from the rural areas ranging from 1-8 days interval as shown in Table 9.3.

Table 9.3 Main Occupation, Sources of Income and Frequency of Market Days

Variables		
Main Occupation	Frequency	Percentage
Farming	54	57.4
Trading	48	45.7
Services	2	1.9
Others	1	1.0
Total	105	100
Secondary Occupation		
Farming	6	5.5
Trading	95	90.5
Services	4	3.8
Total	105	100
Sources of Income		
Trading	41	39
Farming and Trading	59	56.2
Services and farming	5	4.8
Total	105	100
Marketing Day Frequency (Intervals in Days)		
1Day	4	3.8
2 Days	3	2.8
4 Days	67	63.2
5-8 Days	23	17.0
Total	105	100

Source: Field Survey, 2008

9.2.8 Distance from Place of Purchase to Market

The distance of the market from the place of purchase and/or from the household generally affects the cost of marketing and also the efficiency of marketing. Cassava root tubers and most agricultural produce are bulky and so the cost of transportation and the conditions of road networks influences the price of produce. The average distance from marketers' household and the place of purchase to the market is 2.93 kilometres, with standard deviation of 3.13 and a range from 0 to 15 km in the study areas as shown in Table 9.1. This indicates that due to the bulky nature and quick deterioration in quality of CRT after harvest, coupled with the expensive cost of transportation over long distance, most marketers are based close to the farms where they buy their produce and travel only short distances to sell it.

9.2.9 Family Size Numbers

Table 9.1 indicates that the mean family size in the study area is 5.8 with standard deviation of 2.25, where there is a minimum of one and maximum of 13 persons per household. The majority of households in the study (48.6 percent) were found to have 6-10 persons per household; followed by 1-5 persons (47.6 percent) and 3.85 percent of households were found to have more than 11 persons as shown in Table 9.4 below.

Table 9.4 Family Sizes

Sizes (Actual Number)	Frequency	Percentage
1-5	50	47.6
6-10	51	48.6
>11	4	3.8
Total	105	100

9.2.10 Sources of Marketing Capital

Marketers obtain marketing capital from various sources. A majority of market respondents obtain funds for marketing from their personal savings from current incomes and other occupations. A few get extra funds from close associates and informal thrift saving (Okoh, 1999; Adekanye, 1988).

The majority of traders do not have access to borrow money from formal credit institutions such as commercial banks and investment houses. Those who obtained money from these formal institutions may have formal contacts or special relationships with some of the officers of these institutions. Other sources of capital are from cooperatives or traders associations, or from money lenders often with very high interest rates. Table 9.5 indicates the various sources of funds accessed by the marketing respondents in the areas of study.

Table 9.5 shows that personal saving is the primary source of funding (85.6 percent), followed by funds from cooperatives and trader associations with only 6.7 percent. Even money lenders make a very low contribution as a source of funding.

Table 9.5 Source of Market Capital

Finance Sources	Percentage
Personal Savings	85.6
Bank loans	2.9
Cooperative or Trader Association	6.7
Osusu (thrift Savings)	1.0
Money lenders (Quick Cash services)	3.8

9.3 Supply and Demand of Cassava products

Supply of Cassava

The supply of cassava is being governed by its comparative advantage as a crop in the farming system, and the ease with which it can be processed, stored and marketed (Okoh, 1999). The main mode of supply is in small quantities by large numbers of peasant farmers in the study areas. The major determinants that may lead to an increase in supply are product prices, labour availability and processing periods, as well as access to credits and favourable growing conditions.

Demand for Cassava

The major determinants of the various forms in which cassava is demanded are mainly urban-based and are linked to the marketing mechanisms in the study areas. It was found that the cassava product is seen as a major source of cheap carbohydrate, particularly in the form of gari. It has low income elasticity, but demand is higher in towns and central markets rather than in rural/village markets (Nweke, 1992). Demand for cassava contracts as household income increases. The demand for cassava root tubers as fodder for livestock and as a source of raw materials for industries also put pressure on available supplies.

A large variety of staples are sold in the various markets. These include cassava root tubers, cassava products, yam tubers, yam products, plantain, potatoes, maize and maize products, cocoyam fish, meat, pineapples and vegetables and so on. This variety means that for cassava to be a popular product, it needs to be competitive amongst this range.

Table 9.6 indicates that cassava products are the most important traded staples in terms of volume (of both supply and demand) in the study area. This agrees with findings of Okoh (1999), but is at contrast with the conclusions drawn from COSCA data which states that yam was the most important food stuff (followed by cassava root tubers and products) in the Delta and Edo States (Okoh, 1999). This means it is reasonable to assume a growing importance of cassava root tubers and its products as sources of income for farmers and marketers, as well as its growing significance as raw material for industrial uses.

Table 9.6 Food Staples Sold in Markets in Delta State

Staples and associated Products	Percentage	Mean	Ranking	Significance (p value)
Cassava Products	100	1.19	1	.059
Cassava tuber	80	2.50	2	.247
Yam	99	2.99	3	.000
Others (plantain, Pineapple, etc)	32.4	3.02	4	.029
Vegetable	94.3	3.94	5	.001
Yam Product	28	4.00	6	-
Sweet Potato	43.8	4.00	6	-
Legume	70.5	4.21	7	.357
Maize	83.8	4.52	8	.334
Maize Products	70.5	5.00	8	-
Irish potato	47.3	5.00	9	-
Cocoyam	58	.00	10	.221

Anova test at 95pecent level
Source: Field Survey, 2008

The demand for cassava for the purpose of this study is grouped according to traditional and industrial usages. For the traditional demand, cassava root tubers are used to process *gari*, which is the most important product in the ranking scale of cassava and cassava products, followed by fresh tapioca (*akpu*), starch (not industrial starch), dried tapioca and *fufu* processed for home consumption. Only the quantity in excess of the processors consumption requirements is being sold in the market. Industrial usage of cassava includes processing into cassava starch (industrial starch), cassava chips, cassava crumbs and flours. These processes are very insignificant in the area of study as revealed in Table 9.7.

Table 9.7 Most Important forms in which Cassava is distributed in markets

Cassava Products	Mean	Ranking	Significance (p value)
Cassava Chips	0.90	-	.000
Cassava Crumbs	0.00	-	-
Cassava Flour	0.06	-	-
Gari	1.26	1	0.025
Tapioca Fresh (Starch)	1.49	2	.000
Tapioca Fresh	1.56	3	.002
Starch	1.93	4	.244
Tapioca Dried	2.56	5	.002
Root Tuber	2.16	6	.000
Fufu	2.70	7	.000

(Ranking: 1 most important and 7 least important)
Anova test at 95pecent level

9.4 Marketing Structure, Conduct and Performance

9.4.1 Marketing Structure

The markets for cassava root tubers have many sellers and buyers. There are virtually no barriers to entry and exit. There is a free flow of information and goods available, and their prices are determined by supply and demand. There is also prior-knowledge of any activities that will disturb the distribution of goods and services. It exhibits the characteristics of a competitive and perfect market.

9.4.2 Marketing Infrastructures

The majority of cassava root tubers and products are marketed mainly in open spaces, and are sold directly by farmers, assemblers (commission agents), processors, wholesalers or and retailers to the final consumers. Sometimes there is no clear line of separation between the wholesalers and the retailers. This is determined by the function of the marketers at that particular time. Marketers were asked to state the type infrastructure used to store products in the markets. Table 9.8 indicates the marketers' assessment of the marketing infrastructure, with 1 being most common response and 6 the least common. Results show that open space on the market floor is the most prevalent marketing style (99 percent), followed by semi-permanent booth or stall (81.6 percent). Only 24.4 percent of marketers have permanent locked stalls.

Table 9.8 Market Infrastructure

Description of market structure	Percent	Ranking
Space on the Floor	99	1
Semi-Permanent Vent Booth or Stall	81.6	2
Carried Home after Sales	24.8	3
Permanent Lock-up Stall	24.4	4
Storage after Sales in Store or Warehouse	18.1	5
Storage Room Provision	9.5	6

Source: Field Survey, 2008

9.4.3 Transportation

Some of the basic characteristics of the market infrastructure are assessed from the marketer respondents in the study areas. Scrutiny of the local road network shows that most of the roads leading to most markets are accessible all year, apart from sometimes during the raining season where it can be difficult as shown in Table 9.9. Since the majority of the roads are in good condition, or at least passable, the movement of cassava has little practical barriers except in terms of high transport cost. The major means of transportation of cassava root tubers and products is shown in Table 9.10.

Table 9.9 Road Condition Linking Markets

Condition	Percentage	Ranking
Unpassable all year round	0	0
Untarred, but fairly good	84.8	1
Untarred, waterlogged during raining season	82.9	2
Tarred Road	67.7	3
Untarred, waterlogged all season	1.9	4

Table 9.10 Means of Transportation

Means of Transportation	**Percentage**	**Ranking**
Animal	0	0
Pick-up Van	92.7	1
Bike	63.8	2
Motor bike	52.9	3
Head load	19	4
Wheelbarrow	19	4
Motor Car	5.7	5
Lorry	3.8	6
Ownership of Means of Transportation		
Cooperative	0	0
Government	0	0
Commercial	99	1
Private Own	2.9	2

Source: Field Survey, 2008

9.4.4 Market Information

One of the criteria for a perfect and competitive market is the unrestricted flow of marketing information on prices and quantities of produce. This factor plays a crucial role in the efficiency of marketing. Information in marketing is not restricted, but could not be said to be perfect due to poor processing of the sources of information. Sources of marketing information accessible by the marketers are revealed in Table 9.11. The table suggests that the information is mainly passed through traders. Table 9.12 shows the modes by which marketers pass information in the market.

Table 9.11 Sources of Marketing Information

Sources of Marketing Information	Percentage
Traders	100
Buyers	32.4
Market Association	32.4
Government Agency	0
Influence by News media	26

Table 9.12 Modes of Marketing Communication

Modes of Marketing Communication	Percentage
Direct Contact	100
Phone	7.6

9.4.5 Factors for Entry and Exit of Cassava Markets

There is free entry and exit to cassava markets. The marketers operate independently and they are decentralized in terms of decision making. There is no barrier to the cassava markets, main obstacles to the market include: capital needs; distance involved in collection; labour demand; lack of institutional support; lack of marketing information; the bulky nature of cassava tuber and its perishability.

9.5 Marketing Chain for Cassava Root Tubers

The main marketing chain in the study area is the movement of cassava roots and products from the producers to the marketers, and then to the final consumers. The producers and the marketers will perform some of the duties of cassava processors in order to create or add value to cassava root tubers. This is done to increase their returns and increase the marketing value. It is a marketing strategy to increase sales and to enable cassava to have a longer shelf life. Most cassava producers, processors and marketers who are involved in buying and selling do not keep records of their activities and transactions.

9.5.1 Intermediaries Involved in Cassava Marketing

Some of the intermediaries, involved in the distribution of cassava root tubers and its products from producers to final consumers, are now examined. Note that the role of most intermediaries is often subject to being interwoven with that of other intermediaries. Some perform multiple functions and therefore there are no clear lines of demarcation between them.

Processors

Processors buy cassava root tubers from farmers, mainly direct from the farm gate or from village markets. The roots are then processed into gari and/or any other cassava products. Depending on the scale of production, after removing a quantity for home consumption, the processors may sell cassava root tubers to assemblers, wholesalers, retailers or final consumers from the same market or to marketers from different markets. Marketing transactions generally either take place at processors' homes or the market.

Wholesalers

Wholesalers buy in large quantities of cassava root tubers or products from farmers, processors and assembling agents. Cassava root tubers may be bought for resale or processed into cassava products. These may be sold directly to the retailers, final consumers or stored in warehouses (depending on the form of the products) within the market/town, or to buyers from other markets/towns. Their major functions performed are buying, selling, risk bearing, financing, storage and transportation.

Commission/Assembling Agents

These intermediaries buy cassava root tubers and their products from farmers and processors. They may also be the farmers and/or processors, buying up small quantities from other farmers and processors as they come into the market. They may even act as money lenders, from whom farmers and processors receive loans. After procuring products, they reassemble and resell to the wholesalers, processors, industries, retailers and final consumers within the market or to marketers from other markets.

Retailers

Retailers purchase cassava root tubers and products from the farmers, wholesalers, assemblers or commission agents to resell to final consumers. In case of gari, cassava flour, cassava chips and crumbs; they sell small quantities in cups, baskets and large basins, while in case of starch, fresh tapioca and dried tapioca; they sell in baskets, basins and wraps. They operate in rented stalls in towns or central markets. In rural markets, they operate in temporary structures, on platforms and often on the floor. They may have shops in their homes or platforms by roadsides where they sell on market days. Retailers represent a greater number than all other marketing intermediaries.

9.6. Marketing Channels for Cassava Root Tubers and Associated Products

The channel of distribution could be taken to be a set of institutions which perform similar functions, facilitating the movements of goods and services from production to consumption. The marketing channels for cassava root tubers and associated products can be grouped according to the process of distribution. The number of channels differs by product,, by the rural or urban nature of the setting and according to the number and type of functions. Table 9.13 indicates the marketing channels and ranks them according to prevalence found in the study area ranging from one, most frequent, to six, least frequent.

Table 9.13 Marketing Channels

Channels	Ranking	Percentage
Farmers – Wholesalers – Retailers - Consumers	1	100
Farmers – Retailers – Final Consumers	2	100
Farmers – Final Consumers	3	100
Farmers – Government Agency – Final Consumers	4	0.00
Farming – Wholesalers – Industries – Wholesalers – Retailers – Final Consumers	5	17.1
Farming – Industries – Wholesalers – Retailers – Final Consumers	6	9.2

Source: Field Survey, 2008

9.7 Degree of Marketing Competition

One of the most important characteristics of cassava market structure is the large number of intermediaries and participants, particularly at the level of retail marketing. This may be due to the fact that retailers do not have to belong to any associations, they do not face any barrier to enter markets, capital required is low, there is no special training or skills required and they may be located in any physical place. Other striking characteristics are that retailers may be in control of all stages in a channel of distribution – they may be the farmer, the processor and the retailer of cassava root tubers or products being distributed. Most marketers buy their stock from a large number of small scale sellers and sell to a large number of individual consumers. At every level of the marketing chain there are large numbers of buyers and sellers, with few of them large enough to influence the general price level. The presence of marketing associations may also influence the general price level in the markets. Table 9.14 shows the frequency of different types of markets and Table 9.15 shows the ways in which prices are determined in the study areas.

Table 9.14 Types of Marketing Location for Selling Staple Food Crops in Delta State

Location	Frequency	Percentage
Village Markets	55	51.9
Town Markets	16	15.2
Central Markets	34	32.4
Total	105	100

Table 9.15 Marketing Price Determination

Means of Price Determination	Percentage
Fixed by Market Association	1
Haggling between Buyers and Sellers	100
Buyers Force Sellers at a given Price	25
Each Sellers Decides	100
Fixed by Government Agency	0

9.8 Strategies for Cassava Marketing Development

One of the important aspects of marketing strategy refers to vertical and horizontal integration. Vertical integration is the process of combining management functions by moving forward or backward in the marketing channel. This is visible in the marketing of cassava products, where a large number of wholesalers integrate backwards in the supply chain to purchase large farms or cassava fields so that they can produce roots to process into *gari* or other cassava products. This guarantees an adequate and regular supply of cassava roots and enhances their marketing power. Such stability also helps to provide price stabilization. Horizontal integration is the combination of management functions of two or more firms at the same level of marketing, and this is much rarer in cassava marketing. Most cassava producers are small scale and are producing first for household consumption, with only the leftovers for market. The marketing strategy to exploit cassava production potential is encouraging cassava farmers to become more market orientated that is, producing more specifically for market. This market-driven approach integrates production, processing and distribution issues into a common concern for producers.

The main objectives of the market driven approach are as follows:

1) increase production of CRT
2) adopt improved processing technology
3) increase support and training in marketing activities and providing stakeholders with access to marketing information.

The development strategy is to provide information on the potential industrial market that uses CRT as an important source of raw materials for industrial uses. Cassava marketers would benefit from targeting this market, by requiring additional produce to satisfy demand

and adding value to further exploit the market according to customer preferences (Kotler and Keller, 2012; Hooley et al. 2012; Hines, 2004). In terms of policy implications, this suggests that encouraging an increase in the scale of processing at farm level, increasing investment opportunities in the value chain and promoting sustainable interaction between producers, processors, marketers and consumers in the agro-food-chain (Osagie, 2013; Kohls and Uhl, 1990) would be beneficial, as well as policy enforce the substitution of imported raw material and food crops (known as 'import substitution') (Osagie, 2013; Schaikwyk et al., 2012). Such policies would unlock markets for local cassava farmers, and allow them to exploit CRT as a crop for agricultural growth and economic development.

9.9 Grading and Local Units of Measurements

There are four grades of *gari* (white, yellow, fine grains and powder grains textures) being sold in the Delta State. Table 9.16 shows the determinants of quality, which also influences the prices of cassava products in the areas of study, although it was noted that price differentials emanating from grading of *gari* are inconsequential. As a result, most marketers deal in only one grade, but in order to increase consumer choice in terms of taste and market efficiency, some traders use all grades of cassava products. *Akpu* (*fufu*), starch and tapioca (fresh or dried) are homogenous, that is they are not sold by grading. Cassava root tubers have different varieties classified by colour, taste (sweet or bitter) and sizes of the roots.

Table 9.16 Product Quality Determination and its Ranking

Quality Determination Characteristics	Mean	Ranking
Fermentation	0.37	0
Technology	0.2	0
Other	0.00	0
Amount Foreign Particles	1.87	1
Fineness	2.27	2
Colour	3.05	3
Dryness	3.26	4
Smell	3.92	5

Source: Field Survey, 2008

There is a high degree of uniformity in the local units of measurement and packaging used for sale of cassava products, particularly with *gari*, in each market. However, while names and shapes of measurements vary from one market location to another, their volume in kilograms remains approximately the same. This evidence controls efficiency (Okoh, 1999; Adekanye, 1988) in the marketing system for cassava root tubers and products in Delta State.

9.10 Marketing Concentration

In the study area, total mean values of cassava root tubers bought and sold vary between large numbers of small-scale buyers, to few medium-scale buyers and very few large marketers. This suggests that at every level of the marketing chain, although there are numerous small scale participants, some participants are large enough to influence the setting of the market price. These large marketers are mainly wholesalers.

9.11 Measuring the Performance of Cassava Marketing

Marketing performance refers to the impact of the marketing structure, conduct on prices and the costs and volumes of output supplied and sold (Pomeroy and Trinidad, 1995). The marketing efficiency could be described as the degree of marketing performance. This section seeks to examine the marketing performance of cassava root tubers and some of its products by analysis using cost and returns, profitability, marketing margins, marketing efficiency as used by other scholars (for example, Akinpelu and Adenegan, 2011; Obasi and Mejeha, 2008; Anuebunwa, 2008 and Olukosi and Isitor, 1990). Finally, this section will determine the factors that affect the gross margin of cassava and cassava product marketing using multiple regression analysis. The models are specified in natural double logs, hence incorporating non-linearities in the modelling structure, which is more likely to be close to the true scenario unlike the methods employed by many researchers shown above.

The base model is expressed as:

$$\ln G = \beta \ln C_1 + \beta \ln C_2 + \beta \ln C_3 + \beta \ln C_4 + \beta \ln C_5 + \beta \ln C_6 + \beta \ln C_7 + \delta D_1 + \delta D_2 + \varepsilon \quad (9.1)$$

G = total quantity of products purchased

C_1= fees; C_2= utility cost; C_3= Loading cost; C_4=transportation cost; C_5=rent; C_6= storage cost; C_7 = security; C_8=marketers age; C_9=marketing experience; C_{10}= Education level; C_{11}=family size; C_{12}=gender and D_1 and D_2 account for regional dummy.

Marketing margin = Selling price- Purchase Price X100/Selling Price

Marketing Efficiency = Total Revenue/Total Costs

Table 9.17 Marketing Activities Costs (Naira)

Regions	Commissions /Agent Fees	Association Fees	Loader costs	Trans	Storage	Mkt Sellers	Security	Utility	Rent (TFC)	Council Fees	Others	TMC	TLMC
Delta Central													
Mean	92.86	53.43	2271.43	3194.57	192.20	254.29	100.00	282.86	300	20.29	138.86	6646.29	6900.57
Std Div.	29.162	4.816	1220.793	634.662	62.110	57.358	000	83.967	63.013	1.690	37.790	1438.668	1458.444
Min.	50	50	1000	1000	150	200	100	100	150	20	100	3520	3720
Max.	200	60	5000	4500	300	400	100	500	500	30	200	9820	10120
Delta South													
Mean	101	52.71	1757.14	3525.71	195.71	228.57	100	255.71	229.43	30.00	143.43	6391.14	6619.71
Std Div.	19.119	5.054	770.518	406.812	53.374	72.109	000	28.286	25.109	.000	37.096	703.695	707.325
Min.	50	50	1000	3000	150	200	100	200	150	30	100	5530	5730
Max.	100	70	3000	4000	300	250	100	300	250	30	200	8350	8600
Delta North													
Mean	98.00	51.71	2271.43	3617.14	210.57	245.14	117.14	282.86	266.38	40.00	138.57	7097.71	7342.86
Std Div.	8.452	3.824	1146.240	568.570	59.899	32.118	15.063	79.468	79.857	.000	38.512	1270.961	1283.826
Min.	50	50	1000	1000	150	200	100	100	150	20	100	5370	5340
Max.	100	60	5000	5000	300	300	130	500	500	40	200	10270	10570
Total Mean													
Mean	97.62	52.57	2100.00	3445.81	199.43	242.67	105.71	272.81	266.38	30	140.29	6711.71	6954.38
Std Div.	20.825	4.605	1081.754	568.498	58.570	41.632	11.837	71.082	79.857	8.145	37.505	1205.323	1212.525
Min.	50	50	1000	1000	150	200	100	100	150	20	100	3520	3720
Max.	200	70	5000	5000	300	400	130	500	500	40	200	10270	10570

Source: Field Survey, 2008

9.11.1 Marketing Cost Activity

The marketing costs affect the gross margins, profitability and the efficiency of the marketing system. High costs of marketing could be associated with low marketing efficiency (Achike et al., 2010; Emam, 2010; Anataprana, 2009; Falayan, 2002). Therefore in order to improve on the marketing profitability of cassava, reducing the costs of marketing is important.

Various costs that are incurred in the marketing of cassava and its products are transportation, loading/unloading, commission/agent fees, utility fees, association fees and storage, security, rent, sellers' fees and so on. Table 9.17 provides the breakup of various marketing activity costs. These costs are based on the current prices recorded in the survey.

There are some variations in the costs of marketing activities in the three regions of the study area, with Delta North showing the highest cost of total marketing activity (N7, 342.86), followed by Delta Central (N6, 900.57) and Delta South (N6, 619.17). This variation in the total marketing activity cost may be due to variations in the cost of transportation and loading costs. Shares of the marketing activity cost in the study area were accounted for, in order of significance, by transportation with the highest proportion of cost (42.76 percent), followed by loading (34.74percent) as shown in Table 9.18.

9 .11.2 Marketing Margin Spread and Marketing Margin

The marketing margins, farm gate prices in Naira and the relative share of marketing activity costs in all regions of Delta State are illustrated in Table 9.19. The percentage share of marketing activity cost in Naira ranges from 4.04 percent for cassava flour to 39.69 percent for cassava root tubers. Thus, cassava root tubers are noted to have the highest marketing cost, while the value added products have lower marketing costs.

Table 9.18 Percentage Shares of Marketing Activities Costs

Regions	Commissions /Agent Fees	Association Fees	Loader costs	Trans	Storage	Mkt Sellers	Security	Utility	Rent (TFC)	Council Fees	Others	TMC	TLMC
Mean	97.62	52.57	2100.00	3445.81	199.43	242.67	105.71	272.81	266.38	30	140.29	6711.71	6954.38
Std D.	20.825	4.605	1081.754	568.498	58.570	41.632	11.837	71.082	79.857	8.145	37.505	1205.323	1212.525
Min.	50	50	1000	1000	150	200	100	100	150	20	100	3520	3720
Max.	200	70	5000	5000	300	400	130	500	500	40	200	10270	10570
%Share	0.81	0.87	34.74	42.76	3.30	4.02	1.75	4.51	4.41	0.50	2.32	-	12088.22(100)

Source: Field Survey, 2008

Table 9.19 Marketing Spread/Shares

Prices	Cassava Root	Gari	Starch	Fufu	Tapioca Dried	Cassava Flour	Total Mean Margin
Farmgate	14710.88 (52.36%)	51000.00 (65.26%)	68129.00 (66.31%)	63586.21 (65.95%)	63846.15 (25.52%)	83555.56 (27.96%)	50.56
Wholesalers	-1144.43 - (4.07%)	7722.09 (9.88%)	7819.85 (7.61%)	12523.38 (12.99%)	50199.47 (20.06%)	58934.50 (19.72%)	11.03
Retailers	3380.07 (12.03%)	7579.40 (9.70%)	14947.52 (14.55%)	8215.97 (8.52%)	124058.46 (49.59%)	144310.60 (48.28%)	23.77
Marketing Activities	11151.62 (39.69%)	12088.23 (15.47%)	12088.23 (11.77%)	12088.23 (12.54%)	12088.23 (4.83%)	12088.23 (4.04%)	14.64
Total	28098.04 (100%)	78147.06 (100%)	102741.94 (100%)	96413.79 (100%)	250192.31 (100%)	298888.89 (100%)	100%

Source: Field Survey, 2008

The shares of cost for marketing intermediaries showed a range from 11.03 percent for wholesalers to 50.56 percent for farmers, with the cost shared between marketing expenses and retailers with 14.64percent and 23.77percent respectively. The margin varies with marketing activity, for different cassava products, and according to the quantity purchased. For traditional products, primarily raw cassava, the margin is lower compared to staple food products of *gari*, starch and *fufu* which have higher demand and supply levels. For those added value products with low demand and supply, the farm gate margin is low when compared with that of other marketing intermediaries like wholesalers and retailers.

9.11.3 Cost and Returns, Gross Margin, Profitability and Marketing Efficiency Analysis

The results of the profitability analysis including gross margin, market margin, net margin and marketing efficiency are presented in Table 9.20. The table shows that the market for cassava root tubers and cassava products is profitable; apart from the gross margin of the wholesalers which has a negative value, but all others are positive. The negative return may arise due to the perishable and short shelf life of cassava root tubers, and in the real market scenario the wholesale activity is not common. Processors buy to process immediately and not for resale.

As value is added to root tubers, the gross margin, net margin and profitability increases as indicated in Table 9.20. The cassava root had the lowest gross margin (N3, 380.07), and the margin increases as the period of storage of cassava products increases: *gari* (N7, 579.40); starch (N14, 947.52) and *fufu* (N8, 458.63); while the gross margin, net margin and profitability of cassava products increases as the quantity in demand and supply decreases, as for dried tapioca (N124, 301.12) and cassava flour (N144, 553.26). The marketing efficiency is above 1 with all the products, which implies that cassava marketing is profitable under all

Table 9.20 Gross Margin, Profitability and Marketing Efficiency for CRT and Other Cassava Products (Naira per Tonne

	Cassava Root	Gari	Starch	Fufu	Tapioca dried	Cassava Flour
Farmgate Purchase Price	14710.88	51000.00	68129.00	63586.21	63846.15	83555.56
Total Variable Marketing Cost	5575.81	6711.71	6711.71	6711.71	6711.71	6711.71
Total Marketing Cost	5575.81	6954.38	6954.38	6954.38	6954.38	6954.38
Wholesalers						
Total Revenue	19142.16	65676.47	82903.23	83063.97	121000.00	149444.44
Gross Margin	-1144.43	7964.76	8062.52	12766.05	50442.14	59177.17
Net Margin	1144.43	7722.09	7819.85	12523.38	50199.47	58934.50
Retailers						
Purchase Price	19142.16	65676.47	82903.71	83063.97	121000.00	149444.44
Total Variable Marketing Cost	5575.81	4891.19	4891.19	4891.19	4891.19	4891.19
Total Marketing Cost	-	5133.85	5133.85	5133.85	5133.85	5133.85
Total Revenue	28098.04	78147.06	102741.94	96413.79	250192.31	298888.89
Gross Margin	3380.07	7579.40	14947.52	8458.63	124301.12	144553.26
Net Margin	3380.07	7336.74	14704.86	8215.97	124058.46	144310.60
Marketing Efficiency (Total Revenue/Total Marketing Costs)	1.14	1.10	1.17	1.09	1.98	1.98

Table 9.21 Costs Structure, Marketing Margins and Efficiency of Gari Marketers by Region

Variable	Delta Central	Delta South	Delta North	Total (All Regions)
Total Marketing Cost N/tonne	77787.07	85351.10	97036.00	70810.32
Total Revenue N/tonne	78147.06	87771.43	95971.43	78147.06
Marketing Margin (b-a) N/tonne	359.99	2417.33	-1046.86	7579.40
Marketing Efficiency =b/a	1.01	1.03	.99	1.10

Source: Calculated from Field Survey, 2008

marketing forms. Table 9.20 also indicates that the more value is added, the more profit is obtained in marketing. The marketing of cassava and cassava products is also profitable and efficient in all regions of the study areas, with a marketing efficiency of 1.10 or 110 percent, as shown in Table 9.21, with the exception of Delta North where there is a breaking even point (0.99). This finding is supported by similar studies (Afolabi, 2009; Fawole and Odebode, 2007; Mafimisebi, 2007; Adenije, 2006)

9.11.4 Factors that Determine the Gross Margin of Cassava Marketing

Regression analysis was used to examine the relationships between the gross margin (dependent variable), marketing activities and socio-economic variables (independent variables), and their significance.

$$\ln Y = \beta \ln X_1 + \beta \ln X_2 + \beta \ln X_3 + \beta \ln X_4 + \beta \ln X_5 + \beta \ln X_6 + \beta \ln X_7 + \delta D_1 + \delta D_2 + \varepsilon \quad (9.2)$$

The regression is expressed in double logarithms and its coefficients on the variables except the dummy variable can be read directly as elasticities. While Y represents gross margins, $X_{1,}$ $X_{2,}$ ………., X_7 represent the inpendent variables, δD represent coefficients of dummy variables, ε represents the error terms, and this allows the effects of the multiple variables to be indentified separately.

Regression Estimate of Cassava Root Tubers

Results from the regression of cassava root tubers indicate that the coefficient on root tuber purchased is 0.83; giving the implication that for a 1 percent increase in the quantity of cassava root tuber purchased, the gross margin will increase significantly, by 0.83 percent (see Table 9.22). Similarly, among the socio-economic variables, the education variable has a significantly positive impact on gross margins.

Table 9.22 Result of Regression Estimates of Cassava Tubers Marketing Costs against Gross Margin

Variable	Coefficients	t Value	P>[t]
Root Purchase Qty	0.8319*	3.78	0.000
Fees	-0.0521	-0.05	0.963
Utility Costs	-0.6361	-1.01	0.317
Transportation Cost	-0.6189	1.17	0.246
Loading Cost	0.0819	0.38	0.703
Educational Level	0.6179**	2.38	0.020
Rent	-0.1481	-2.27	0.787
Delta Central	-0.7955**	-2.59	0.012
Delta North	-0.4831***	-1.75	0.085
Constants	11.9872***	8.98	0.186

R- Square = 0.4313; Adjusted R- Square =0.3584.
***=1% level significant, ** =5 % level significant and *=10% level significant.

The coefficient on the educational variable implies that a 1 percent increase in the number of years spent in education will increase the gross margin by 0.061 ($p<0.05$). In other words, educated traders are capable of making more profit from marketing. The gross margin from marketing is significantly lower in Delta Central and Delta South than in Delta North. The variation of the adjusted coefficient is 0.36, indicating that 36 percent of the variation is explained by the variables revealed in Table 9.22.

Regression Estimates of Gari

Table 9.23 suggests that the coefficient on marketing fees is 0.43. This means that fees, utility and transportation costs have a significant positive effect on the gross margin, while storage, loading and rent have a significant negative effect. The coefficient on transportation, utility and fees costs implies that increases of these cost elements will increases the gross margin, which is surprising. Increases in the cost of storage and loading will slightly decrease gross margin, as expected. The adjusted R-Square is 0.24 which suggest that 24 percent of variation in gross margin is explained by these variables.

Table 9.23 Result of Regression Estimates of *Gari* Marketing Costs against Gross Margin

Variable	Coefficients	t Value	P>[t]
Fees	0.4332**	2.56	0.012
Utility	0.4547***	1.41	0.163
Storage	-0.1004	-3.36	0.001
Loading	-0.0056*	-0.35	0.001
transportation	0.0234***	1.34	0.183
Rent	-0.0021***	-4.25	0.000
Security	0.0020763	-0.07	0.946
Delta Central	-0.6214*	-3.22	0.002
Delta North	-0.3844**	-2.01	0.048
Constants	9.3552*	40.63	0.000

R-Squared = 0.2972; Adjusted R = 0.2394.
***=1% level significant, ** =5 % level significant and *=10% level significant

Regression Estimates for Dried Tapioca

Table 9.24 shows that the coefficient on dried tapioca 0.88, indicating that for a 1 percent increase in the quantity of dried tapioca purchased, the gross margin will increase significantly by 89 percent and . It should also be noted that the cost of fees and utility have a positive influence on the gross margin. The value of the adjusted R^2 is 0.61 indicating that 61percent of the variation in gross margin is explained by these variables.

Table 9.24 Result of Regression Estimates of Tapioca Dried Marketing Costs against Gross Margin

Variable	Coefficient	t Ratio	P>[t]
Qty Purchased	0.8788*	10.00	0.000
Fees	1.0494***	1.58	0.120
Utility Cost	0.0414	0.10	0.921
Transportation	0.1943	0.06	0.953
Loading	0.3142**	2.24	0.029
Education level	-0.0111	-0.76	0.450
Rent	0.1357	0.37	0.710
Delta Central	-0.6214*	-3.22	0.002
Delta South	-0.3844**	-2.01	0.048
Constants	-2.5251	5.2537	0.632

R- Squared=0.6628, Adjusted R- Squared= 0.610,
***=1% level significant, ** =5 % level significant and *=10% level significant.
Source: Calculated from Field Survey, 2008

9.12 Chapter Summary

This part of the study has attempted to examine the marketing structure, conducts and performance of cassava marketing in Delta State, Nigeria. Simple descriptive statistics, marketing margin analysis and multiple regression techniques were used. Results show that the market structure and conducts provide free entry and exit; prices were determined by negotiation between the marketers and the buyers and there is a free flow of market information, indicating the characteristics of a perfect market. The marketing margins show that producer share of the total margin was 50.56percent, wholesalers (11.03percent), retailers (23.77percent) and marketing cost activities (14.64percent). This result is supported by that of Nwaru et al. (2011), but contradicts the findings of Obasi (2008) and Echebiri and Mejeha (2004), who reported a higher gross margin for wholesalers than that of retailers in rice marketing in Abia State. According to Scarborough and Kydd (1992), 5 and 10 percent marketing margins are acceptable for stored and perishable goods respectively. The gross margin analysis shows that cassava marketing is profitable in all areas of study. The total mean marketing efficiency was 1.10.

Quantity purchased and education level have a positively significant effect on the gross margin, a result which is in line with the study of Nwaru et al. (2011) and Ali et al. (2008), while fees, utility and storage costs have negative significant effects on the gross margin, a conclusion which is also supported by Ali et al. (2008).

The coefficients of regression indicate that marketing efficiency is lower for Delta Central and Delta South than for Delta North. The key finding of this section is that as value is added to CRT, the gross, net and profitability margins increase. Therefore, the hypothesis that marketing efficiency increases with the level of processing seems to be valid, however, this result cannot be formally tested because of the relatively small sample size in each category of processed cassava. The study suggests that government policy should be directed towards reducing the costs of marketing activities by improving infrastructure facilities, providing micro credit for marketers to expand, provision of marketing information and encouraging substitution of CRT as a source of raw material for industrial usage.

CHAPTER 10

CONSTRAINTS TO CASSAVA PRODUCTION

10.1 Introduction

The previous chapters have examined productivity, processing and marketing of cassava root tubers and its products. Analysis from the results indicate that production, processing and marketing of cassava is profitable in all regions of the study areas, which is in accordance with the results of other studies (Afolabi, 2009; Ayoade and Adeola, 2009; Awoyinka, 2009; Enete, 2009; Knipscheer et al., 2007). Analysis of the results has shown that cassava farmers, processors and marketers are operating at very low levels of technical, allocative and cost efficiency.

Agricultural productivity trends (discussed in the next chapter) indicate declines in productivity from the 1970s to mid-1980s. Nigeria has witnessed strong economic growth in the past few years, averaging 8.8 percent in real annual growth from 2000 to 2012 (Eboh et al., 2012; Izuchuhwu, 2011; Phillips et al., 2009), but the agricultural sector has lagged behind GDP growth, growing at between 3.7 and 6.5 percent (Rekass, 2009; Phillips et al., 2009; and CBN various issues).

According to Eboh (2012) and Phillips et al. (2009), the agricultural sector has been limited by production and postharvest constraints, and by the fact that farmers are operating at the low end of production function (low efficiency). This underscores the potential to raise productivity through increased use of more efficient inputs rather than by expansion of production area. Many studies have argued that the most important factor to influence Nigeria's agricultural productivity is the ability to add value and this is affected by rainfall/climatic conditions, technology (efficiency parameters), management and fertilizer use. Studies generally show that land is the least important factor. This chapter tries to examine various constraints affecting the potential of cassava as a crop for agricultural growth and development in the study area of Delta State, Nigeria.

This section will focus on identifying the constraints to cassava cultivation, processing and marketing in Delta State and seeks means for cassava productivity to be improved, as discussed in Chapter Two. The production of cassava and other crops are hampered by a number of socio-economic, biological and environmental factors, therefore possible solutions to these constraints may provide opportunities to boost productivity. Regarding this objective, farmers were asked about problems with crop production in the area of study. Farmers' responses were recorded as lists of the major constraints encountered during farming of cassava in the case study area. Based on the types of constraints identified by other studies, questions were asked about the opinions of the respondents on which of the major constraints they were most likely to encounter, for example in terms of infrastructure and services provision, and farmers were asked to rank them in order of importance. These responses are categorised using a five-point Likert-scale (i.e., strongly disagreed, disagreed, neutral, agreed and strongly agreed). Constraints and probable solutions identified are analysed and discussed in the remainder of this chapter.

10.2 Constraints Affecting Farmers

According to other studies (for example, Saingle, 2010; Ayoade and Adeola, 2009; Awoyinka, 2009; Enete, 2008; Twiwo, 2006; Okuneye et al., 2003; and Nweke, 1996), a number of constraints to efficient agriculture are identified, such as low commodity prices, unstable markets, lack of infrastructure e.g. storage facilities and a shortage of all-weather roads, which combine to limit agricultural production in Nigeria and most other developing countries. Other studies, such as by Odoemenem and Obinne (2010), Afolabi (2009), Reardon et al. (2000) and Nweke (1996) viewed that the lack of adoption and use of improved inputs and technology were among the major factors limiting increases in agricultural productivity.

An investigation to assess the major constraints facing farmers, including assessment of the government provision of infrastructure and services, in the area of study was therefore completed. Respondents ranked constraints. Not all responded on all eight constraints. The results are presented in Table 10.1.

Table 10.1 Constraints to Cassava Production by Infrastructure Provision

Constraints	Delta Central	Delta South	Delta North	All Regions	Weighted Ranking
Water Provision	3.49	3.82	2.51	3.27	1
Processing Facilities	3.70	3.54	2,41	3.22	2
Electricity Provision	4.05	2.38	2.83	3.09	3
Marketing Facilities	3.79	2.52	2.90	3.07	4
Credit Facilities	3.69	2.37	2.42	2.83	5
Road Network	3.82	1.88	2.70	2.80	6
Extension Services	3.39	1.94	2.72	2.69	7
Information Provision	3.24	1.85	2.66	2.58	8

Ranking Scale:
1 = Strongly Disagree 2= Disagree 3= Neutral 4= Agreed 5= Strongly Agree
Source: Calculated from Field Survey, 2008

10.2.1 Provision of Portable Water Supplies

Water is needed for human consumption, for irrigation and often for processing farm produce. Due to the geographical location of the study area, in the tropical forest zone, vegetation found here needs to do well with limited water supplies, which cassava can. Water management is very important in the area and there are recognised to be some problems associated with rain patterns in the area, with threats of periodic flooding, which destroys most cassava root tubers, or late rains in more water scarce years. Water provision in all areas has a total average mean of 3.27 in the ranking of 1 – 5 and ranks first in weighed rank value from 1 – 8 as shown in Table 10.1. This assessment also agrees with the finding of Iyagba (2010) in a study of root and tuber crop production in Nigeria.

10.2.2 Provision of Processing Facilities

In addition, irrigation facilities and exposure to flooding problems can be used to make predictions about yields of crop harvests and the timing of the harvest of cassava root tubers. Constraints of processing facilities is another main reason given by farmers, while they sell cassava as root tubers, sales in this form reduce their capacity to raise their net profits on cassava production. The provision of processing facilities has a mean result of 3.22 and ranks second in the weighted ranking. This assessment is supported by Ayoade and Adeola (2009) in their study to investigate constraints to domestic industrialization of cassava in Osun State, in South west Nigeria, who stated that inadequate processing equipment, high processing costs and an ineffective link between farmers and processors were the most important factors constraining agricultural productivity. Cassava farmers in the study area, and throughout Nigeria, have limited diversification options and given their inadequate access to improved processing technology, most farmers are processing CRT manually. This has discouraged farmers from exploring the potential markets for CRT. Studies by FAO and IFAD, (2005) and Oyewole and Sanni, (1995) have agreed with this assessment.

10.2.3 Provision of Electricity

Power supply was one of the major constraints to expanding processing facilities in the study area. Electricity could be used for storage facilities; for the processing of root tuber; for processing drinking water and in some cases for irrigation purposes. Lack of reliable supplies of electricity could lead to high production costs, by demanding that limited capital is spent on the fuel to run generators and processing machines. The provision of electricity is said to be improving, but it remains unreliable. Relatively, this was seen as an important constraint, producing an average of 3.09 according to the ranking and 3rd in the weighted rank value.

10.2.4 Provision of Marketing Facilities

Marketing of root tubers is associated with low prices during the period of flooding or periods of higher output since the farmers are price takers and cannot determine the price of the commodity. Low prices during the period of flooding and/or higher productivity lead to a reduction in levels of cultivation in the following planting season. Although, there are regular marketing areas, these areas are not equipped with full storage and security facilities, and are often without accessible road networks. Inputs are important for increasing agricultural productivity, but they need to be accompanied by access to good quality information informing their use. The market of inputs has been characterised with irregular supplies and high costs even when they are available; especially the shortage of improved variety cassava cuttings coupled with poor market access. Provision of local market is 3.07 and ranks fourth in the weighted order.

10.2.5 Provision of Credit Facilities

Purchasing farm implements, inputs such as seeds, fertilizers or pesticides, hiring labour and so on is being limited by a lack of capital, or by the lack of access to credit facilities that would enable farmers to use more of these inputs. Although most of the farmers could access capital from personal savings, others obtain credit from local sources of borrowing for which the interest rates are generally very high. The institutional (bank or government) credit facilities, where credit is supplied at lower interest rates and with easy terms and conditions are largely not available in the areas studied, or at least the famers are not aware of such facilities. Table 10.1 indicates that lack of credit is 2.83 and rank 5th in the weighted ranking value.

10.2.6 Provision of Road Networks

Most of the roads to farms or input and output markets are seasonal, that is they are not passable during the rainy season. This severely affects the chains of supply and demand of farm produce, and has led to irregular fluctuations in prices caused by high transportation costs. Provision of better roads in the study area was 2.80 and ranked 6^{th} on the weighted rank value as shown in Table 10.1. This finding is supported by the study of Ayoade and Adeola (2009) on the constraints to domestic industrialization of cassava in Osun State, South West Nigeria.

10.2.7 Provision of Extension Services

The primary role of the provision of extension services is to provide technical information about production technologies and predicted weather information to farmers. Extension services provide the linkage between researchers, policy makers and farmers, so access is vital to generate increases in productivity. Table 10.1 shows that access to extension services is 2.69 and seventh in weighted ranking. This supports the view given by the FAO and IFAD (2005) that the extension delivery system is inefficient, and as a result is not effective in the delivery of extension services.

10.2.8 Provision of Information

Lastly, among the constraints of cassava farm production, information provision is vital to access knowledge on modern technology, access markets for farm inputs and produce, even in the area of providing information on the weather would boost productivity. Access to credit facilities and training programmes for farmers is either selective or information does not get to the relevant users. Provision of information was the least important in terms of constraints, measuring 2.58 and lying 8th in the weighted ranking.

10.3 Constraints to Cassava Root Tuber Processing

The linkage between the production of cassava root tubers and marketing is processing. Any effort to make increases in cassava production will involve the processing for markets, if it is to improve farmers income, as it is necessary to reduce the weight of bulky CRT for easy transportation and to reduce/or stop spoilage of cassava root tubers.

Findings from Chapter 7 indicate that farmers process 88 percent of cassava root tuber into *gari*, which is more than the national average of 65-70 percent rate of processing. This may be due to the lack of developed markets for industrial uses of cassava root as raw material or the high cost of processing which makes it uncompetitive as a raw material substitute in the international markets. Processing is also limited by unstable market conditions, unstable government trade policy and difficulty in sustaining the supply of cassava.

The processing rate of root tubers often influences the price that can be gained. When farmers and marketers are unable to process harvested roots, they are forced to sell their produce at a very low price: 1 kg of root tuber fetches about N14 while 1 kg of processed *gari* is about N65. Moreover, the supply of cassava greatly influences the market price; as a result, when cassava is in short supply and the prices are high farmers increase production. This causes oversupply which lowers the market price and encourages farmers to cultivate fewer hectares of cassava, and results in fluctuation in the price cycle for approximately two to three years (Folayan and Bifarin, 2011; Amoah, 2010; Saingbe et al. 2010; Ayoade and Adeola, 2009; Afolabi, 2009; Chukwuyi et al., 2006; Nweke et al., 1994).

In addition, the largest share of added value goes to secondary processors and middlemen. Organising farmers and training them in entrepreneurship skills is necessary to improve their bargaining position and their production and processing methods (Oyewole, 2011; Phillips et al., 2009). The results of the investigation to assess the major constraints faced by farmers, processors and marketers in adding value to cassava root tubers are briefly stated below in Table 10.2, ranking with 1 as the highest.

Table 10.2 Constraints to Adding Value

Constraints	Percent	Ranking
Transportation Difficulties	91.5	1
Lack of Adequate Information	91.4	2
Too Many Buyers for Limited Raw Materials	76.6	3
Lack of Processing Equipment	76.2	4
High Cost of Raw Materials/processing equipment	72.4	5
Lack of Adequate Infrastructure	70.5	6
Others	23.8	7

Source: Calculated from Field Survey, 2008

10.3.1 Transportation Difficulties

About 91.5 percent of the processing respondents agreed that transportation of root tubers from either farm or market to processing site is costly, leading to high costs of production particularly given that long distant movement could result in the deterioration of CRT. This is a major determinant that affects the cost and efficiency of processing. Agricultural produce largely remains on farms or goes to the nearest local market, implying that processors are always close to the sources of CRT supplies. This assertion is also supported by the studies of Ohimian (2014), Akinnagbe (2010) and, Okezie and Kosikowski (2004).

10.3.2 Lack of Information

Table 10.2 reveals that a lack of information also acts a major constraint to cassava processing. The majority of processors are not aware of the most recent technologies that will reduce the need for human labour and therefore cost, which would increase their efficiency. Such technological innovation is mainly seen in the research and big time processing industries. Where technologies which improve efficiency are available and affordable to average small scale processors, a lack of information about industrial end-users may act as a disincentive to diversifying processing methods, since most processors do not have links to the markets for cassava chips, crumbs and other forms of cassava markets.

10.3.3 Too Many Buyers for Limited Raw Materials

Most processors also agreed that sometimes in the cassava markets, too many buyers try to purchase from a limited supply of root tubers. This extra demand causes increases in the numbers of big time processors in the markets, and increases in the prices of root tubers. This also leads to a decrease in the supply of traditional process products in the markets, which by reducing supply also creates an increase in the price of such products..

10.3.4 High Cost of Raw Materials and Processing Equipment

The lack of knowledge of the current production output, weather and marketing/farm accessibility could result in a high cost of processing raw materials, like raw tubers and firewood, whose supplies are greatly affected by the current weather situation. Supplies of grating machines, dryers, roasters and frying pots are limited, and when available the prices are very high. This also contributes to a high cost of production as indicated in Chapters 5 and 7, where data showed that the cost of raw materials and other inputs make up the largest proportion of the cost of production.

10.3.5 Lack of Adequate Infrastructure

Table 10.2 indicates that 70.5 percent of processors view the lack of infrastructure as hampering the processing of root tubers in all the regions of the study areas. Given the lack of storage facilities for when there is an oversupply of root tubers, the left over is wasted. In most cases lack of good networks of roads to processing sites, farms and markets was also problematic. Additionally, the shortage of power supplies, which even when available are erratic, and the lack water of supply in many areas constrains efficiency of production; with the effort to sink a water borehole greatly increasing the cost of processing. This agrees with assertions from Gajigo and Lukoma (2011) in work presented on infrastructure and agricultural productivity in Africa.

10.3.6 Other Constraints to Cassava Processing

Other constraints that affect cassava processing in the area of study include: the inability of the processors to form cohesive groups to discuss their problems, seek common approaches or possible ways for government and stakeholders to intervene; and the high cost of labour in peeling, grating, sieving and frying of dried grain into the required forms. There are also constraints introduced by the lack of linkages between research institutes, stakeholders and processors, which results in insufficient representation of the needs of processors. Such linkages would be advantageous to develop in order to examine how government could make funds available to research which may provide answers to processors questions and problems, or establish how government could distribute information concerning the most recent technologies which apply to processors.

10.4 Constraints to Cassava Marketing

Exploring the potential of cassava root tubers as a source of agricultural growth and economic development will not be effective if there is no local and international market, generated by demand for cassava root tubers for consumption and as a source of raw material for industry. Furthermore, supplies must be reliable and be resilient to potential fluctuations in demand within the local and national markets. This sub-section will examine the constraints to cassava marketing in the area of study that affect the marketing of cassava root tubers and cassava products.

Questionnaires were administered to cassava marketer respondents to ascertain the problems faced in carrying out marketing activities. The actual questions asked are presented in Appendix C (Question numbers: 55). The results of this questionnaire are presented in Table 10.3.

10.4.1 Marketing Accessibility

All marketing respondents agreed that transportation difficulties in getting produce to markets are more extensive than simply the high cost of transportation. Many of the rural communities in the study area are not readily accessible; feeder roads are either absent or in very poor condition. Most of the villages rely mainly on human transport, either through carrying on the head, by wheelbarrow, by push-bike or motor-bike to the main markets or some significant distances before using motor transport. The high cost of this kind of human portage, apart from being very slow, is a very high cost of marketing resulting in high consumer prices, which in turn results in low producer prices and damage to significant amounts of produce.

Table 10.3 Marketing Constraints

Constraints	Percent
Market Accessibility	100
Unstable Prices	100
High Cost of Marketing	100
Lack of Market Infrastructure	98.1

Constraints	Percent
Storage Problems	65.7
Lack of Information	61.9

Source: Calculated from Field Survey, 2008

10.4.2 Unstable Prices

Table 10.3 reveals that prices for agricultural produce fluctuate frequently. This is due to the fact that agricultural produce supply and prices instabilities characterise the agricultural markets in Delta State. Due to the nature of food production and the limitations imposed by marketing constraints, farmers in the study area usually adjust levels of production according to the prevailing market prices. Also, due to the short life shelf, caused by the perishable nature of cassava, and the threat of bad weather, farmers and marketers are often willing to sell at depressed prices knowing they are unable to store any surplus.

10.4.3 High Cost of Marketing

Other factors that reduce the effectiveness and efficiency of marketing agricultural produce in the study area are the high costs involved in carrying out marketing activities. Transportation costs represent the highest proportion of the total marketing cost, followed by high costs of loading/unloading, with fees also having to be paid to local councils and for marketing group activities. All marketing respondents indicate that transportation cost contributes to the high marketing cost as shown in Table 10.3.

10.4.4 Lack of Market Infrastructure

Table 10.3 indicates that 92 percent of the market respondents viewed a lack of marketing infrastructure as limiting their market. Market facilities in the study area generally had inadequate or absent toilet facilities, clean drinking water, electricity supplies and road networks. Additionally, marketing areas were often not secure, so marketers were not willing to leave after sales since there are no lock-up stalls or protective fences.

10.4.5 Storage Problems

Another constraint limiting cassava marketing in the study area is in the lack of adequate storage facilities. As a consequence, there is substantial waste at farm level, and poor storage also contributes to marketing prices fluctuations where produce prices are low during harvesting or flooding periods which adversely affects the marketing margins.

10.4.6 Lack of Marketing Information

Marketing information is lacking in the study areas. 61 percent of marketing respondents revealed that information regarding farm level outputs from different areas could not easily be accessed. Thus, when there are large quantities of supplies in some areas, and marketers there were able to buy large quantities at relatively low prices, in other areas marketers find a shortage of supplies at a higher price. The market for cassava in the study areas is not organised. Markets are manipulated by wholesalers and commission agents whose interests are not served by passing on information about the true nature of supply and demand in the market. Since there is no official or organised means to transmit price information, there is no mechanism for coordinating the production activities of farmers with the demand of individual, corporate and institutional consumers.

Thus, the market for cassava and cassava derived farm produce is being hampered by an array of problems. There is a need to assist farmers in marketing their produce and also to facilitate all the intermediaries involved in marketing to make informed choices in accordance with current market conditions. This will help stabilise prices and improve the efficiency of the market.

10.5 Suggestions on how to Improve Cassava Marketing

Respondents and stakeholders in the survey areas were requested to forward suggestions about how to reduce or remove constraints in the marketing of cassava. A synopsis of their suggestions is briefly stated below:

The Role of Government

- Favourable government policies should be sustained
- Industrial end-users should be encouraged to invest in the construction of storage facilities at nodal points within easy access of a network of core processors and suppliers
- Accelerate the development of a functional marketing information system
- Incentives, especially credit facilities, improved inputs and capacity building programmes, should be used to encourage people to form groups or cooperative to strengthen their bargaining power
- Help in funding research for the development of prototype peeling, washing and drying machines, suitable for small and medium scale operations
- Facilitate linkages between farmers, processors and marketers and potential industrial end-users
- Guaranteed access to affordable credit facilities for farmers, processors and marketers
- Build linkages between research institutes and farmers, processors and marketers in order to encourage the development of technologies that will increase the efficiency of farming, processing and marketing

Respondent/Actors Role

- Farmers, processors and marketers should to work together, both between themselves and with government agencies, and they should be encouraged to participate in any programmes which are available
- Farmers, processors and marketers involved in the sale of cassava products should be willing to give all necessary information to relevant agencies
- Should be willing and be able to meet all contracting and credits agreements

10.6 Chapter Summary

Cassava production, processing and marketing in Delta State Nigeria is being limited by various constraints. The main constraint is imposed by high costs involved in production, processing, and marketing activities. Others include lack of credit facilities, lack of information, lack of infrastructural facilities and poor product quality resulting from continued dependence on traditional production and processing technologies.

In respect of all these points, survey respondents and stakeholders who participated in this research agreed that investments in technology and education; improvement of infrastructure facilities like good road networks; greater distribution of information and easier access to credit facilities will be needed to promote improved growth in the production, processing and marketing, thus the utilisation, of cassava. The findings presented in this study agree with the work of others, namely that increasing access to credit facilities would not necessarily improve productivity, largely depending on how such facility is managed (Omonama et al., 2010; Otitoju and Arene, 2010; Phillips et al., 2009). The common position throughout the literature recognises that the lack of access to credit, good road networks, and stable government policy place significant constraints on the efficiencies of cassava production and marketing. The most important constraints found in this study also included pests, lack of rain, seasonal flooding and the use of non-commercial production systems in small and fragmented farm holdings.

Constraints to cassava production and productivity have been identified as numerous, and this agrees with the findings of a large numbers of other studies. For example, Dixon et al. (2011), Addy et al. (2004) and Nweke (2004) among others have argued that efficient use of inputs, improvements in technology (including irrigation, pesticides, cuttings and storage methods), provision of market information, and the development and dissemination of adequate cassava planters, harvesters, peelers, hydraulic presses and dryers would all contribute to additional efficiency in cassava production. Such technologies would enable value to be added more extensively, remove the drudgery involved in current means of production and processing, and would overall make the cassava enterprise more economically attractive and help to standardise quality. Cassava processing could enhance the stability of market prices (which was identified as one of the main problems in the literature review), as well adding value to primary forms of production leading to higher incomes and eventual increases in agricultural productivity and economic growth in Nigeria.

CHAPTER 11

AGRICULTURAL POLICY REVIEW AND CROPS (CASSAVA) PERFORMANCE TRENDS IN NIGERIA (1970-2009)

11.1 Introduction

The preceding chapters have highlighted the production costs, gross margins, profitability and efficiency of production, processing and marketing of cassava, as well as exploring ways in which cassava could be utilised as a crop to boost agricultural productivity and growth in Delta State, Nigeria. The findings indicate that cassava production, processing and marketing is profitable in all aspects, but has low levels of efficiencies and low profit margins. According to Eboh et al (2012), Izuchukwu (2011) and Phillips et al (2009), factors of inefficiencies and low incomes could be attributed to the socio-economic characteristics of cassava farmers, processors and marketers coupled with policy distortions. However, Grote (2001) and Guirkinger and Boucher (2006) consider that such poor performance may be exacerbated by external new challenges arising from environmental and food security standards such as labelling, internal constraints in developing countries and weak markets for agricultural products. Food production and the attainment of agricultural self-sufficiency are among one of the major criteria in assessing a country's level of development.

Developed countries employ less than 10 percent of the population to produce enough food for domestic consumption and export while in developing countries, more than 50 percent are employed in the agricultural sector yet they remain lacking in the capability to be self-sufficient in food production (Navarrete, 2007; Grote, 2001). As stated in Chapter 1, some developing countries like India, China, Brazil, Argentina, Chile and most of the OECD countries that were once major food importers are now self-sufficient in food production in some areas and have become the major exporters of agricultural commodities (OECD, 2009, 2010), while others, particularly in SSA, are lagging behind. Agricultural development is dependent on many factors such as education, technology, climatic conditions, markets; as well as conditions of world commodity trade, socio-economic and cultural background, and can therefore be boosted with the help of a good policy environment as discussed in Chapters 1 and 2. These are clearly keys to helping Nigeria towards self-sufficiency in food production, the efficient marketing of agricultural raw materials and the processing and marketing of many other value added products. A good policy environment implies political conditions that will encourage sufficient food production and act as an engine of growth, despite resource constraints (DFID, 2004). This, supported by good budgetary allocations, should be able to address the effects of high costs of transportation and the provision of reliable and functioning extension services to improve access to inputs available during planting seasons at reasonable cost, and provide basic training and information to all farmers, processors and marketers. Reducing the effects of the above mentioned adverse market conditions should lead to increases in efficiencies and farmers' incomes.

This chapter considers why, despite several decades of agricultural development policies, plans and implementations, agricultural efficiency and productivity is still low in Nigeria, (as illustrated in Chapters 5, 6 and 8) and why its productivity continues to be characterised by multiple constraints as Chapters 1 and 10 have illustrated. To explore this area, the ensuing chapter is composed of two parts. First, it presents a survey of the agricultural policies undertaken in Nigeria over the past three decades (1970-2009), with a view to examining some of the main causes of agricultural policies not having achieved their objectives. Secondly, the chapter examines trends in output, yield and area of cultivation of some of the major staple crops in Nigeria. This data supported by responses from the field survey which reflect on government policies over the period of time focusing on several time periods: Pre-SAP (<1986), SAP (1986-1992) and Post-SAP (>1993). Average annual compound growth rates of production, yield and cultivated area of cassava, yam, maize, groundnut and millet, and fertilizer use were estimated by fitting a semi-log trend equation, as discussed in Chapter 3 using the SPSS software for analysis.

11.2 Review of agricultural development in Nigeria

The importance of agricultural policy in boosting food production and in accelerating agricultural development cannot be over-emphasised (OECD, 2010). Agriculture, in conjunction with other land-based industries such as forestry, has played an important part in the development of rural economies in OECD member countries (Dewbre et al., 2008). Although the contribution of agriculture to rural incomes and employment is low in most developing countries and in many cases is declining, it continues to have a key role in the management of natural resources, particularly land and water. Akpan (2012), Olowu, (2011) and OECD (2010) concluded that the greatest benefits to rural areas are likely to be generated by a shift away from emphasis on the agricultural sector and a move towards place-based policies that address the overall economic performance of rural areas. Support to farmers in OECD countries from agricultural policies accounted for 23 percent of farmers' gross receipts, declining from 26 percent in 2006 and 28 percent in 2005. Such support discourages agricultural growth in developing economies, by fulfilling demand with artificially low prices (OCED 2010, Awoyinka 2009, Walkenhorst, 2006).

Agricultural policy measures that support commodity prices are poor instruments for improving the rural economy. Measures that target economic sustainability in rural areas are better, for example encouraging the development of new or more diversified economic activities for farm households or ensuring the supply of rural amenities (OCED, 2008). In Chile, agricultural policies were used to increase demand; specifically, internal demand was strongly increased through a policy of increasing the minimum wage. External demand was also increased through the efforts undertaken by the government to expand fruit exports to Asia and the Pacific, namely by convincing Japan and Taiwan that, irrespective of the fact that Chile has fruit fly infestation in the extreme North of the country and the driest desert in the world, it could still produce fruits for export of good quality (OCED, 2008). Policy measures can also be used to encourage farmers to get maximum income from their products (Ohimain, 2014; Olowu, 2011; Mogues et al., 2008, Erhabor etal, 2007, Nweke, 2004).

This chapter reviews existing efforts in terms of agricultural development policies in Nigeria, and examines the potential of adding value to boost agricultural growth and development. A number of authors (for example, Izuchukwu, 2011; Chinedu et al., 2010; Enoma, 2010; Eze, 2010; Okoye et al., 2008; Erhabor et al, 2007; Abdullahi, 2003 and Olewunne, 2002) argue that agriculture is the mainstay of the Nigerian economy. About 70 per cent of the country's labour force is engaged in agriculture. Production is largely in the hands of peasant farmers and small-holders, with large-scale farming operations and plantations numbering relatively few. Most agricultural enterprises remain with a low level of mechanisation overall. In the 1960s, this sector accounted for about 70 percent of t Gross Domestic Product (GDP), but by 1980 this proportion had declined to 22 per cent (Kanayo et al., 2013). The reasons for this decline are widely recognised to be due to a significant rise in the productivity of the petroleum sector and the relative neglect of agriculture during these oil boom years, which have caused stagnation in other economic sectors (Ugwu and Kanu, 2012; Okezie and Amir, 2011; Awe and Ajayi, 2009; Philips et al., 2009; Onoja and Agumaga, 2009; Nweke, 1999, 2004; Eleazu, 1988; Eteng, 1997; Ayoola, 2001 and Mbada, 1992). Nigeria was once the world's largest exporter of groundnut and oil palm products, as well as cocoa, rubber, cotton, hides and skin. These latter five products accounted for 30 percent of total export receipts and 70 percent of non-oil exports (World Bank Report, 2007). In the production of so-called 'cash crops' (cocoa, palm produce, groundnut, hides, skin and so on), Nigeria has almost dropped out of international trade. Given its climatic and agro-ecological conditions, Nigeria has the potential to produce a wide variety of food and other exportable crops. While the Northern part of the country can guarantee the production of cereals such as sorghum, maize, millet, groundnut, cowpea and other crops like cotton, onions, etc., the middle belt and the south have potential to produce root tubers such as cassava, yam, cocoyam, oil palm, rubber, cocoa and other crops like banana, plantain and maize.

Many commentators see the continued import of food and food items, which Nigeria has the potential to produce (see Chapter 8), as arising from neglect of production of staple food crops and agricultural policy inconsistence. The value of imports of food and food items rose from only 48 million Naira in 1960 to 1,978 million Naira in 1981, dropping off slightly to 1,005 million Naira in 1984 and increasing rapidly again to 51.5 billion Naira in 2000 (Odedinal et al., 2011, Eze et al., 2010, Nurudeen and Usman, 2010; Diao et al., 2009, Abang et al., 2006, Sanusi, 2000 and Eleazu, 1988). The importance of agriculture in any society cannot be overemphasised, especially given the food needs of the growing population found in Nigeria. Falawiyo (1999) asserted that the majority of the Nigerian population depend on agriculture for food and that, in order to be self-sufficient in food production, the government must diversify its efforts to support sectors other than crude oil. A number of authors (e.g., Izuchuku, 2011; Eze et at., 2010; Nurudeen and Usman, 2010; Mogues et al., 2008; Iyoha and Oriakhi, 2003; Ekuerrharey, 1997 and Upton, 1996) have made an appealing argument for reduced dependence on food imports and greater national self-sufficiency in food production. In many cases the dependency on imports results from government policies, such as the maintenance of an overvalued currency, which have an adverse impact on the prices received by domestic producers. An important aim of the Structural Adjustment Programme (SAP) was to eliminate price distortions and to provide incentives for increased home production and import substitution. This is to be pursued even where it is cheaper to import than to produce domestically, to build resilience against the instability of world markets, and this provides a motive for seeking greater self-sufficiency for security reasons.

A number of authors (e.g., Ugwu and Kanu, 2012; Eze et al., 2010; Okoye et al., 2008, Nweke 2003, 2004; Mbada, 1997 and CBN/NISER, 1992) conclude that various succeeding governments have adopted one form of economic stabilisation measure or another to solve such problems, but with little success. The SAP policies were therefore adopted with a view to totally revamping the ailing economy, with particular emphasis on the agricultural sector for improved productivity and structural transformation. The package of reform measures were designed to stabilise the economy and restructure patterns of production and consumption by eliminating price distortions, which had characterised the system for many years deterring reasonable growth. The principal strategy was to let free market forces rather than administrative measures determine relative prices of goods and services. It was hoped that such free market forces would ensure that various economic agents get the right signals regarding what and how much to produce, with an incentive created by minimising economic cost in order to maximize returns. The new policy drive was therefore to diversify the Nigerian economy and to provide active promotion of a pre-eminent role for the private sector in the development process to encourage timely access to affordable and good quality agricultural inputs.

Daramola et al. (2009), Nweke (2004), Okoh (2004), Ayoola (2001) and Adubi and Okunma-Dewa (1999) have traced the agricultural policy and programme implementation as a product of both pre- and post-colonial administration and conclude that Nigerian agricultural policy has evolved in overlapping phases. Policies, in many cases, were not explicitly stated but could be inferred from the programmes that were implemented. Therefore, a need is identified to analyse the details of these programmes.

11.3 Agricultural Development Policies in Nigeria (1970-2009)

This section is seen in a wider context of the literature reviewed on Nigerian agriculture. Agricultural policies in Nigeria are grouped according to the Nigerian planning phases into four plans preceding the structural adjustment phase since independence in 1960 (Ayoola 2001). In the first National plan (1962-1968), efforts were made to quantify national objectives and the general priorities of the government. The second plan (1970-1974) was a general policy for self-sufficiency, while the third plan (1975-1980) (affected by the civil war) came into being at the height of the oil boom, during which foreign currency was not a serious constraint, thus relegating the notion of self-reliance and self-sufficiency to the lowest priority. The fourth plan (1981-1985) re-emphasised the notion of self-reliance and agricultural exports thrived during these early plan periods, but later suffered from shortages of food and raw materials leading to scarcity of essential food items.

Agricultural development policies in Nigeria could also be examined in terms of three distinct stages since independence in 1960 to present day: Pre-SAP, SAP and the Post SAP periods.

Table 11.1 Phases of Agricultural Development Policies in Nigeria: 1960- 2009

STAGES	FACTOR POLICY	COMMODITY POLICY	MACRO-RELATED POLICY
1: 1st Phase Minimal State Intervention (1960-69)	Approach generally 'laissez-faire'	Export crop marketing and pricing through activities of marketing boards	-Agriculture conceived as a residual sector from which surplus labour could be withdrawn for the development of "modern capitalist sector"
1: 2nd Phase Provision of Inputs at subsidized rate (1970-1985)	-Centralization of fertilizer procurement and distribution at federal level in 1975 -Establishment of a Superphosphate fertilizer plant Increase agricultural research institution, -Provision of farm inputs at subsidized rate -Promulgation of the Land Use Decree in 1978 -Creation of river basin authorities and establishment of communal farms	-Creation of Commodity Boards (CBs) in 1977 for cocoa, groundnut, palm produce, cotton, rubber and food grains to replace the marketing boards operating since 1954 -Launching of National Accelerated Food Production Project in 1973 -Introduction of Guaranteed Minimum price (GMP) -export of agricultural produce by CBs. -fixing of product prices -strategic grain reserve	Proceeds from agriculture used for the development of other sectors -Imposition of export tax -direct importation and sale of imported food commodities such as rice, wheat, flour, vegetable oils, livestock products etc -overvalue exchange rate -credit control -concessional interest rate -establishment of NACB in1972, ACGS and rural Banking Scheme 1977, Peoples Banks in 1980s
2: SAP (1986-1993)	-Subsidy withdrawal	-price control removed -abolition of CBs -liberalization of agricultural trade	-abolition of export tax -exchange rate deregulation -expenditure reduction -abolition of import licensing -rationalization of tariff structure -relaxation of import restrictions but when necessary, ban on food importation (e.g. rice, maize, wheat, barley and

STAGES	FACTOR POLICY	COMMODITY POLICY	MACRO-RELATED POLICY
			vegetable oils) was imposed and rationalization of input subsidies -commercialization and privatization of agro-parastatals -provision in 1987 of a five year tax-free period for profits earned by companies engaged in agricultural production and agro-processing. -direct government production discouraged -emphasis focus to encouraged small-scale farmers to increased food production
3: Phase 1 Period of military dictatorship (1994-1999) 3: Phase 11 Democratic system Widespread Economic Reforms (2000-Present)	-solving the problems introduced by SAP -disconnect the IMF policy -Government disengaged from fertilizer procurement and distribution -privatization of National Fertilizer Company (NAFCON)	-Cassava initiative (2002) -privatization of sugar companies -creation of agricultural production companies and subsequent handover to private sector -attract foreign investor into farming	Merging of NACB, People,s Bank, FEAP to form NACRDB -Tax reform -Trade policy reform -Modernization of customs and port management -Adoption of ECOWAS common external Triff (CET) in October 2005

Table 11.1 Phases of Agricultural Development Policies in Nigeria: 1960- 2009
Source: Idachaba, 2009; Olomola, 2008; FAO, 2006; CBN, 2004

The Pre-SAP could be divided into various phases. In the first phase (1960-69), agriculture was mainly in the hands of private-sector operators while government concerns were limited to the development of research institutions and product marketing (World Bank, 2006). The second phase (1970-1985) of the pre-SAP is a period of intensive state control of agricultural activities. During this period, the state established many communal farms, River Basin Authorities and irrigation/fadama (low-cost irrigation development of lowland areas) farms. This phase was characterised with providing farm inputs at subsidised rates and the state controlling the marketing of agricultural produce through marketing boards (Ndebbio, and Ekpo, 1991; Upton, 1996; Ekuerrhaey, 1997; Shimada, 1999; World Bank, 2005; Daramola et al., 2009).

The second stage is the period of the SAP (1986-1993). As previously mentioned, an important aim of the SAP was to eliminate price distortions and to provide incentives for increased production and import substitution. This was a period of deregulation which demanded the removal of farm subsidies and the dissolution of marketing boards. The principal strategy was to allow the forces of supply and demand (free market forces) to determine the prices of goods and services. The policy drive was also to aid diversification of the economy, to promote active participation of the private sector in the development process and to encourage timely access to affordable and good quality agricultural inputs (Garba, 2000; Ayoola, 2001; Daramola et al., 2009). Direct government food production throughout this period was discouraged, and the emphasis was firmly on small-scale farmers as the central focus of the food production process (FMAWRRD, 1988, 2009).

The third stage of Nigerian agricultural development policy is the post-SAP period (1993-present). This period has been focussed on encouraging privatisation and commercialisation of farming enterprises (Bello 2004). The first phase was during the period of military dictatorship, while the second phase represents the new era of reform under a democratic government, in which the economy is conceived of as market-oriented and private-sector led (Olumola, 2005; Awerije, 2004). These stages are examined based on three broad policy categories namely; factor policies, commodity policies and macro-policies. The major policies are illustrated in Table 11.1.

11.3.1 Structural Adjustment Programs (SAPs) in Nigeria

Structural Adjustment Programs (SAPs) were packages of economic and institutional measures designed to solve macroeconomic problems that led to decline and distortion in the economy of developing countries, by reducing government intervention in the economy correcting the borrowing country's deficits and opening the economy to the global market. Often, such measures are required as a condition for receiving World Bank and IMF loans (Ammani, 2012).

The broad objectives of Nigeria's SAP were to encourage the restructuring and diversification of the productive base of the economy in such a way as to reduce dependency on the oil sector and imports of food products and raw materials from abroad. One of the key strategies designed to achieve the Nigeria's SAP goals was development towards self-sufficiency in food production and substitution of foreign raw materials with those locally produced (Manyong eta l., 2005).

Among others, the centre-piece was a market-based exchange rate and liberalization of trade, developing a new tariff schedule, and the implementations of policies to increase export growth. The Structural Adjustments Program and supporting World Bank loan helped finance the foreign exchange gap that accumulated in 1986-87 arising from decline in oil revenue. The World Bank assisted with the development of trade policy as well as providing a loan export development loan of $452 million, in addition, the IMF approved a standby arrangement of SDR 650 million, subject to implementation of SAP. In addition, financial assistance in the form of debt repayment and other moneys from the Paris and London Club accompanied Nigeria's adoption of the SAP (World Bank, 1994).

A summary of the broad outline of the SAP in Nigeria can be highlighted as follows:

- The adoption of tight fiscal and monetary policy to reduce inflationary pressure and rationalization of public expenditures and public investment programs to promote growth
- The dismantling of exchange rate controls and the adoption of a market determined exchange rate policy
- The liberalization of trade regime and the rationalization of custom tariffs and excise duties and the abolition of price control
- Financial sector reforms
- The privatization and commercialization of public enterprise and abolition of marketing boards.
- Expanding non-oil export
- Attaining self-sufficiency in food and raw material production among others.

The next subsection will briefly review other specific programmes and institutions to boost agricultural development in Nigeria.

11.3.2 Specific programmes and institutions of Agricultural Policy in Nigeria

Some specific agricultural policies and programmes of the governments as shown in Table 11.2 have been analysed by a large numbers of authors (Garba, 2000; Oyoola, 2001; MANR, 2006; CBN, 2007; Idachaba, 2009). Table 11.2 shows the programmes, periods, methods of intended operations and their drawbacks, which are briefly discussed below.

(a) *Directorate of Food, Road and Rural Infrastructure (DFRRI)*: Created by the Presidency in 1986 to solve the problems of neglect and deterioration of infrastructure facilities in the rural areas. Rural infrastructures are fundamental to the success of agricultural productivity and it is only the central government that have the huge resources necessary to build roads, rural markets, rural electrification, water supply and telecommunications. DFRRI was also involved in communication with rural women in order to provide farm inputs such as seedlings and fish fingerlings. All such measures are needed to accelerate food production in Nigeria in areas where they are lacking.

Table 11.2 Agricultural Policy Development Initiatives in Nigeria

Programmes/Programs	Year of Established	Nature of intervention	Limitation
Cooperative	1935-date	To regulate Cooperative activities in Nigeria	Policy inconsistency and administration dislocations of the federal department in charge of cooperative
Commodity Boards	1946 to 1986	Served as buyers of last resort, at fixed prices or buffer stock	Inability to pay farmers the subsisting market prices, scrapped in 1986 under SAP
Agricultural research Institutes	1964 to date	To conduct research in various crops, livestock, fisheries and machines	Instability of the research institutes arising from changing/or interchanging ministers/ministries/department and lack of funding
National Acceleration Food Production Project (NAFPP)	1970s	To increase the yield of seeds varieties and enhance fertilizer usage, promote extension and credit services	Started very well, affected by political support.
Agricultural Development Programmes (ADP)	1975 - date	To provide extension services, technical input support and rural infrastructures services.	The decline in oil prices that started in 1982 had serious fiscal effects in Nigeria and led to

Programmes/Programs	Year of Established	Nature of intervention	Limitation
		Also provide advisory services	shortages of counterpart funds for these projects
National Agricultural Land Development Authority (NALDA)	1991-1999	Providing strategic public support for land development, promoting and supporting utilization of rural and natural resources, providing gainful employment	The NALDA approach increased rather than reduced the direct public provision
Presidential Initiatives on cocoa, cassava, rice, livestock, fisheries and vegetable	1999-2007	To improve Nigeria's food production, adding value, with the objective line with vision 2020	Arrangements for its implementation was not effective but only on the pages of newspapers.

Sources: Various (Ministry of agriculture and water resources, 2008; Draft on National food security programme, Ayoola, 2005; Daramola et al., 2009

(b) *Better Life for Rural Women*: This programme was established by President Babangida. It was particularly focused on women as a target group. Networks of communication and new links were established to send messages about techniques and requirements of undertaking in various cottage industries. The programme was associated with the president's wife, and as a result had political undertones causing more educated and elite women to hijack it, while the real target group of disadvantaged women were left out.

(c) *MAMSER Programme*: The Mass Mobilization for Social and Economic Recovery programme (MAMSER) was focused as a central source for all mobilization of energy during the SAP period. Only the political aspect of mobilization was undertaken while the economic aspect was left out.

(d) *Operation Feed the Nation (OFN)* was established in 1976-1979. The programme involved enlightening the populace on the need for everyone to go to farms, to cultivate their gardens with staple crops. The message was that by feeding your household, you are feeding the nation. The OFN programme lost its importance as a result of a food glut, where supply significantly outweighed demand.

(e) *Green Revolution programme* was launched by establishing River Basins Authorities and communal farms where government undertook to provide farm lands and seedlings, then to plough the land and handover to farmers to maintain and harvest. After the sale of crops, farmers were expected to pay back the government fund for the inputs. These programmes collapsed because corruption and insincerity between the operators and the farmers.

(f) *Presidential Initiative for rice, cassava and other crops*. This programme was established in 2003 and was responsible for bringing cassava and its relative agricultural potential to public attention. It has the goal of promoting cassava as a viable source of foreign exchange, and to enhance the status of cassava by adding value to harness its potential not only as a staple crop but also as an exportable crop. The summary of government programmes for various years is shown in Table 11.2, but the following are of particular relevance in the context of the current research agenda and are among the major programmes for agricultural development in Nigeria.

11.3.3 Cassava Policy Package

Significant slowing of the rapid petroleum-led economic growth in the early 1980s, with consequent decline in national revenue in the mid-1980s, led to renewed interest in cassava and other major staples in Nigeria (Asogwa et al. 2012; Nweke, 2004).

According to Asogwa et al. (2012), due the declining oil revenue at this time, large-scale subsidized grain imports were discouraged. The Nigerian government banned the importation of maize, rice and wheat; as well as the export of yam and cassava products in 1985. The authors further argued that, prior to the introduction of the SAP in 1986, the marketing of cassava and its products had been affected by limited forms of policy intervention. Increases in prices of most tradable agricultural exports, following the Naira devaluation and liberalization policy, were not applicable to cassava and its products since non-tradable food prices were not directly influenced by international market development as suggested by the World Bank (2000).

The main policy programmes concerning cassava were part of the Presidential Initiative which created a presidential committee on cassava exports, with the aim of making Nigeria a cassava exporting country (Abdullahi, 2003). In accordance with this, the Nigerian government directed that flour used in bread making in Nigeria must contain at least 10 percent cassava (Gumm, 2005). In addition, the Roots and Tubers Expansion Programme (RTEP) (Dambatta, 2004), which succeeded the earlier IFAD-assisted Cassava Multiplication Programme (CMP), facilitated the provision of and access to improved cassava cuttings. Established in 2001, the RTEP extended support to other root and tuber crops like potatoes and yam, and placed additional emphasis on processing and marketing (Ibrahim and Onuk, 2010:2, citing IFAD, 2001) with the following specific objectives:

1) Increase productivity through the development of root and tuber production technology
2) Multiplication of improved planting materials for roots and tuber crops
3) Development of processing technology and marketing activities

4) Collaboration with NGOs to provide training to farmers (FMANR, 2006)

It is further considered by some that the RTEP also lead the way to a new orientation in the research-extension-farmers linkage. Studies indicate that there was significant improvement in output after the introduction of RTEP. It is suggested that this output increase was possibly due to improved varieties which produced greater yields per area cultivated (Tijani and Thomas, 2011; FMARD, 2004: Philip, 2004). However, these programmes were carried out in only some areas of Nigeria, in only 25 out of 36 states.

11.4 Agricultural Development Programmes in Delta State

Apart from the national agriculture programmes, the government of Delta State, like other states in Nigeria, have their own respective policies and programmes to complement national ones. Delta State has initiated a number of agricultural programmes since its inception (having been created from the formal Bendel State in 1991). Agricultural programmes in Delta State fall within the post-SAP period, such as the programmes shown in Table 11.3. Most of the programmes last within a planting season, or are short-term for two to three years. Loans were given to a few selected farmers and political associates for farm input procurement for farmers of staple crops, tree crops, poultry and fisheries. Evaluation of these programmes suggests that, notwithstanding commendable good intentions, the short programme time frames and the reduction of available monies from the amounts that were allocated to programmes through embezzlement and corruption were considerable barriers to success. These issues, evident from Table 11.3, are noted as not being unusual in the implementation of Nigerian agricultural policy. All these programmes had short term positive impacts on total outputs, and stabilized prices of food stuff (MANR, 2008), but the long-time effects remain to be evaluated. The short time frame of these programmes shows inconsistencies in government policy that make these programmes not effective to achieve their goals and objectives.

It should also be noted that none of the programmes were specifically targeted towards cassava production *per se*, but were promoting instead the value added uses of cassava food products, as livestock feeds and uses of cassava flour. Although the state government is aware of the potential of cassava, no special policy has been formulated to explore its importance.

Table 11.3 Agricultural Policy and Programmes in Delta State

Programmes	Period	Period of Duration	Amount Budgeted/RCD	Objectives
Communal farms/settlement	2000-Date	3-5 years	Not Available	Provide farm land to farmers, encourage farmers to farm together in other to allow mechanization
Agricultural mechanization	2000-date but not in operation	3-5years	Not Available	To encourage large-scale farming and the provision of tractor hiring service at cheaper rate.
Rapid food production programme	2001-2002	2001 only	Not Available	To raise and distribute farm inputs to farmers at a subsidized rate
Integrated agricultural programme (Songhai Delta)	2001-date	3years	Not Available	To empower youth in farming and promote self-employment
Cocoa seeds multiplication project	2002-2004	2years	Not Available	Purchase seedlings, raise to point of transplanting and distributes to interested farmers

Programmes	Period	Period of Duration	Amount Budgeted/RCD	Objectives
Others: Oil palm holder scheme; Small holder rubber development project; Planning, monitoring & evaluation of agricultural projects & distribution of oil palm Seedlings	2002-2004	2years	Not Available	Similar with the once above objective with particular focus on the programmes/program name.
Loans to small-scale farmers (LOAF)	2004-2007	1year	N1billion (N400m)	To assist farmers with small- scale for procurement of farm inputs
Famers support programme (FSP)	2008-2009	2008 only	N600m (N60m)	Loans to small-scale farmers
Commercial Agriculture Scheme (CAS)	2012-2014	2years	N1billion (N1billion)	Loan given to assist large-scale farmers for inputs procurement, clearing of farm land and processing

Source: MANR (various years)

11.5 Trend Analysis of Production, Inputs and other Major Economic Variables

After a review of relevant policies and programmes over the last 40 years, this section examines the trends and growth rates of selected major staple crops, specifically, cassava, yam, maize, groundnut and millet. The main purpose is to examine how these major staple crops performed over the period (1970-2009), encompassing Pre-SAP (<1986), SAP (1986-1993) and Post-SAP (>1993) periods. Such analysis will provide an indication of the robustness of cassava and its relative potential in relation to other crops during these three phases of the policy environment. The implication of this exercise is that, if productivity for all the major crops is also low, any effort to improve the efficiency of CRT might also be applied to other major crops.

Trend and growth rate estimations are generally criticised as problematic, largely due to the consideration that change in agricultural output in a given year or over a period would be affected by the output in the preceding year (Okoye et al., 2008 and Shadmehri 2008; Deosthali and Chadraheklar 2004; Rahman 1999). This main limitation in the variations of data, which may occur due to seasonality, political and other effects, can be reduced to a large extent by the use of the moving average that absorbs the lagging effects of variations and the effects of shock (or error), thus increasing degree of fitness by minimizing error (Badmus and Ariyo, 2011; Zhao and Wei, 2001).

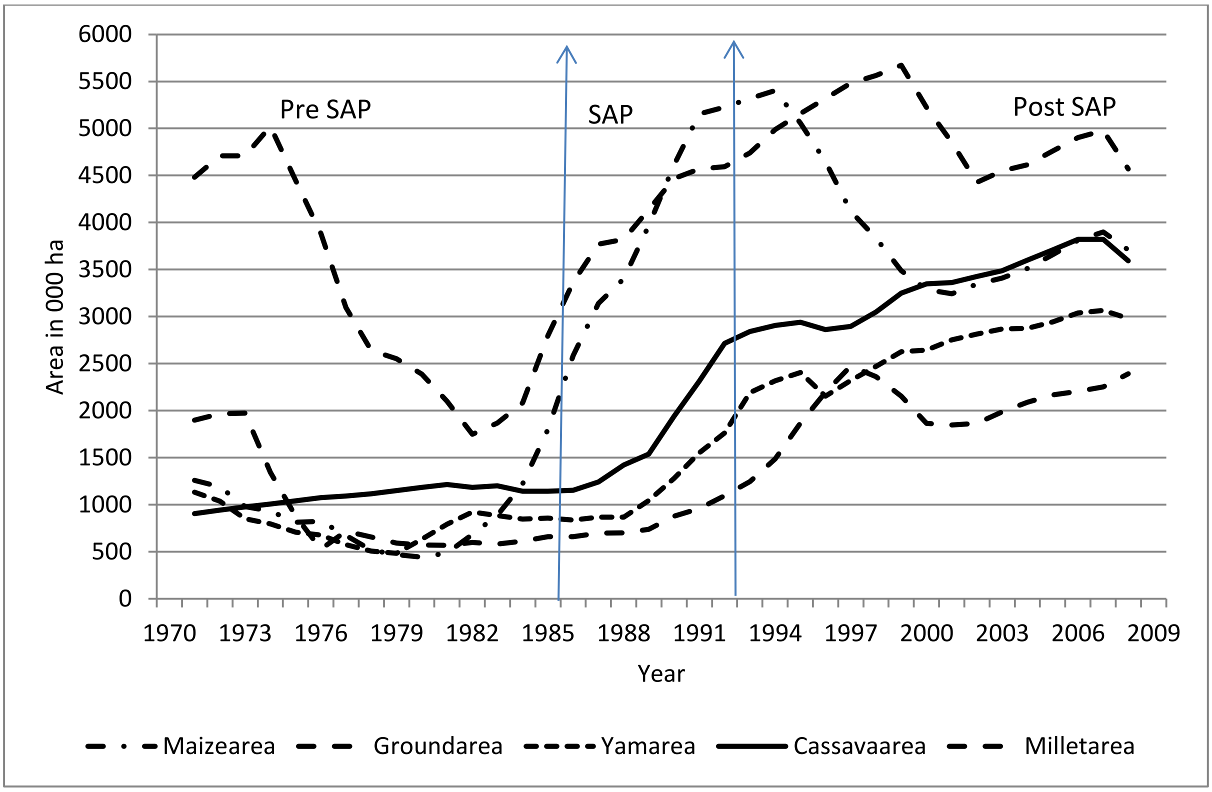
11.5.1 Trend Analysis of Inputs and Outputs

As indicators to measure the effects and performance of government agricultural development policies and programmes, trends in production outputs, yields per hectare and total area of cultivation are considered. In addition a number of other measures are investigated, including the share of agricultural GDP contribution to total national income, allocation of budgets to the agricultural sector and the Consumer Price Index (CPI, which is a rough proxy for purchasing power of the population).

Trends in area use for crop cultivation

Figure 11.1 presents the trends in area cultivated for major staple crops in Nigeria over the period 1970-2009, using 3-year moving averages, and Table 11.4 presents the associated growth rate of land usage and some selected indicators.

Figure 11.1 Areas of Cultivation of Maize, Groundnut, Yam, Cassava and Millet (per 000 hectares)



Source: Computed by the Author

Table 11.4 Growth Rate Estimates from 1970 - 2009

Crops	Variables	Pre-SAP (1970-1985)	SAP (1986-1992)	Post SAP (1993-2009)	Average (1970-2009)
		Coefficient	Coefficient	Coefficient	Coefficient
Cassava	Production	0.065**	0.138***	0.025 ***	0.055***
	Yield	-0.050	-0.010	0.007*	0.056***
	Area	0.020	0.148***	0.018***	0.044***
Yam	Production	-0.012	0.228***	0.028***	0.058***
	Yield	0.123***	0.094***	0.003	0.039***
	Area	-0.019	0.134***	0.018***	0.046***
Maize	Production	0.005	0.067***	0.012	0.080***
	Yield	0.028	-0.037**	0.032***	0.016***
	Area	-0.025	0.100***	-0.020***	0.054***
Groundnut	Production	-0.073***	0.082***	0.045***	0.047***
	Yield	0.030**	-0.003	0.025**	0.021***
	Area	-0.085***	0.077***	0.140	0.031***
Millet	Production	-0.023	0.021	0.022***	0.027***
	Yield	0.071	-0.026	0.034***	0.017***
	Area	-0.076	0.036	0.012***	0.012***
Fertilizer	Input for all	0.248***	0.108***	-0.033	0.054***
Agriculture	GDP share	0.183**	-0.216**	0.039	-0.020
CPI	Prices	0.147***	0.261	0.139***	0.214***

Note : *= 10 percent significant; **= 5 percent significant; ***= 1 percent significant Computer from CBN ; FAOSTAL (Various issues)

All growth rates computed using semi-logarithmic trends function. $\ln Y = \alpha + \beta t + \varepsilon$; where Y = the dependent variable of which growth rate is to be estimated; t = time; α and β = parameter, to be estimated and ε = error term; ln = natural logarithm as discussed in equation 3.1 in Chapter 3.

Source: Calculated by the Author

The overall cropping area has increased over the period for all five crops under consideration. The growth rates were higher for cassava, yam and maize estimated at 4.4 percent - 5.4 percent per annum than for millet, where growth was very low at 1.2 percent per annum. (see Table 11.4). However, these overall growth rates mask high fluctuations in all cropped areas during the period under consideration.

Figure 11.1 indicates that with an initial rise in the area under groundnut and millet, all crops except cassava showed sharp declines in cropped areas during the Pre-SAP period. However, during the SAP period, all crops recorded sharp growth rates, with cassava recording the highest rate of 14.8 percent followed by yam at 13.4 percent. Positive high growth rates during the SAP period might have been expected, due to the greater effort of government in this direction and this was a good sign. However, during the Post-SAP period, the area cultivates under maize declined sharply to -2.0 percent of its former production capacity, while other crop areas increased at low growth rates, for example 1.8 percent per annum for cassava and yam.

The reasons for such poor and fluctuating performance may be the inconsistency in the government’s land use policy and land fragmentation, since the land tenure system encourages fragmentations of land. Another important factor that may have led to a drop in the area of cultivation may be the price movement of the commodities and crops that have substitutes. The decrease in 2002–2004 is largely due to drought. The decline in cultivated area was followed by increases in food prices and shortages witnessed in the global trend in 2006 and 2007, which then led to increases in area in 2007 and 2008. This assessment was supported by the study of Badmus and Ogundele (2008).

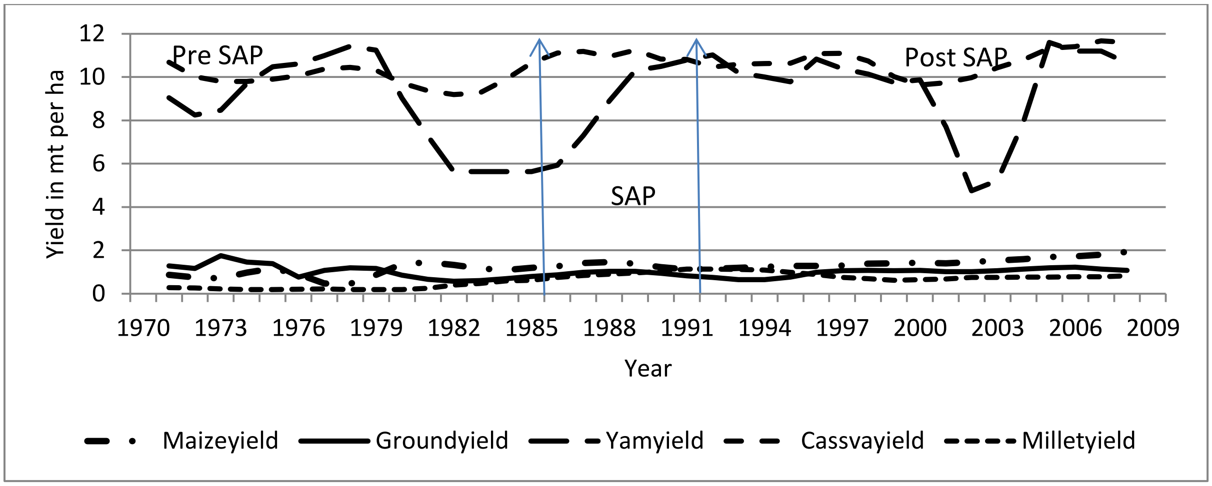
It is clear from Figure 11.1 that although all crops areas fluctuated during the whole period assessed, the area given to cassava remained fairly consistent throughout. This is also supported by growth rate estimates indicating potential for this crop in Nigeria. The overall growth in area of all crops may perhaps be explained by more people going into farming as a result of population increase. In general, area expansion tends to depress average yield since the additional land cultivated is associated with lower quality (World Bank, 2000).

Another way to assess the effect of agricultural policy on crop production is to examine the production performance of crops and the provision of government funding for developing infrastructure, research agendas, information and marketing through pricing policy among others. These form the subject of the next section.

Trend in yield performance

Figure 11.2 presents the most important indicator of performance over time, yield per hectare. It should be emphasised that cassava and yam are bulky products, so their yield levels are much higher that maize, groundnut and millet.

Figure 11.2 Yield trends for maize, groundnut, yam, cassava and millet Mt/ha (000)



Source: Computed by the Author

It is clear from Figure 11.3 that overall production levels of cassava recorded the strongest growth rate compared with all other crops under consideration. Cassava yield grew at 5.6percent p.a. during 1970–2009 followed by yam at 3.9percent p.a. (Table 11.4). The production level of yam showed sharp declines during later years of Pre-SAP, during drought of 2002–2004 and in the Post-SAP period, although it did show a gain in yield during the SAP period. This demonstrates that cassava has great potential for improving farmer incomes, which provides the main justification for exploring the potential of cassava in this study.

The higher growth rate of crop productivity during SAP and Post-SAP periods, compared with those of the Pre-SAP period, may be due to policy changes. The increase in total production of crops is more a result of land expansion than a result of improvement in use of technology (seed, fertilizer, machines among others). This assessment is supported by the studies of Okoye et al. (2008) and Enete and Achike (2008) who assert that in

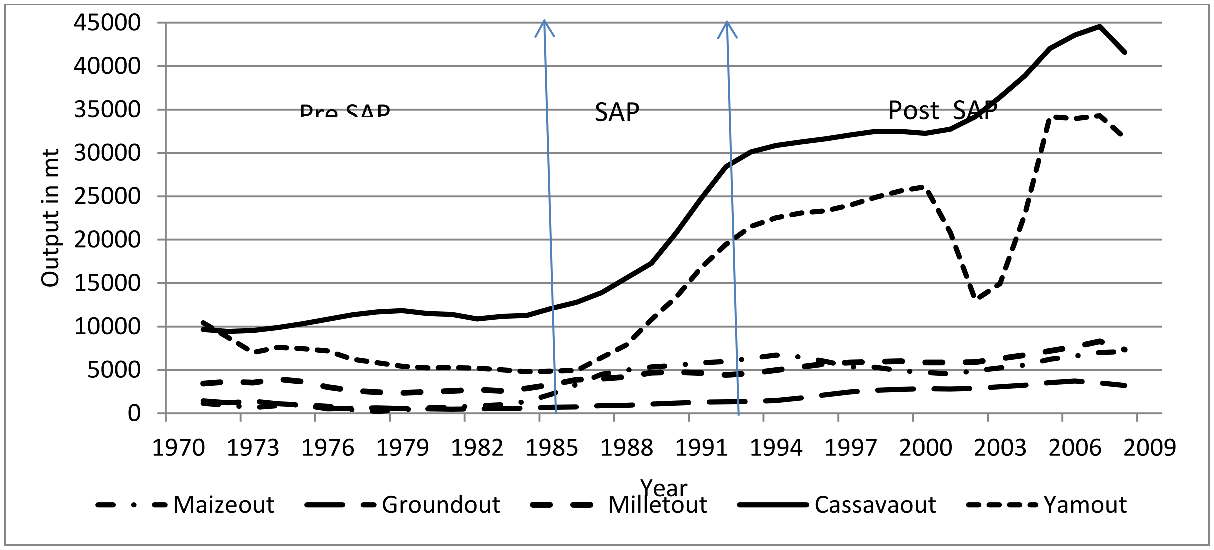
Southeast Nigeria, undercapitalised farmers did not adopt more efficient inputs in the right quantity and were generally not innovative in their farming practices mostly because of poverty. This assessment is further supported by Aters (2007) who reveals that fertilizer application was only 8 kg per ha, far less than 200 kg per ha world average. This position is also argued by the stakeholders in the study area survey where 80 percent of them indicated lack of access to improved technology, farm inputs, credits, extension services, general information about market and weather information as the main factors in restricting output.

It may also be suggested that the decline in yield for various periods are the result of drought, namely 1972-1974 and 1982-1984 in Pre-SAP period (Bello et al. 2012; Abdullahi et al. 2006) and in 2002-2004 in the Post-SAP period. Decline in yield may also be due to flooding or increases in the incidents of infestation by pests and diseases, as well as demographic changes as able young people migrate to the cities to search for white collar jobs (Iheke and Oliver-Abali, 2011; Aregheore, 2009). According to Badmus and Ogundele (2008) growth in yield may be attributed to research by the International Institute of Agriculture (IITA) and other research institutes in producing seed varieties resistant to pest and diseases, crop varieties tolerant to drought, increases in food prices, increased uses of farm inputs, expansion in area cultivated and predictions of rainfall patterns. However, the research institute is not as influential as it could be as poor funding as this hampers its ability to respond to farmers' needs (Enete and Amusa, 2010).

Trends in Crop Production

The production trends of cassava, maize, groundnut, millet and yam from 1970 to 2009 are presented in Figure 11.3. It is clear that total production of all crops is almost static, with groundnut production declining at -8.5 percent p.a. (Table 11.4). However, during the SAP period, total production of cassava and yam recorded sharp rises, growing at 13.8 percent and 22.8 percent p.a. respectively. Production of maize and groundnuts also grew but at lower rates of 6.7 percent and 8.2 percent respectively during the SAP period.

Figure 11.3 Production Trends of Maize, Groundnut, Yam, Cassava and Millet MT (000)



Source: Computed by Author

During the Post-SAP period, analysis suggests that the potential of cassava becomes clearer. Although in terms of growth rate, yam recorded slightly higher growth of 2.8 percent p.a. compared to cassava at 2.5 percent p.a., yam production recorded a sharp decline during the drought period of 2002–2004, while cassava production kept increasing as it is a drought resistant crop. The growth in total production of the remaining three crops (groundnut, millet and maize) remained very low during the Post-SAP period.

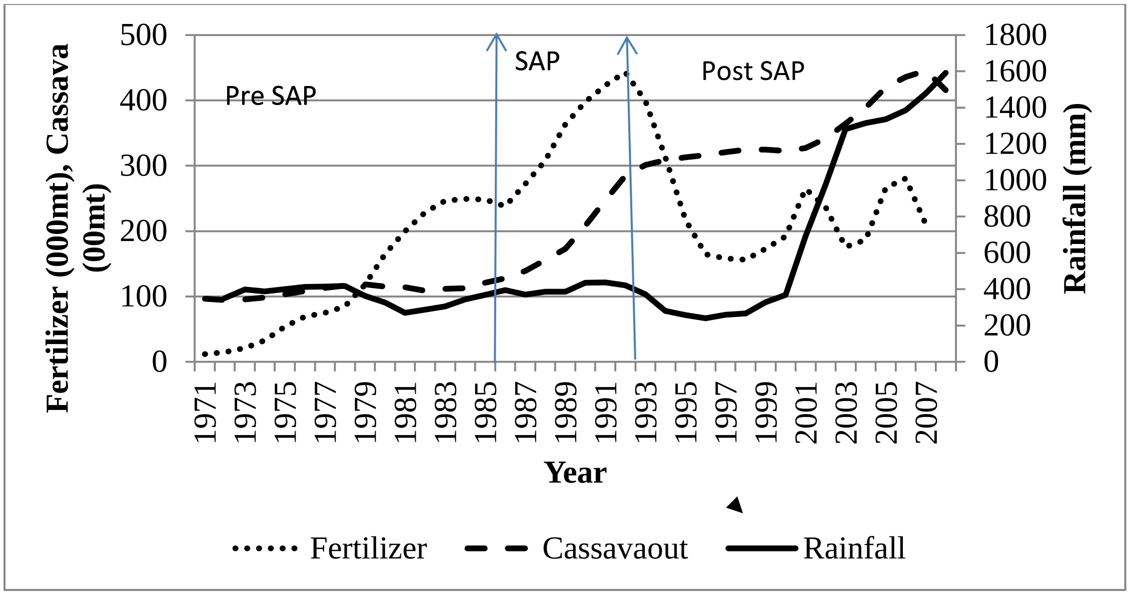
Badmus and Ogundele (2008) asserted that the poor demand for maize may have discouraged farmers from maize production in 2006/2007 season, thus lowering and consequently increases the price in 2008. Prices of major crops rose by 55 percent from June 2007 to February 2008 as a result of higher prices in the previous years, and this is followed by cycles leading to a drop in demand. The significant increase in the overall production of crops during SAP and Post-SAP periods is due to market liberalisation and free market policies that encourage staple food crops to raise their prices. This view is also supported by 55 percent of the stakeholder respondents, who agree regarding the effect on agricultural policy in increasing food production.

Trends in Cassava Output and Input use

Figure 11.4 presents the trends in the use of two key inputs for agriculture, i.e., fertilizer and rainfall; supplementary irrigation is almost negligible in Nigeria. The figure also reproduces the trend in total cassava production from Figure 11.3 for comparison purposes.

It is clear from Figure 11.4 that the government pushed for fertilizer usage as early as 1970s in order to increase agricultural production. From 1971 fertilizer use in Nigeria recorded a sharp rise, reaching its peak during the final years of the SAP period (1992-93), and then fell sharply during the post-SAP period. In terms of growth rate, fertilizer usage grew at 24.8 percent p.a. during pre-SAP and 10.8 percent p.a. during SAP periods and declined -3.3 percent during the post-SAP period (not significant).

Figure11.4 Trends in input usage of fertilizer, rainfall, and cassava output



Source: Computed by Author

It should then be noted that the observed growth in total cassava production, even when fertilizer use had declined during the post-SAP period, shows convincingly that cassava farming in Nigeria is at the subsistence level. Figure 11.4 indicates that cassava output is not affected by the rainfall pattern, although it was affected slightly by the most severe droughts of 1980-1982; 1997 and 2000-2002 (Bello et al. 2012, Ayinde et al. 2010; Badmus and Ogundele, 2008; Abdullahi et al. 2006). Apart from rainfall, other climatic factors that influence crop production are temperature, sunshine, day light pattern, although detailed discussion of these outlying variables is outside the scope of this study.

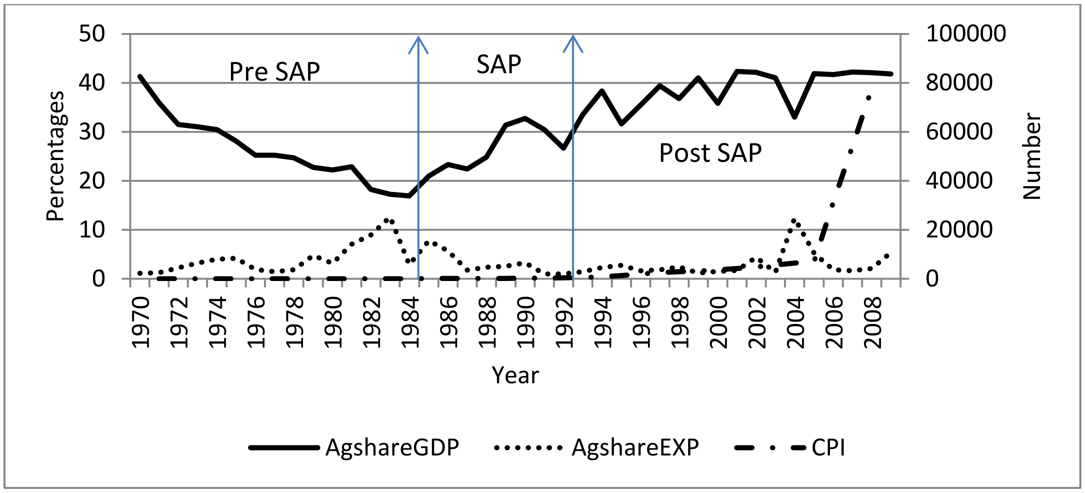
Trends in Agriculture’s Contribution to the Economy, Budget Allocation, and Consumer Price Indices (CPI)

In this subsection, trends in the contribution of agriculture to total national income, the national allocation of budget to agriculture, and the Consumer Price Indices are examined. The main purpose is to highlight the importance of agriculture to the national income, the consistency of government in supporting agriculture and the effect of price during the period under study.

Contribution of Agriculture to National Income

Figure 11.5 shows that during the pre-SAP period, the contribution of agriculture declined sharply, which led the government to launch the SAP. As expected, during the SAP period, the share of agriculture to GDP rose sharply and since then has kept on increasing, notwithstanding year to year fluctuations. The increase from 22 percent of GDP during the start of SAP to 42 percent in 2009 is notably positive. This indicates that agriculture has caused desirable economic growth, as well as further potential to contribute to the economy overall through increasing funding and consistent policy frameworks. This assessment is supported by the studies of Adufu et al. (2012) and Iganiga and Unemhillin (2011), both reflecting on the effect of government budgetary allocations on agricultural production in Nigeria.

Figure 11.5 Agriculture share, gross domestic product share and Consumer index price (CPI)



Source: Computed by Author

Budgetary Allocation

Although agriculture has contributed positively to GDP since the SAP period, budgetary allocations to support agriculture have remained consistently below 5 percent of total expenditure during most of the period, except in 1983 and 2004, which were both drought periods. This shows serious inconsistency of the government in supporting agriculture, which may be responsible for high levels of fluctuation in area allocated to crops, total production and poor yield growth, except in the case of cassava. A comparative analysis by RESAKSS leaders in CAADP agreed, that 10 percent of the total budget should be allocated to agriculture to maintain at least a 6 percent growth rate (Maputo Declaration) although Figure 11.5 suggested a different story. This instability in the budget allocation could also be observed in the recurrent and capital agricultural expenditures. This fact is also agreed by 86 percent of stakeholders in the study area. Among the effects of poor budgetary allocation is that it reduces the ability of researchers to respond to farmers needs and, according to Atser (2007), the national bureau of statistics estimates that about 70 percent of fruits and vegetable produced in Nigeria are wasted simply due to poor infrastructure and inadequate research efforts in preservation techniques. This in turn results from low funding and such conclusions are also relevant to cassava production in Nigeria.

This supports the arguments of Philips et al. (2009) and Izuchukwu (2011) that estimates for Nigeria showed a decline in agricultural productivity from the 1960s to 1980s, but witnessed strong growth in the past few years, averaging 8.8 percent real annual GDP growth during and after the Post-SAP periods, indicating that agricultural productivity has lagged behind GDP growth, growing at 3.7 percent in 2007. However, this is in contrast with the studies of Adofu et al. (2012) and Iganiga and Unemhillin (2011) who state that there is a positive relationship between budgetary allocation to agricultural sectors and agricultural outputs.

Consumer Price Indices

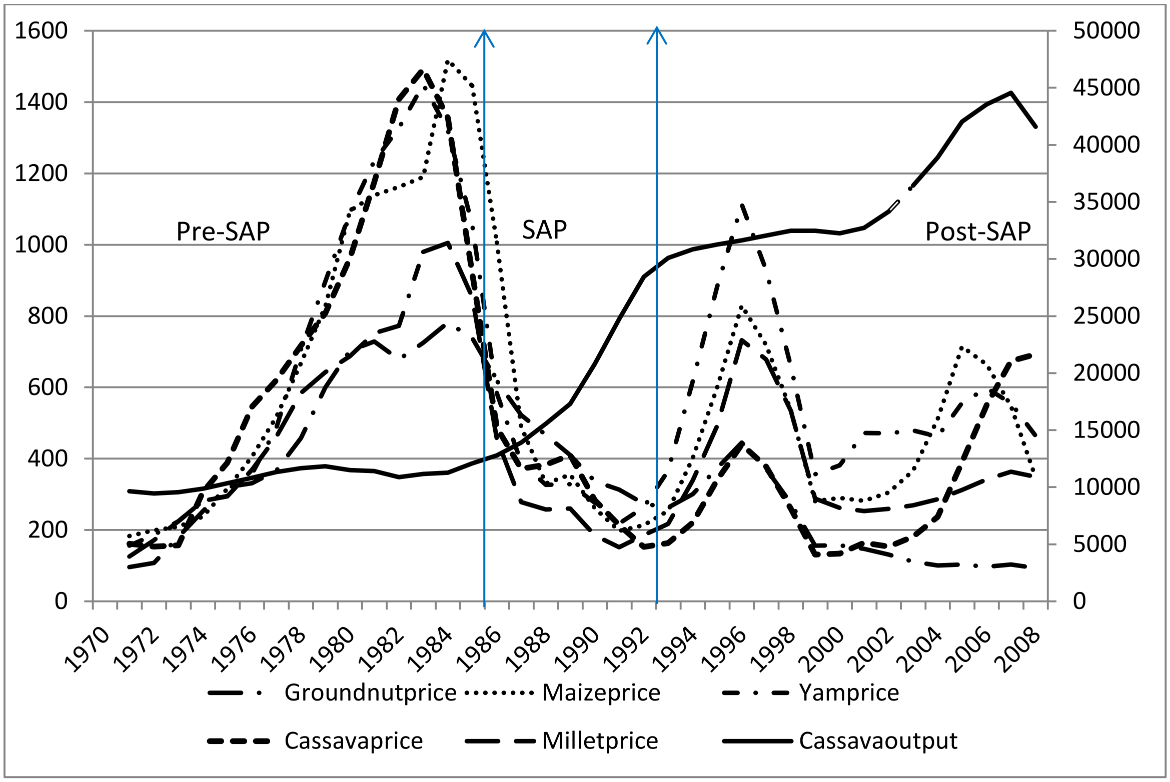
Nigeria has experienced an explosive growth rate in prices, reflected by the CPI recording a 21.4 percent growth rate (Table 11.5). This sharp rise in 2005 and onwards provides an indication of the deep level of distortion in the economy of Nigeria. Iganiga and Unemhillin (2011) further asserted that CPI, as a proxy for price, increases, would result in increases in expansion of areas of cultivation, therefore leading to increases output. It is also suggested that the impact of government budget allocation on agriculture is not instantaneous as indicated by Figure 11.5. The resulting trends of the relationship between the positive and negative trend of the average share of agriculture and CPI may be due to inflation. This study uses the constant market price in US dollars USD) to adjust for inflation.

Price trends

There have been steep increasing trends in the prices of all major agricultural commodities during pre-SAP period as shown by Figure 11.6. But this may be due to over-valued Naira (Nigerian currency), as indicated by the fact that there is no significant growth when evaluated in terms of USD (see Table 11.4). Another implication is that it is cheaper to import substitutes of these major crops (Chinedu et al. 2010; Erhabor et al. 2007). This is also illustrated by the price trends as shown in Figure 11.6 below.

However, the nominal prices continue to increase rapidly during the Post-SAP period, while the real prices in USD showed a decline due to a significant devaluation of the Naira. The implication is that now it is more costly to import the substitutes of these major staples. This phenomenon has encouraged sharp increases in the nominal prices of staples inn Nigeria and also led to increases in the production of cassava and other local crops. Table 11.4 shows the high fluctuations in cassava prices which increased at 0.5 percent (Pre-SAP), -14.0 percent (SAP) and increased sharply to 22.3 percent (Post-SAP), with an average mean fall of -0.8 percent over the period (1970-2009) in line with similar patterns for other crops.

Figure 11.6 Trend in average price of selected crops in Nigeria from 1970-2009 (at current market price USD per tonne)



Source: Computed by Author

During Post-SAP, government fiscal policy led to a steady increase in the value of the Naira which led to increases in the real prices of the major staples (Figure 11.6). Apart from the effects of drought, demand and supply and substitution effects, all selected major crop prices were affected by the exchange rate of the Naira to the USD.

Although all crops show a boost in output during SAP and Post-SAP periods, the rise in cassava prices is smaller than for other crops. This said, cassava output maintained an upward trend all the time. Asogwa et al. (2012:83) state that the main source of price stability for cassava and its products, as well as other non-tradable crops on account of the SAP and market liberalization policies, resulted largely from increases in the prices of substitute products such as rice, wheat and maize. The ban placed on the importation of these tradable products, reduced demand for imported substitutes. As a consequence, the demand for domestic crops increased and consumers switched over to the consumption of cassava and its products which culminated in price increases.

The general trend of increased prices may also result from the depreciation of the Naira against major currencies and the high level of cereal price in the international market during SAP and Post-SAP periods. Increases in production and growth in agriculture during SAP and Post-SAP periods was also attributed to favourable weather conditions and high prices of major crops. The increase in prices was due to significant declines in the total world production of crops in 2007/2008 (Loto, 2011). Josserant (2008), which in turn may be attributed to the higher prices during the Post-SAP period created by demand driven by household's effective demand and consumption, the demand for raw materials for poultry, food processing industries and breweries. These increasing trends in prices of these major crops may not, however, imply increases in producer incomes, as the real incomes of the farmers have fallen and levels of welfare have reduced due to high rate of inflation over this period (Mkpado, 2012).

11.6 Chapter Summary

The foregoing trend analysis and growth rate estimates of major crops covering the period 1970–2009 indicate positive trends in the production of crops, with declines in output during Pre-SAP period and increasing output trends during the SAP and Post-SAP periods. Increases in production were not due to increases in the use of improved technology, high level of inputs or the provision of information, extension services or improved infrastructural facilities, as, for example, more fertilizer was used during Pre-SAP than during SAP and Post-SAP period as shown Table 11.4 with growth rate of 248 percent, 108 percent and -33 percent for Pre-SAP, SAP and Post-SAP, respectively. This may be attributed to market liberalisation and deregulation of the market, in addition to expansion of area cultivated, as suggested by Samuel et al., (2010), Nin Pratt and Yu, (2008) Ojiako et al. (2008) and Otte, (2006). Increasing demand from a growing population may also contribute to these trends. The high prices registered by the CPI and increases in prices of the major staples may also have contributed to increases in production, an interpretation which is supported by Iganiga and Unemhillin (2011) and Nweke, (2004), among others.

The results from this chapter clearly indicate that, despite all constraints and inconsistencies in government policies regarding budget allocation and price distortions, cassava stands out as the crop with potential to withstand and grow throughout changes to climatic conditions and policy environments. This is in contrast to all other crops under consideration, which suffered to a varied extent with regard to total cropped area, total production and yield growth. Therefore, the overall results provide a weak support to the hypothesized positive relationship between changing agricultural policies and cassava production.

The study shows that low productivity and growth in Nigerian agriculture could be linked to constraints as discussed in previous sections, concerning production, processing and marketing characterised by:

- Poor agricultural pricing policy
- Low input use and limited access to inputs
- Low access to agricultural extension services and agricultural credit facilities
- Low and unstable investment opportunities in storage, processing and infrastructural facilities that are framed by declines and fluctuations in agricultural sector budgeting
- Lack of government commitments in funding and development of appropriate technology to improve seedlings, planters, harvesters or processing machines to reduce labour requirements and increase efficiencies in productivity
- Poor market access and low marketing efficiency, resulting in low prices for cassava root tubers and high costs of production
- Lack of information and low education levels, as demonstrated by the ongoing prevalence of traditional management practices which limit cassava productivity
- Policies of developed countries to fracture the market of value added products and lack of vigorous research to encourage the substitution of cassava for wheat, maize and barley in the production of industrial products among others

Some of the limitations of this study may arise from the level of accuracy and reliability of the secondary data, as well as the effect of the lag period. The latter is reduced by making use of the moving average of three years and the error used for growth rate measured for the weather variation and unforeseen circumstance.

The analysis above suggests that government should formulate policy that would encourage farmers to make use of improved technology (seed, fertilizer and other inputs) by improving access to inputs, making them available at a low cost in order to improve yield and increase agricultural efficiency, and, in equal measure, to ensure that policies remain consistent. A considerable issue barrier to research has been observed during this study concerning the lack of access to agricultural statistics in Nigeria, as argued by Adamu (1989). Improvement in this area could be achieved by establishing a statistics ministry to coordinate the data from various bodies and to provide a basic standard for the collection of data.

CHAPTER 12

SUMMARY AND CONCLUSIONS

12.1 Introduction

The aim of this research was to explore how the traditionally non-tradable surplus of cassava root tubers could be utilised to improve the potential for agricultural growth and economic development in Nigeria. This research takes the Delta State of Nigeria as the case study area, which is among the states making up the Niger Delta region. This is an area where socio-economic deficiencies have been compounded by severe environmental challenges as a result of crude oil exploration, flooding, Atlantic Ocean encroachment, poor levels of soil nutrition, youth unrest, among other issues which have continued to affect overall productivity. However, it is possible to improve agricultural productivity in the area through enhanced efficiency. Low productivity has been reported to be responsible for increasing poverty levels in this area in particular, and in Nigeria and across Africa in general.

As stated in Chapter 3, the Delta State also has comparative advantages in the production of cassava and as a result produces about 1 million metric tonnes CRT per annum. Any attempt to improve on the productivity and profitability of cassava production in Delta State could just as well be applied to other states in Nigeria, as well to other developing countries where similar problems and constraints to production are experienced. Apart from the comparative advantages of cassava production in Delta State, other main reasons to select this state as the focus for study included the economic situation of most inhabitants and the familiarity of the researcher to the geographic and political terrain in this area. Even though cassava is an important crop with multiple uses ranging from consumption to export or industrial uses, systems of production and marketing of cassava in Africa, and particularly in Nigeria, are riddled with low productivity and efficiency. These factors are caused by poor infrastructure and other constraints, leading to low levels of processing and poor marketing of the products as indicated in the introduction and literature reviews in Chapters 1 and 2. These chapters provided a detailed background and rationale of the study, accompanied by up to date information on existing literature regarding cassava production, efficiency, processing and marketing of agricultural products. The results of this study have been detailed in Chapters 4 to 11 and they are found, on the whole, to support the arguments raised elsewhere in the literature.

The research study was carried out in three regions of Delta State, Nigeria, due to the importance of cassava production, processing and marketing in this state as a realistic source of diversification within the economy. Greater diversity in the economy has the potential to improve farmers' incomes and reduce their suffering from socio-economic impoverishment. The time series analysis of major crops including cassava grown in Nigeria over a 39 year period (covering pre-SAP, SAP and post-SAP period) showed the clear potential of cassava to record an upward trend in production, despite fluctuations in policies and programmes over time.

The main aim of this concluding chapter is to synthesise the results, draw policy implications and provide guidance for future research. Therefore, the chapter is organised into the following sections: Section 12.2 summarises the main findings and results, Section 12.3 details key contributions to the literature arising from the research, Section 12.4 draws out the policy implications and Section 12.5 provides recommendations for future studies.

12.2 Synthesis of Main Findings

The key findings from this research are discussed below:

1) In examining the relationship between the socio-economic factors associated with cassava production at the farm level, the results indicate that farmers in Delta State have similar socio-economic characteristics to those seen at national level. For example, average age of the farmers is 42 years; average family size is 5.8 persons; average farm size 2.1ha; a majority of the farmers are educated up to primary level at least; farmers have low levels of access to credit; the use of extension contact visits is low and use of modern farm inputs and technology is low. These factors in turn have led to low levels of productivity and efficiency, with significant differences by region as well as by farm size categories. Poor access to credit, extension and training provisions add to the problem of low productivity and efficiency of cassava production. This supports the findings of Ogundari and Amos (2012), Idrisa et al. (2010), Asogwa et al. (2009), Ogundari (2009), Oni et al. (2009), Erhabor and Emokaro (2007), Mafimisebi (2007) and Nweke, (2003) among others.

2) Profitability analysis of cassava production, with respect to regional variation and farm size categories provides some interesting results with the total costs of N58, 154.32 per ha. In terms of cost elements, labour cost is the greatest proportion, accounting for 62

percent of total cost, followed by seeds (23 percent), land rent (7.5 percent), fertilizer (6.7 percent) and pesticides (1.1 percent), respectively. Cassava production is profitable irrespective of regional variation and/or farm size categories. The average gross margin of cassava root tuber production is N110, 884.09 per ha, and the overall BCR is 2.83. For the regions, the BCR is 2.1 for Delta Central (DC), 1.82 for Delta South (DS), and 2.66 for Delta North (DN) and the difference across regions is significant. The BCR according to farm size categories varies less than between regions. The average BCR for small farms is 2.23, medium farms 2.32 and large farms 2.17. However, the difference is not significant across farm size categories, which is unexpected and do not clearly support the hypothesis of positive farm size-profitability relationship.

3) The results from the DEA and corresponding determinant analysis of efficiency measures show that the mean levels of efficiencies are very low, estimated at TE (0.40), AE (0.72) and CE (0.29), when compared with results found in the literature review, which indicated that TE is less than 0.70 but falls within the range of 0.14-0.98. The AE results are greater than the average mean of 0.53 and CE less than the average mean of 0.45. The main differences in this study is that in terms of TE, while only 20.8 percent are <0.50 range of those identified in the literature review on Table 2.2 and 2.3; 80.0 percent fall within the same range of (0.50) in this study. Despite the differences between ranges of results found here and those identified elsewhere in the literature, both findings imply that there is substantial scope to increase productivity of cassava by removing barriers to TE, AE and CE. The efficiency scores are significantly different across farm size categories as well as regions.

Contrary to expectations (Anyaebunam et al. 2012; Okoye et al. 2009; Ogundari and Ojo, 2006), the large farms are relatively more technically efficient (50.9 percent), while medium farms are least technically efficient (34.7 percent). In contrast, small farms are relatively more allocatively efficient (75.6 percent), as compared with medium farms (63.2 percent) and large (73 percent). Overall, large farms are relatively more cost efficient (34.5 percent) compared with medium farms (21.9 percent) and small farms (30 percent). The large farms are economically more efficient due to the economies of scale enjoyed by them. The relative superiority of large farms in production performance indicates a positive farm size-efficiency relationship, which supports the main hypothesis of the study and is also supported by the findings in the literature (Ebong et al. 2009 and Chirwa, 2003 among others). At the regional level, DN is more technically efficient than DC and DS, while DS is more allocatively efficient than DC and DN.

The second-stage Tobit regression analysis of the determinants of efficiency showed significant influences of extension contacts in significantly improving AE but reducing TE. Older farmers are relatively more inefficient than younger ones. Farm size has a negative influence on AE, small size farms tend to manage and efficiently utilise their limited resources, especially family labour (Masterson, 2007 and Eastwood et al. 2006).

4) The profitability analysis of *gari* processing indicates that the average yield of processed *gari* is 4671.49kg per ha. The cassava root tuber to *gari* conversion ratio is 2.6:1. The processing task is highly labour intensive, using a total of 106.25 man-days per ha of crop, with peeling and frying of the dried granules to dried grains accounting for the

highest level of labour use. The distribution of the costs of processing is as follows: labour accounting for 20.8 percent of total cost, firewood (1.0 percent), CRT purchase (74.9 percent), land rent (1.6 percent) and miscellaneous (1.6 percent). The gross margin for processing is N 65,746.63 per ha or N 13,697.21 per tonne, and the profitability of processing 1kg of *gari* is N 23.80, with an average BCR of 1.22. Results also show that *gari* processing is profitable in all regions and farm size categories.

5) The findings of the DEA for *gari* processing efficiency shows that efficiency levels are again low but relatively higher than for cassava production. The mean total TE score is 0.55, implying that efficiency can be increased by 45 percent by eliminating technical inefficiency. The AE is extremely low at only 0.17, implying that using optimum levels of resources given observed prices could reduce the cost of *gari* processing by 83 percent. At the regional level, DN has the highest TE and a majority of *gari* processors are below the total mean of 0.55. Within the processors farm size group categories, the TE for small farms is 0.53, medium farms (0.32) and large farms (0.21). The AE scores for these groups are: large farms (0.76), small farms (0.69) and medium farms (0.06). However, within processors firm size group categories, the TE for small and medium size processors (0.54) and for large size processors firms (0.59) is fairly similar. The AE scores for these groups are: large size processors (0.29), small size (0.14) and medium size processors (0.14). The study therefore shows that the group of large size processors group are most technically, allocatively and cost efficient. This is another key finding and provides support to the hypothesis of positive size-efficiency relationship.

Results of the determinant analysis show that all categories of efficiency are positively correlated with processors scale, increasing as size of processor increases, while extension contact significantly reduces efficiency levels. Large-scale processing encourages the use of improved technology and also takes advantages of economies of scale. The findings indicate that extension services significantly improve allocative efficiency but also reduce technical efficiency. Weak or ineffective extension services will reduce the efficiency of cassava production (Aye and Mungatana, 2011, Adebayo and Iduwo, 2000). The World Bank assisted extension services in Nigeria had being not effective after the withdrawal of funding by the World Bank (Aye and Mungatana, 2011). This implies that provided extension services if not back-up with use of appropriate inputs may also reduce efficiency

6) Productivity is actually a function of efficiency and effectiveness. These two are essential for a productive firm. Evindence from Chapter 2 and 11 suggest that agricultural sector has low productivity. In addition, the findings from Chapters 6 and 8 suggest that cassava firms' efficiency is low in the study study areas which may be due to inconsistency in agricultural policy. The main reason of the low efficiency could be attributed to the identification of poor practice in cultivation of CRT and gari processing, managerial decision and specific-farm characteristics that affect the ability of producer to adequately use existing technology, which could be reflected on the following:

- Technological factor
- Traditional farming method
- Lack of adequate machinery

- Lack of finance for producer
- Lack of good quality farm inputs
- Inadequate and poor harvest and processing technology
- Absence of sound infrastructure
- Inadequate of agricultural programmes
- Economic and social factors
- Weakness in policy perceptions

7) Marketing analysis of cassava and its products supports the view that cassava markets exhibit perfect market conditions. The marketing share or margins are made of producers' shares (50.6 percent), wholesalers (11.0 percent), retailers (23.8 percent) and marketing costs (14.6 percent). The gross margin analyses also indicate that cassava marketing is profitable in any marketing forms and that profit increases as more value is added. Mean level of marketing efficiency is 1.10, an indication of the profitability in all regions of the case study area. Amongst the products, marketing efficiency is highest for tapioca and cassava flour (1.98 each). This finding, therefore, supports the hypothesis of positive level of processing-marketing efficiency relationship. Marketing efficiency is highest in the Delta South region and lowest in the Delta North region. Another key finding of this study is that the marketing of cassava, in various forms, is significantly influenced by supply and demand within a region. Perhaps not surprisingly, the areas of high supply and demand are significantly associated with lower selling prices. Supply and demand for starch is high in both DC and DS, and lower in DN; the price of cassava is lower in both DC and DS than the price in DN. The supply and demand, as well as prices, for *gari* is

almost uniform in all areas of the study. Finally, a number of marketing cost elements significantly influence marketing margins but the pattern of influence is not consistent across products.

8) The analysis of constraints in cassava production revealed a number of key influences. Among the infrastructural constraints, the provision of water was identified as the first ranked constraint followed by access to processing facilities, electricity provision and marketing facilities, in addition, quality constraints and grading of products that affect prices of cassava products. The farmers also regarded other factors as serious constraints, like the problems of pests and diseases, drought, lack of rainfall and flooding.

9) Finally, the review of agricultural policies and trends in cropping area, production and yield of major crops, including cassava, showed a consistent upward trend of cassava production, despite fluctuation and inconsistency of agricultural policies. The results show that government policy in agriculture has been inconsistent and that the supply of inputs does not easily reach farmers, thus hindering productivity. The research also indicates that the growth in production has been led by increases in the amount of area cultivated, as well as slight yield growth. The results, therefore, provides only a weak support to the hypothesized relationship between changing Nigerian agricultural policy and growth in cassava over time.

12.3 Contribution of Findings to Existing Literature

It is clear that there is an expanding demand for production, processing and marketing of cassava as food and also as a source of agro-industrial raw material, both in Nigeria and in the international markets (Liverpool-Tasie, 2011; Adeniyi, 2006; Nweke, 2003). Therefore, a detailed analysis of cassava production, processing, marketing and constraints in the sector was required, in order that a grounded overall picture can be drawn to assist various stakeholders in making informed decisions based on empirical evidence.

The present research is framed with all these issues in mind and, as such, investigated the production of cassava at the farm-level; the processing of cassava by farmers/processors at the farm-level and the market conduct and performance of marketers of cassava within the same region where the aforementioned farm surveys were conducted. This is the key contribution of this research, to draw all elements of the production, processing and marketing of cassava in Nigeria into one analysis. It is set apart from previous work (Anyaegbunam et al. 2012; Kaine, 2011; Afolabi, 2009; Ayewole, 2009; Adebayo et al. 2003; Camera, 2001) which focussed on a particular stage of the process, either on the production of cassava; or processing of cassava into various products; or marketing issues and constraints from different locations and at different time-scales, and which was therefore unable to provide a coherent picture of the sector.

The analysis in this research project was conducted with respect to farm size categories as well as regions, in order to identify the role of farm operation size in combination with regional factors in respect of various aspects of cassava production, processing and marketing. This constitutes another key contribution of this research. The study also examined the potential to add value to cassava and assessed the existing nature of demand for its products. It has also examined the performance of the sector at the macro level over time, encompassing pre-SAP, SAP and post-SAP periods. The findings indicate that there is much potential to add value to cassava to expand the markets for cassava, targeting local, regional and international markets. These opportunities focus on increasing the shelf life of cassava, since perishability of cassava is one of the main disadvantages of the crop. Increasing shelf life can arrest price instability and lead to increases in income for producers, leading to greater savings and demand for other goods (Kaine, 2011; Chukwuji et al. 2006), a situation with the potential not only for growth in agriculture but also other sectors of the economy (Erhabor et al.. 2007). Such potential remains to be released by providing the enabling policy environment for medium and large scale producers, processors and marketers to enter the cassava enterprise market (Liverpool-Tasie, 2011; Knipscheer et al. 2007; Nweke, 2004).

12.4 Policy Implications

Based on the findings of this study, it can be concluded that resources are not used efficiently by farmers, processors and marketers owing to a range of factors which include limited use of modern technological inputs, such as improved cassava cuttings, inorganic fertilizers, and a lack of sufficient education, poor access to extension services, credit facilities and training programmes. Therefore, the policy implication includes increased provision of modern technological inputs which can improve cassava production and processing. Ogundele and Okoruwa (2004) found that the use of improved rice varieties and area expansion had positive influences on levels of technical efficiency. Further, Okoye et al. (2006) found that the use of inorganic fertilizer had positive effects on allocative efficiency on cocoyam farmers.

The results clearly indicated that large farms and/or processors are relatively more efficient in the production and processing of cassava. Therefore, the policy implication is to investigate current land tenure policy and encourage land reform policies aimed at consolidation of small and medium farms to increase their operation size, which should lead to increases in productivity and efficiency.

Findings also reveal that among the cost elements, labour represents the highest proportion of the cost element in production and processing of cassava (excluding the purchase of cassava root tuber). Although reductions in the cost of labour is not a welfare oriented measure, because such action will hit the low income wage labourers, the focus needs to be directed at the provision of other inputs in production to reduce the burden of labour costs (Langintuyo, 2011). It would also be beneficial to raise the general level of education as regards farm management and accounting, innovation technology applications among others for cassava farmers, processors and marketers to increase efficiency and returns (Kuwornu et al., 2013).

Among the range of constraints, lack of infrastructure came out very strongly. This is an important factor that limits production, processing and marketing efficiency. This research found high cost of inputs and high costs of marketing activities were primarily the result of a lack of good road networks and poor information distribution systems. Therefore, targeted investment is needed to improve provision of water, processing facilities, marketing facilities and information dissemination. Improvement in productivity efficiency is one of the main avenues to expand productivity ((Kuwornu et al. 2013; Langintuyo, 2011; Liverpool-Tasie, 2011; Eyitayo et al. 2011; Bravo-Ureta et al. 2007; Ogundele and Okoruwa, 2004; Nweke, 2003).

The negative influence of extension contacts on efficiency measures raises concern about the ineffectiveness of the Nigerian extension system, confirming the findings of Aye and Mungatana (2011). Javed et al. (2009) in production of crop in Pakistan and lack of information (Phillips et al. 2004) are noted as a limiting factor associated with all aspect of crop productivity. The extension service needs to be revitalized so that it contributes to improvements in all measures of efficiency at every stage of the cassava production process. This would require investment in developing the knowledge of extension workers on new and improved technologies, as well as dissemination strategies so that they can effectively serve to benefit farmers and processors.

Among the policy suggestions, a priority policy will be to focus on removing the constraints identified by the farmers, such as provision infrastructure for production, processing and marketing to reduce the costs of production. This then can be followed by strengthening extension services and the provision of training to farmers, processors, and marketers. Finally, the land reform policies can address long term issues regarding farm size consolidation. The results of this study will be of practical importance to a range of stakeholders and implementation of these policies will positively affect cassava production and agricultural productivity overall.

12.5 Recommendations for Further Research

It is clear from this study that there is an expanding demand for production, processing and marketing of cassava as a source of food, agro-industrial raw material and processed products in Nigeria and international markets. The producers' profitability of cassava is low and qualities of products are of low and grading of products is not uniform. In order to improve its production efficiency, increase profitability for producers and improve qualities and grading of cassava products, further study is needed to determine how to improve the quality and grading of cassava products production, processing and marketing.

Secondly, research should be commissioned on methods of improving quality control and uniformity in standards of cassava root tubers and cassava products. This will reduce current limitations in the standard of measurements and help to create uniformity in cassava markets.

Thirdly, in order to determine the true cost of producing cassava products, a comparative country-wide study of cassava marketing, from the point of production through processing and marketing should be compared with other staple crops and their products. Such studies should be conducted with a view to formulating agricultural policy that will encourage comparative advantages among the competing crops in different regions. Finally, this study examined only one type of processing cassava (into *gari*), so further study should be carried out to examine other forms of cassava processing, such as cassava flour and tapioca which are very high value added products of cassava as this study showed in order to supply (meet) the increasing demand for cassava and its products.

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APPENDIX A: QUESTIONNAIRE 2008

FARM HOUSEHOLD AND FARMS QUESTIONAIRE

Demography

Section A1 Personal Information

1. Name:

____

2. Gender: [ ] M [ ] F

3. Age: [ ] years

4. Date interviewed: ______________________________

5. Marital status: Married [ ] Single [ ] Divorced [ ]

6. Household numbers or Size:____________________

7. Education level (Year of completion of school)____________________

8. Region: Delta South [ ] Delta Central [ ] Delta North [ ]

9. Location (Town/village):_________________________

Section A2 Social Economic Information

1. Main Occupation: _________________________

2. Other Sources of Incomes:

____

3. Farming Experiences (Years):

____

4. Farm Size (Hactere):

____

5. Farming system:

____

6. Family members available for farm work (Mandays)

____

7. Major crops

Crops	Areas (ha)	Year	Total (Output/kg)
cassava			
maize			
Legume			
yam			
vegetable			
others (specific)			
others (specific)			

Section A3 Farming inputs:

1. Capital source

Source	Amount Required (Naira)	Amount Obtained (Naira)
Personal capital		
Borrow capital		

2. What are the total farm areas (ha)? _______________________________________

3. About your farm size last year, how much is your own and how is rented?

Owned land (ha)	Rented land (ha)

4. What type of fertilizer use in your last cropping season?

[ ] organic % [ ] inorganic %

fertilizers	Quantity used (kg)	Price (naira)
organic		
inorganic		

5. Do you think you applying enough fertilizers for your farm?

[ ] yes [ ] No

(If "No") How much more you need? (Specify the fertilizer and chemicals types

Fertilizers ______________________________________ (kg)

6. Where do you buy your fertilizers?

Place: _________________. Distance from Farm: _________________ km

7. Do you have problems in buying fertilizers?

[ ] Yes [ ] No

(If "Yes") What are those problems? Please provide details.

____

____

____

A4. PESTICIDES USE INFORMATION

1. Which type of pesticides do you use? (Specify each types used for different crops)

Crop Name	Name and prices of Pesticides
Cassava	
Maize	
Legume	
Vegetables	
Others (Specific)	

2. Do you think that you use appropriate amount of pesticides for your crops?

[ ] Yes [ ] No

If (If "No") how much more you would like to use?

Pesticides: ________________ (kg) or Litre.

3. Where do you buy your pesticides?

Place:______________________. Distance from farm: _________________km

4. Do you have any problems?. Please, provide details.

____

____

5. How many times you generally use pesticides: _____________ times

6. What are the good and harmful effects of using pesticides? Please give details

Good effects	
Harmful effects	

7. What do you think about the current use level of pesticides for your farm operation?
____

____

____

8. What type land preparation did you use for the last season cropping?

[ ] manual [ ] tractor [ ] both manual and tractor

9. If was manual, how many family mandays was used?

____

10. If manual hire labour mandays used?

____

11. If tractor was used how many mandays power use?

____

12. Total mandays power used in the cropping season

____

13. What type of weeding, pest and diseases control and prevention method did you used?

Methods	Rate of application (%)	Costs (Naira)	Effects
Agrochemicals			
Biological			
Manual			

A4. TECHNOLOGY

1. What type of seed variety did use in planting?

Varieties	Quantity used (kg)	Costs (Naira)
Local variety		
Improved variety		

2. What method do you use in harvesting?

Methods (Mandays)	Costs (Naire)	Associated problems in harvesting
Manual Labour		
Mechanical		

A5. MARKETING OF AGRICULTURAL PRODUCTS (FARMERS)

1. Where do you sale your crops?

Location	Distance from Farm (Km)	Carrying cost (including labour cost) Naira/ton)	Transportation cost (Naira/ton)
At farmgate			
Village market			
Town market			
Central market			
Others (Specific)			

2. What are your reasons for selling your produce at the chosen place?
____

____
____

3. Do you have problems with marketing? [ ] Yes [ ] NO

(If "Yes", provide details): ____

____

A6. FOOD STOCK AND STORAGE FACILITIES

1. Do you have sufficient food stock at present? [ ] Yes [ ] No

2. Where do you usually store your crops?

Place	Distance from	Carrying cost (	Transportation cost	Storage charge

	Farm (Km)	(Naira/ton)	(Naira/ton)	(Naira/ton)
Own storehouse				
Private warehouse				
On farm				
Others (Specify)				

PROCESSING (FARMERS)

1. Do you process the crop before sale?

[ ] Yes [ ] No

(If "Yes") What are your reasons for processing the crop before sale?

____

____

2. (If "Yes") what quantities do you processes before the sale of crop?

____

____

A7. CROP PRODDUCTION

1. What type of Crops did you grow in last year? (First record types of crops grown by the farmer and then ask details).

____

2. What are your reasons for chosen these crops for cultivation?

____

____

Name of Crops	Variety	Area Cultivated (ha)	Land Owning category	Total Production (kg)	Use of total production (kg)						
					Consumption	Kept as food	Sold	Price Naira/kg	Value of Sale	Stored	Debt Services
1	2	3	4	5	6	7	8	9	10	11	12

CROP DAMAGE

	Local Variety	Improved Variety	Cassava	Maize	Yam	Legume	Vegetables
Percentage damaged							
Area cultivated prevoius years							
Production obtained then							

COSTS OF CROP PRODDUCTION

Name of crop	Land owning category	Area cultivated (ha)	Seed cost			Ploughing cost			Fertilizer cost	
			Own (Kg)	Buy (Kg)	Price N/Kg	Own (M.days)	Buy (M.days)	Price (N/AD)	Qty (Kg)	Price (N/Kg)
1	2	3	4	5	6	7	8	9	10	11

Name of crop	Manure cost			Labour cost			IR cost (N)	Pesticides cost (N)	Others equipment hiring cost (N)
	Own Qty.(Kg)	Purchase Qty. (Kg)	Price (N/Kg)	Own (M.day)	Hire (M.day)	Wage (N/M.day)			
1	12	13	14	15	16	17	18	19	20

CROP PROCESSING COST

Name of crop	Washing cost (N)	Pealing cost (N)	Grating cost (N)	Fermenting cost (N)	Drying cost (N)	Frying cost (N)	Pelleting cost (N)	Crumbs cost (N)	Flour cost (N)	Others cost (N)
1	2	3	4	5	6	7	8	9	10	11

. List Five Major constraints encounter during in farming in your area.

____

____

____

____

____

4. Would increased your farming area and processing capacity if the above mention constraints are removed? [ ] Yes [ ] No

A8. DETERMINATION OF MODERN VARIETY SELECTION

1. How long have you been growing the improved variety?

____

2. What are the sources of the improved variety seeds/cuttings?

Name of crop	Variety	Own	Purchase	Source	
Cassava					
Maize					
Legume					
Vegetables					
Others (Specific)					
Others (Specific)					

3. Please provide your opinion on the following questions. Why do you grow the improved variety?

What is the most important factor regarding the improved variety? If you do not grow HYV,

Please provide your reason reasoning for that too. (Spell out all the "reasons for growing HYV" first and ask to rank these reasons over a FIVE-POINT SCALE. Then repeat the procedure with "reason for not growing HYV").

Reasons for Growing HYV	1=Yes 2=No	If "Yes" Then Rank
High yield		
High price		
Ready market		
Short maturity period		
High quality		
Higher profit		

Reasons for not growing HYV	1=Yes 2=No	If "Yes" Then Rank
Seed unavailability		
Unreliable yield		
Lack of irrigation		
Fertilizer shortage		
Pesticides shortage		
Low price		
Poor quality		
Disease/pest prone		
Labour intensive		
No fodder output		
High production cost		
Others (Specific)		

4. Please provide your opinion on the following questions. Why do you grow local variety?

What is the most important factor as regard the local variety? If you do not grow local variety, please provide your reasoning for that too. (Spell out all the "reasons for growing local variety" first and ask to rank these reasons over a FIVE-POINT SCALE. Then repeat the procedure with "reasons for not growing local variety"). 1= least to 5 most important

Reasons for cultivating local variety	1=Yes 2=No	If "Yes" Then Rank
Reliable yield		
High price		
Ready market		
High quantity		
Higher profit		
Low labour requirement		
Disease resistance		
No need irrigation		
Low production		
Higher fodder output		
Others (Specific)		

Reasons for not cultivating local variety	1=Yes 2= No	If "Yes" then Rank
Low yield		
Low price		
Poor quality		
Also need fertilizer		
Also need pesticide		
Long maturity		
Nobody do it		
Others (Specific)		

A9. PRODUCTION TRENDS

1. Do you think that over past five years, the crops production of the HYV is?

[ ] Increasing [ ] Decreasing [ ] or at the same level?

(If "increasing") Please explain why?

____

____

A10. OFF-FARM INCOME

1. What are the off-farm incomes of each of the members of your family household for the past one month?

Name of person (household members)	Worked during last month		Earnings	
	Details of work	Day's work per week	Type	Amount (Naira)
1	2	3	4	5

Col. 4: Type of earnings: 1=Daily; 2=Weekly; 3= Monthly; 4= Contract (for the week); 5= Goods sold; 6= processing of crops; 7= Small trade; 8= Shop.

9= Crop sale (crops that are continuously harvested); Others (Specific)

____

2. If earned through shop/trade, then what is the amount and value of stock? (Fill up the categories

Stock	Credit to be received	Current debt	Own consumption

A11. ASSET OWNERSHIP

1. Do you have the following agricultural implements and assets?

Type of implements	1= Yes; 2= NO	Number	Present Value
Plough and yoke	2	3	4
Cutlasses			
Sickles			
Shovels			
Measuring tapes			
Power tiller/Tractor			
Grater			
Grounding Machine			
Dryer			
Fryer			
Others (Specify)			
Others (Specify)			

A12. PROVISION OF INFRASTRUCTURE AND SERVICES

Please select the box that best represent your opinion				
1.Strongly Disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly Agree

	1	2	3	4	5
Water					
Electricity					
Marketing facilities					
Road network					
Information					
Extension services					
Credit facilities					
Processing facilities					

Others (Specify)					
Others (Specify)					

A14. KNOWLEDGE OF MODERN TECHNOLOGY

1. From where are you getting information on modern technology for your crop, processing and marketing of your production?

Sources of Information	Crop production	Processing	Storage	Marketing
Co-farmers				
Principal Agricultural Officer				
Extension agent				
Demonstration Plot				
Media/TV/Radio				
Trade fair				
Others (Specify)				
Others (Specify)				

2. Did you have any training in crop production, processing, storage and marketing in the past 5 years? [ ] Yes [ ] No

(If "No") Why?

____

(If "Yes", provide details).

Training types	Duration	Organizers

3. How far is the nearest Agricultural Extension Office from your village?________________ Km.

4. How many times did the Agricultural Extension Officer visited you in the past one year?

5. How many times did you visit the nearest Agricultural Extension Office in past one year?

____________ Times. Why?

____

A15. LAND ACQUISITION AND CONSOLIDATION

1. Did you purchase any land in the past 5 years? [ ]Yes; [ ] No.

(If "Yes" provide details)

Land type	Purpose/Use	Purchase value	Present value	Source of finance
Homestead land				
Cultivated land				
Others (Specify)				

2. Did you sell any land in the last 5 years? [ ] Yes [ ] No

Land type	Sale value	Purchase value	Reason for sale
Homestead land			
Cultivated land			
Others (Specify)			

A16. DEBT SITUATION

1. Is anyone of your household members has taken loan and still under? [ ] Yes [ ] No

(If "Yes") Please provide details

Person	Source of loan	Type of loan	Duration of loan	Amount of loan	Use of loan	Rate of loan	Collateral given	
							Type	Value
1	2	3	4	5	6	7	8	9

A16. ECONOMIC CONDITION

What is the economic condition for the household for last year?

Condition	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surplus												
Level												
Deficit												

A17. HOUSEHOLD EXPENDITURE

What is your household expenditure incurred last week? (Spell out each items and fill accordingly).

Item	Purchase			Own source		
	Quantity		Type expense (Naira)	Quantity		Market value (Naira)
				Unit	Total	
1	2	3	4	5	6	7
Weekly expenditure on the following items						
Rice						
Gari						
Fufu						
Starch						
Bread						
Fish						
Meat						
egg						
milk						
Plantain						
Vegetables						
Others						

Item	Purchase			Own source		
	Quantity		Type expense (Naira)	Quantity		Market value (Naira)
				Unit	Total	
1	2	3	4	5	6	7
Monthly/ Annual expenditure on the following items						
Dress/Clothing						
Fuel wood						
Education						
Savings						
Running capital						
Debt services (non-formal)						
Investment						

Interest payment						
Maintenance						
Social work						
Transport cost						
Religions work						
Others (Specify)						

A18. AGRICULTURAL POLICY PROGRAMMES

1. In the past 7 years have participated in any government/private policy/programs in agriculture?

[ ] Yes [ ] No

(If "Yes",) which program?

Agricultural programmes	Year	Effects

2. From where is getting information on government/private programs on agriculture?

Agricultural Policy	Type of Policy/Programs	Year	Channel of information	Responds/opinion

3. Which of the program did you participated?____

____

If you participated,
why?____

____

4. Has the policy/programs affected your:

Crop production output/ha?-____

Crop Processing
capacity?____

Marketing your produces/products?

____

Costs of;

Production____

Processing____
____

Marketing____
___

5. Were the programs/policy involved changes in technology? [ ] Yes [ ] No

(If "Yes",) how do think it could be made more effective?

____

____

6. What do you think about government agricultural policies/programs in the following areas?

Food
production____

Employment____
____

Income____

Raw material for industries____

Marketing____

Others (Specify)____

7. Do you think that the government policy/programs have been helpful to agricultural development and growth? [ ] Yes [ ] No

If "Yes" why?

If "No" why?

8. How government agricultural policy in these periods [ ] Pre SAP [ ] SAP [ ] Post SAP benefited your farming business.

Effects	Policy periods		
	Pre SAP	SAP	Post SAP
Cost of production			
Cost of Output/ha			
Output/ha			
Processing			
Marketing			
Export			
Income			
Others (Specify)			
Others (Specify)			

Thank you.

APPENDIX B

QUESTIONS FOR THE PROFESSIONALS AND STAKEHOLDERS

The professional's interviews are Bankers, Researchers, Marketers, Civil servants etc.

How long has being acting at this position/capacity?

How has the government policies/programs on agriculture affected your profession?

What periods were they implemented?

How was organisation in involved in the policies programmes?

From your assessments, do you think that these policies were effective?

What was the economic benefit of the policies/programs?

What was social benefit the policies/programs

And which of the periods (Pre-SAP, SAP and Post-SAP) did your profession and agriculture benefited most?

Were your organisations involved in the planning, implementation and evaluation of the policies and programme, if yes?

How were they involved?

What hindrances your participation in the policy implementation?

And which programs/policies were more effective?

What do you think could have made the programs/policies more effectives?

Thank you.

APPENDIX C

MARKETING SURVEY FOR CASSAVA AND CASSAVA PRODUCTS

The purpose of this survey is to find out from the respondents on the various forms which cassava is market, marketing costs, the margins and the channels of distribution for the sale of cassava. This information that will be collected by this survey shall be held confidential and used strictly.

1. Name (Optional):____, Gender: [ ] Male [ ] Female

2. Marital status: [ ] Married [ ] Single [ ] Widow [ ] Divorce

3. Family Size: ___________________________________

3.1. Education level (Year of completion of school)_________________________

3.2. Marketing Experience____

4. Senatorial region:____________________________

5. Market and Town name:____

6. Main occupation:____

If you are Trader, do you sell in: Retail [ ] Wholesalers [ ] both [ ]

7. Other Source of Income:____

8. Mention various forms in which cassava is being sold:

____
____
____
____
____

9. What is the main channel of distribution of cassava and its products in this region:

____

____

____

____

____

B1. MARKET CHARACTERISTICS AND INFRASTRUCTURE

10. Where is the location of the market?

____

11. Is the market a:

[ ] Village market

[ ] Town market

[ ] Central market

12. What is the frequency of market days in this market in a month?

____

13. Does the market have the following? Tick the correct options and state the percentages of the options tick:

Permanent, lockable stalls? [ ] Yes [ ] No
________________ %

Semi- permanent vending booths or stall? [ ] Yes [ ] No
________________ %

Storage rooms? [ ]Yes [ ] No.
________________ %

Space on the ground for selling? [ ] Yes [ ] No
________________ %

14. At the end of the sale where do you store unsold cassava tubers and/or products? Tick the correct options and state percentages of how the unsold are store in the tick options:

Store room? [ ] Yes [ ] No
_________________%

Covering the unsold on the ground? [ ] Yes [ ] No _________________%

Carried home? [ ] Yes [ ] No
_________________%

15. Do cassava and its products sellers have to belong to any association to sell in the market?

[ ] Yes [ ] No

16. Are the stall or space on the ground owned or rented by marketers? [ ] Yes [ ] No

(If "Yes") What is the cost of rent (in Naira)?

Rent	**Cost of rent**	**Cost of providing security**	**Costs of Council levy**	**Market Association levy**	**Cost of electricity**	**Others (Specify)**
Weekly						
Monthly						
Total cost incurred						

17. How price is determined in this market? Tick the correct options

Fixed by marketing association: [ ] Yes [ ] No.

Haggling between buyer and seller: [ ] Yes [ ] No

Sellers [ ] Yes [ ] No

Buyers force sellers to sell at a certain price[ ] Yes [ ] No

Each seller decides to sell at a price based on the demand and supply of

cassava and its products [ ] Yes [ ] No

Fixed by government agents. [ ] Yes [ ] No

18. How is the market price information passed among traders and buyers? Tick the correct options:

By Traders [ ] Yes [ ] No

By buyers [ ] Yes [ ] No

By Market association [ ] Yes [ ] N By Government agencies [ ] Yes [ ] No

By the news media (TV, Radio, Newspaper) [ ] Yes [ ] No

Others (Specify).
____

19. What means of communication within the marketing system? Tick the correct options:

Is by direct contact ? [ ] Yes [ ] No

Is by phone? [ ] yes [ ] No

Any other means (Specify).____

____

20. How would you describe the access road leading to the market: Tick the correct options:

Tarred road? [ ] Yes [ ] No

Untarred/partially tarred, but fairly good? [ ] Yes [ ] No.

Untarred, waterlogged during raining season but motorable? [ ]Yes [ ] No

Untarred, waterlogged and unmotorable during raining season? [ ] Yes [ ] No

Unmotorable all year round? [ ] Yes

[ ] No

21. What is the distance to market from the source of supply?

(Km)______________________

B2 PURCHASE TRANSACTIONS

22. What is the most important staple food items traded in this market? State the important item the market is known for. Rank on a scale of 1 to 5 for each (1 is most important and 5 is least).

Staple Item	**1= important 2= not important**	**Rank**
Yam		
Yam Products		
Maize		
Maize products		
Cassava root tubers		
Cassava products		
Legume		
Vegetables		
Sweet potatoes, Irish potatoes		
Cocoyam		
Others (Specify)		

23. Rank in other of volume traded all cassava products traded in this market

Cassava and its products	**1= important; 2 not important**	**Rank**
Tubers		
Fufu (Akpu)		
Tapioca (from starch)		
Fresh Tapioca		
Dried Tapioca		
Starch		
Garri		
Cassava Chips (fresh or dried)		
Cassava Pellets		
Cassava crumbs		
Cassava Flour		

24. Where do you buy cassava roots from? Tick the correct options

From your own farm? [ ] Yes [ ] No

At farmgate? [ ] Yes [ ] No

From retailers [ ] Yes [ ] No

From wholesellers? [ ] Yes [ ] No

From farmers group or co-oprative? [ ] Yes [ ] No

Government agent? [ ] Yes [ ] No

25. Why do you buy cassava root? Tick the correct options:

For consumption? [ ] Yes [ ] No

Resale? [ ] Yes [ ] No

Processing for home consumption? [ ] Yes [ ] No

Processing for sale [ ] Yes [ ] No

For livestock feed [ ] Yes [ ] No

If ("Yes") for all of the above the rank with 5 for the most important and 1 for the least

26. From whom do you buy processed cassava products? Tick the correct options:

From you own production? [ ] Yes [ ] No

Individual processor ? [ ] Yes [ ] No

Wholesalers? [ ] Yes [ ] No

Processing group or co-operative? [ ] yes [ ] No

Government agent [ ] Yes [ ] No

Retail traders [ ] Yes [ ] No

27. If you buy for resale where do you sell, complete the table below for 5 most important markets, where you sell

Rank	Market/ Town	State	Distance from here	Cost of transportation
1(least important)				
2				
3				
4				
5 (most important)				

28.What price do pay for the cassava root/cassava products, when you buy and other associated costs

Place bought	**1=Yes; 2 = No**	**Cost**
Farmgate		
Retailers market		
Wholesalers		
Commission agent/fee		
Association fee		
Loaders		
Transportation cost		
Storage cost		
Sellers fee		
Rent		
Utility costs		
Others (Specify)		
Others (Specify)		
Total		

29. Which measurement is used in selling cassava product and what is the price per unit/ Kg and its associated selling problems?

Cassava Products	**Measurement Units**	**Packaging Method**	**Storage method**	**Price (N/Kg)**	**Problems associated with marketing**
Fufu (Akpu)					
Tapioca (from Starch)					
Fresh Tapioca					
Dried Tapioca					
Starch					
Garri					
Cassava chips					
Cassava pellets					
Cassava crumbs					
Cassava flour					

30. What is source of your business finance? Tick the correct options:

Personal servings [ ] Yes [ ] No

Bank loan [ ] Yes [ ] No

Cooperative [ ] Yes [ ] No

Trader,s association [ ] Yes [ ] No

Money lender [ ] Yes [ ] No

Others (Specify)

31. Complete the following table for the last two purchases of cassava.

Cassava	**Volume**		**Average Cost**	**Units/ Price**	**Price/Kg**	**Total value paid**
	1st Purchase	2nd purchase				
Tubers						
Garri						
Starch						
Fufu						
Tapioca fresh						
Tapioca dried						
Pellets						
Chips						

32. How you aware that cassava root and cassava products could be added value to make the following products like Industrial starch, syrup for medicine, soft drink, bread, snacks, livestock feeds and others? [ ] Yes [ ] No

33. If "Yes" how did know that cassava and cassava products could value added to make the above final products:

____

____

34. Do you buy cassava roots and cassava products to add value to make final products?

[ ] Yes [ ] No

If "Yes" what are the value added products your business process?____

____

____

35. What are the costs associated with value added products?

____

____

____

36. What is the sales margins when you sell cassava roots, process cassava and value added products of cassava?____

____

37. What are the major constraints of adding value to cassava roots and cassava products?

____

____

38. What are the major constraints in purchase of cassava ? Tick the correct options:

Transportation difficulties	[ ] Yes	[ ] No
High cost of transport	[ ] Yes	[ ] No
Too many buyers	[ ] Yes	[ ] No
Lack of finance or credit	[ ] Yes	[ ] No
Risk of quality deterioration	[ ] Yes	[ ] No
Frequent prices change	[ ] Yes	[ ] No

Others (Specify)

B3. SALES TRANSACTION

39. Who buys your cassava most in this market? Tick the correct options:

Final consumer [ ] Yes [ ] No

Retailer or food seller [ ] Yes [ ] No

Processor or miller [ ] Yes [ ] No

Industries as raw materials [ ] Yes [ ] No

Traders who sells in other markets [ ] Yes [ ] No

Government buying agent [ ] Yes [ ] No

Others (Specify)

40. Complete the table for your last two supplies of cassava in this market

Cassava	**Volume taken in market**		**Volume sold**	**Units/ Price**	**Price/Kg**	**Total value**
	1sr supplies	2nd supplies				
Tubers						
Garri						
Starch						
Fufu						
Tapioca fresh						
Tapioca dried						
Pellets						
Chips						

41. For cassava products sold in this market in which months are volume sold highest (H) and lowest (L) enter H or L.

Month	Jan	Feb	Mar	Apr	May	June	Aug	Sept	Oct	Nov	Dec
Cassava Tubers											
Garri											
Starch											
Fufu											
Fresh tapioca											
Dried tapioca											
pellets											
Chips											
Crumbs											

42. Do you transport cassava to this market for sale? [ ] Yes [ ] No or do you buy here and transport to another market? [ ] Yes [ ] No

43. If "Yes", what is type of vehicle do you use most? Tick the correct options:

Bicycle [ ] Yes [ ] No Lorry [ ] Yes [ ] No

Head load [ ] Yes [ ] No Motorbike [ ] Yes [ ] No

Pick-up [ ] Yes [ ] No Bus [ ] Yes [ ] No

Boat [ ] Yes [ ] No Animal [ ] Yes [ ] No

44. Who owns the vehicle you use most of the time? Tick the correct options:

Your own [ ] Yes [ ] No

Commercial vehicle [ ] Yes [ ] No

Government [ ] Yes [ ] No

Other (Specify)

45. What is cost of hiring a vehicle? ______________________________ (Naira)

46. What is the cost of operating own vehicle?

Petrol _______________________

Driver _______________________

Engine oil ___________________

Service/maintenance____________

Other (Specify)________________

Total amount__________________(Naira)

47. Do you hire permanent labour for selling? [ ] Yes [ ] No

If "Yes", state the cost per week Naira_______ Per month Naira ___________

48. Do you hire temporary labour for the following task? Tick the correct options:

Loading and off-loading [ ] Yes [ ] No

Amount_______________(Naira)

Night/day watch [ ] Yes [ ] No Amount ______________

(Naira)

Bagging [ ] Yes [ ] No Amount __________(Naira)

Others (Specify) Amount ______________(Naira)

49. Do you keep a ledger or an account book? [ ] Yes [ ] No

50. Do you sell different grades/qualities of cassava products at different prices [ ] yes [ ] No.

51. How many different grades did you sell in the last one week?

____

____

52. Rank in order of importance, the quality factors used to grade the cassava products:

Rank (5 for the highest and 1 for the least) and tick the correct options:

Quality Factor	[ ] Yes	[ ] No	_________	Rank
Colour	[ ] Yes	[ ] No	_________	Rank
Fineness	[ ] Yes	[ ] No	__________	Rank
Amount of visible foreign particles	[ ] Yes	[ ] No	__________	Rank
Fermentation	[ ] Yes	[ ] No	__________	Rank
Smell	[ ] Yes	[ ] No	__________	Rank
Dryness	[ ] Yes	[ ] No	__________	Rank
Technology used in processing	[ ] Yes	[ ] No	__________	Rank

Others (Specify)

53. List 5 major constraints that limit your volume for sales of cassava and cassava products:

____

____

54. What suggestions will you give to government and private sector on how to improve cassava and cassava product marketing?

____

____

55. What do you think is the role of following categories in the development of the cassava product markets?

Producer:

____

Processor;

____

Marketers:

____

Users/industries;

____

56. What is your business size?

____

57. What are the future plans of the business?

____

THANK YOU VERY MUCH FOR YOUR TIME

APPENDIX D

Results from DEAP Version 2.1

Instruction file = deabrod.ins
Data file = deabrod.txt

Cost efficiency DEA

Scale assumption: VRS

EFFICIENCY SUMMARY:

firm	te	ae	ce
1	0.387	0.765	0.296
2	0.237	0.660	0.156
3	0.644	0.642	0.414
4	0.234	0.629	0.147
5	0.200	0.874	0.174
6	0.479	0.732	0.350
7	0.145	0.665	0.096
8	1.000	1.000	1.000
9	0.317	0.750	0.238
10	0.457	0.633	0.289
11	0.300	0.808	0.243
12	1.000	0.840	0.840
13	0.294	0.565	0.166
14	0.318	0.985	0.313
15	0.268	0.768	0.206
16	0.413	0.494	0.204
17	1.000	1.000	1.000
18	0.252	0.729	0.184
19	0.235	0.736	0.173
20	0.169	0.637	0.108
21	0.155	0.775	0.120
22	0.321	0.916	0.294
23	0.321	0.906	0.290
24	0.388	0.810	0.315
25	0.326	0.912	0.298
26	0.475	0.590	0.280
27	0.468	0.840	0.393
28	0.440	0.632	0.278
29	0.393	0.549	0.216
30	0.314	0.645	0.203
31	0.331	0.842	0.279
32	0.216	0.710	0.153
33	0.320	0.805	0.257
34	0.277	0.772	0.214
35	0.242	0.756	0.183
36	0.193	0.521	0.100
37	0.264	0.533	0.141
38	0.380	0.736	0.280
39	0.331	0.856	0.283

40	0.195	0.807	0.157
41	0.335	0.722	0.242
42	0.390	0.467	0.182
43	0.423	0.560	0.237
44	0.239	0.735	0.176
45	0.298	0.542	0.162
46	0.237	0.795	0.188
47	0.250	0.718	0.179
48	0.321	0.453	0.145
49	0.260	0.579	0.151
50	0.312	0.470	0.146
51	0.294	0.506	0.149
52	0.572	0.689	0.395
53	0.306	0.783	0.239
54	0.262	0.710	0.186
55	0.620	0.471	0.292
56	0.245	0.696	0.171
57	0.266	0.606	0.161
58	0.260	0.743	0.193
59	1.000	0.685	0.685
60	0.215	0.750	0.161
61	0.148	0.816	0.121
62	1.000	1.000	1.000
63	0.486	0.761	0.370
64	0.337	0.862	0.290
65	1.000	1.000	1.000
66	0.305	0.969	0.295
67	0.363	0.656	0.238
68	0.360	0.732	0.263
69	0.296	0.827	0.245
70	0.403	0.484	0.195
71	0.345	0.708	0.244
72	0.674	0.790	0.532
73	0.478	0.833	0.398
74	0.337	0.548	0.185
75	0.404	0.590	0.238
76	0.313	0.789	0.247
77	0.413	0.834	0.344
78	0.455	0.963	0.439
79	0.354	0.863	0.305
80	0.431	0.773	0.333
81	0.591	0.792	0.468
82	0.394	0.727	0.286
83	0.384	0.504	0.193
84	0.373	0.718	0.268
85	0.246	0.716	0.177
86	0.500	0.845	0.422
87	0.434	0.566	0.245
88	0.265	0.629	0.167
89	0.351	0.712	0.250
90	0.385	0.837	0.322
91	0.314	0.533	0.167
92	0.580	0.863	0.500
93	0.346	0.658	0.228

94	0.442	0.831	0.368
95	0.393	0.822	0.323
96	0.519	0.891	0.463
97	0.426	0.889	0.378
98	0.496	0.478	0.237
99	0.341	0.621	0.212
100	0.504	0.686	0.345
101	0.390	0.837	0.326
102	0.177	0.756	0.134
103	0.340	0.684	0.233
104	0.294	0.688	0.202
105	0.330	0.970	0.320
106	0.250	0.685	0.171
107	0.173	0.778	0.134
108	0.260	0.850	0.221
109	0.184	0.679	0.125
110	0.334	0.622	0.208
111	0.351	0.714	0.251
112	0.188	0.821	0.154
113	0.417	0.722	0.301
114	0.423	0.854	0.361
115	0.426	0.886	0.377
116	0.247	0.618	0.153
117	0.250	0.847	0.211
118	0.337	0.619	0.209
119	0.327	0.795	0.260
120	0.504	0.593	0.299
121	0.435	0.569	0.248
122	0.416	0.534	0.222
123	0.372	0.561	0.209
124	0.233	0.748	0.175
125	0.418	0.136	0.057
126	0.316	0.622	0.196
127	0.216	0.608	0.131
128	0.172	0.689	0.118
129	0.180	0.736	0.132
130	0.188	0.821	0.154
131	0.172	0.745	0.128
132	0.184	0.732	0.135
133	0.475	0.833	0.396
134	0.216	0.700	0.151
135	0.172	0.724	0.124
136	0.272	0.629	0.171
137	0.487	0.849	0.414
138	0.207	0.874	0.181
139	0.247	0.666	0.164
140	0.382	0.491	0.187
141	0.558	0.927	0.518
142	0.408	0.898	0.367
143	0.294	0.858	0.252
144	0.368	0.559	0.206
145	0.476	0.882	0.420
146	0.346	0.818	0.283
147	0.220	0.710	0.156

148	0.344	0.772	0.266
149	0.312	0.844	0.264
150	0.226	0.923	0.208
151	0.346	0.818	0.283
152	0.370	0.651	0.241
153	0.274	0.833	0.228
154	0.436	0.602	0.262
155	0.382	0.585	0.223
156	0.230	0.846	0.195
157	0.397	0.947	0.376
158	0.496	0.879	0.436
159	0.361	0.938	0.338
160	0.430	0.907	0.391
161	0.358	0.876	0.313
162	0.492	0.878	0.432
163	0.368	0.871	0.320
164	0.394	0.941	0.371
165	0.437	0.887	0.387
166	0.382	0.595	0.227
167	0.500	0.746	0.373
168	0.237	0.978	0.232
169	0.205	0.841	0.172
170	0.212	0.826	0.175
171	0.707	0.914	0.646
172	0.368	0.762	0.280
173	0.302	0.890	0.269
174	0.184	0.668	0.123
175	0.172	0.682	0.117
176	0.222	0.812	0.180
177	0.188	0.793	0.149
178	0.288	0.898	0.259
179	0.197	0.876	0.172
180	0.220	0.799	0.176
181	0.221	0.960	0.212
182	0.292	0.852	0.248
183	0.304	0.809	0.246
184	0.284	0.882	0.250
185	0.347	0.902	0.313
186	0.234	0.883	0.207
187	0.319	0.917	0.293
188	0.208	0.832	0.173
189	0.322	0.904	0.291
190	0.243	0.911	0.221
191	0.222	0.797	0.177
192	0.288	0.887	0.256
193	0.290	0.818	0.237
194	0.304	0.778	0.236
195	0.353	0.840	0.296
196	0.317	0.758	0.240
197	0.301	0.914	0.276
198	0.323	0.886	0.286
199	0.214	0.787	0.169
200	0.257	0.981	0.252
201	0.208	0.812	0.169

202	0.188	0.779	0.146
203	0.314	0.807	0.253
204	0.288	0.898	0.259
205	0.253	0.819	0.207
206	0.220	0.811	0.178
207	0.288	0.900	0.259
208	0.317	0.748	0.237
209	0.439	0.781	0.343
210	0.431	0.974	0.420
211	0.323	0.033	0.011
212	0.307	0.787	0.241
213	0.517	0.779	0.403
214	1.000	1.000	1.000
215	1.000	1.000	1.000
216	0.721	0.351	0.253
217	0.742	0.461	0.342
218	0.262	0.761	0.200
219	0.539	0.755	0.407
220	0.077	0.861	0.067
221	0.245	0.647	0.159
222	1.000	0.295	0.295
223	0.330	0.795	0.263
224	0.251	0.784	0.196
225	1.000	0.324	0.324
226	0.282	0.736	0.208
227	0.933	0.565	0.527
228	0.867	0.555	0.481
229	0.320	0.915	0.292
230	0.647	0.789	0.511
231	0.284	0.801	0.228
232	0.457	0.588	0.269
233	0.664	0.749	0.497
234	0.530	0.430	0.228
235	0.933	0.565	0.527
236	0.750	0.635	0.476
237	0.794	0.886	0.703
238	0.604	0.711	0.430
239	1.000	0.263	0.263
240	0.252	0.852	0.215
241	0.393	0.822	0.323
242	0.592	0.435	0.258
243	0.735	0.497	0.365
244	0.651	0.966	0.629
245	0.664	0.277	0.184
246	0.582	0.526	0.306
247	0.591	0.974	0.576
248	0.664	0.749	0.497
249	0.633	0.542	0.343
250	0.573	0.574	0.329
251	0.311	0.857	0.267
252	0.230	0.819	0.188
253	0.305	0.900	0.275
254	0.208	0.828	0.172
255	0.651	0.965	0.628

256	0.674	0.899	0.606
257	0.603	0.939	0.567
258	0.273	0.701	0.191
259	1.000	0.672	0.672
260	0.302	0.662	0.200
261	0.417	0.405	0.169
262	0.417	0.543	0.227
263	0.493	0.423	0.208
264	1.000	0.111	0.111
265	0.294	0.557	0.164
266	0.653	0.898	0.587
267	0.449	0.654	0.294
268	0.631	0.916	0.578
269	0.239	0.698	0.167
270	0.287	0.885	0.254
271	0.521	0.929	0.484
272	0.173	0.628	0.109
273	0.316	0.582	0.184
274	0.364	0.687	0.250
275	0.445	0.703	0.313
276	0.312	0.501	0.156
277	0.647	0.118	0.076
278	0.299	0.597	0.178
279	0.502	0.671	0.337
280	0.551	0.508	0.280
281	0.427	0.458	0.196
282	0.417	0.392	0.163
283	0.463	0.468	0.217
284	0.452	0.898	0.406
285	0.275	0.855	0.235
286	0.530	0.846	0.448
287	0.795	0.751	0.598
288	0.469	0.579	0.272
289	0.316	0.917	0.290
290	0.423	0.907	0.383
291	0.301	0.573	0.173
292	0.348	0.324	0.113
293	0.660	0.413	0.272
294	1.000	0.670	0.670
295	0.529	0.814	0.430
296	0.234	0.777	0.182
297	0.303	0.710	0.215
298	0.230	0.680	0.156
299	1.000	1.000	1.000
300	0.443	0.458	0.203
301	0.517	0.670	0.346
302	0.262	0.683	0.179
303	0.143	0.817	0.117
304	0.476	0.857	0.408
305	0.363	0.799	0.290
306	0.316	0.931	0.295
307	0.427	0.459	0.196
308	0.410	0.873	0.358
309	0.232	0.736	0.171

310	0.407	0.687	0.280
311	0.236	0.726	0.171
312	0.459	0.564	0.259
313	0.417	0.672	0.280
314	0.471	0.660	0.311
315	0.546	0.439	0.240
mean	0.399	0.729	0.287

Note: te = technical efficiency
ae = allocative efficiency = ce/te
ce = cost efficiecy

Results from DEAP Version 2.1

Instruction file = small.ins
Data file = small.txt

Cost efficiency DEA

Scale assumption: VRS

EFFICIENCY SUMMARY:

firm	te	ae	ce
1	0.389	0.761	0.296
2	0.644	0.642	0.414
3	0.200	0.874	0.174
4	0.504	0.696	0.350
5	1.000	1.000	1.000
6	0.321	0.741	0.238
7	0.457	0.633	0.289
8	0.318	0.985	0.313
9	0.268	0.768	0.206
10	1.000	1.000	1.000
11	0.246	0.702	0.173
12	0.155	0.775	0.120
13	0.321	0.916	0.294
14	0.321	0.906	0.290
15	0.388	0.810	0.315
16	0.326	0.912	0.298
17	0.520	0.539	0.280
18	0.477	0.825	0.393
19	0.343	0.592	0.203
20	0.331	0.842	0.279
21	0.320	0.805	0.257
22	0.281	0.761	0.214
23	0.380	0.736	0.280
24	0.331	0.856	0.283
25	0.195	0.807	0.157
26	0.348	0.694	0.242
27	0.477	0.497	0.237
28	0.244	0.721	0.176
29	0.572	0.689	0.395
30	0.306	0.783	0.239
31	0.264	0.705	0.186
32	0.715	0.409	0.292
33	0.283	0.569	0.161
34	0.260	0.743	0.193
35	0.215	0.750	0.161
36	0.148	0.816	0.121
37	0.337	0.862	0.290
38	0.392	0.607	0.238
39	0.374	0.703	0.263
40	0.296	0.827	0.245
41	0.353	0.692	0.244
42	0.487	0.816	0.398
43	0.384	0.480	0.185
44	0.422	0.565	0.238

45	0.318	0.777	0.247
46	0.413	0.834	0.344
47	0.354	0.863	0.305
48	0.431	0.773	0.333
49	0.591	0.792	0.468
50	0.405	0.706	0.286
51	0.414	0.467	0.193
52	0.388	0.691	0.268
53	0.500	0.845	0.422
54	0.478	0.513	0.245
55	0.359	0.696	0.250
56	0.340	0.492	0.167
57	0.580	0.863	0.500
58	0.359	0.634	0.228
59	0.442	0.831	0.368
60	0.393	0.822	0.323
61	0.519	0.891	0.463
62	0.426	0.889	0.378
63	0.572	0.415	0.237
64	0.347	0.610	0.212
65	0.539	0.641	0.345
66	0.390	0.837	0.326
67	0.182	0.736	0.134
68	0.340	0.684	0.233
69	0.294	0.688	0.202
70	0.330	0.970	0.320
71	0.250	0.683	0.171
72	0.260	0.850	0.221
73	0.361	0.693	0.251
74	0.188	0.821	0.154
75	0.423	0.854	0.361
76	0.426	0.886	0.377
77	0.250	0.847	0.211
78	0.339	0.615	0.209
79	0.327	0.795	0.260
80	0.539	0.554	0.299
81	0.478	0.518	0.248
82	0.458	0.486	0.222
83	0.388	0.539	0.209
84	0.316	0.622	0.196
85	0.180	0.736	0.132
86	0.188	0.821	0.154
87	0.480	0.823	0.396
88	0.276	0.620	0.171
89	0.493	0.840	0.414
90	0.209	0.865	0.181
91	0.406	0.461	0.187
92	0.558	0.927	0.518
93	0.408	0.898	0.367
94	0.295	0.854	0.252
95	0.387	0.532	0.206
96	0.476	0.882	0.420
97	0.349	0.810	0.283
98	0.220	0.710	0.156
99	0.349	0.760	0.266
100	0.312	0.843	0.264
101	0.226	0.923	0.208

102	0.349	0.810	0.283
103	0.392	0.615	0.241
104	0.274	0.833	0.228
105	0.475	0.552	0.262
106	0.406	0.550	0.223
107	0.230	0.846	0.195
108	0.397	0.947	0.376
109	0.496	0.879	0.436
110	0.361	0.938	0.338
111	0.430	0.907	0.391
112	0.358	0.876	0.313
113	0.492	0.878	0.432
114	0.368	0.871	0.320
115	0.394	0.941	0.371
116	0.437	0.887	0.387
117	0.406	0.559	0.227
118	0.500	0.746	0.373
119	0.237	0.978	0.232
120	0.209	0.826	0.172
121	0.212	0.826	0.175
122	0.707	0.914	0.646
123	0.369	0.759	0.280
124	0.302	0.890	0.269
125	0.223	0.809	0.180
126	0.188	0.793	0.149
127	0.288	0.898	0.259
128	0.197	0.874	0.172
129	0.220	0.799	0.176
130	0.221	0.960	0.212
131	0.292	0.852	0.248
132	0.307	0.802	0.246
133	0.284	0.882	0.250
134	0.347	0.902	0.313
135	0.234	0.883	0.207
136	0.319	0.917	0.293
137	0.208	0.832	0.173
138	0.322	0.904	0.291
139	0.243	0.911	0.221
140	0.223	0.794	0.177
141	0.288	0.887	0.256
142	0.290	0.818	0.237
143	0.304	0.778	0.236
144	0.353	0.840	0.296
145	0.323	0.743	0.240
146	0.301	0.914	0.276
147	0.323	0.885	0.286
148	0.214	0.787	0.169
149	0.257	0.981	0.252
150	0.208	0.812	0.169
151	0.188	0.779	0.146
152	0.314	0.807	0.253
153	0.288	0.898	0.259
154	0.260	0.798	0.207
155	0.220	0.811	0.178
156	0.288	0.900	0.259
157	0.323	0.732	0.237
158	0.439	0.781	0.343

159	0.431	0.974	0.420
160	0.323	0.033	0.011
161	0.307	0.787	0.241
162	0.517	0.779	0.403
163	1.000	1.000	1.000
164	1.000	1.000	1.000
165	0.834	0.410	0.342
166	0.262	0.761	0.200
167	0.539	0.755	0.407
168	0.260	0.611	0.159
169	1.000	0.295	0.295
170	0.330	0.795	0.263
171	0.260	0.757	0.196
172	1.000	0.324	0.324
173	0.284	0.731	0.208
174	0.984	0.536	0.527
175	0.937	0.513	0.481
176	0.320	0.915	0.292
177	0.647	0.789	0.511
178	0.284	0.801	0.228
179	0.664	0.749	0.497
180	0.984	0.536	0.527
181	0.750	0.635	0.476
182	0.797	0.882	0.703
183	0.604	0.711	0.430
184	1.000	0.263	0.263
185	0.252	0.852	0.215
186	0.393	0.822	0.323
187	0.666	0.387	0.258
188	0.802	0.455	0.365
189	0.651	0.966	0.629
190	0.664	0.277	0.184
191	0.653	0.469	0.306
192	0.591	0.974	0.576
193	0.664	0.749	0.497
194	0.656	0.502	0.329
195	0.311	0.857	0.267
196	0.230	0.819	0.188
197	0.305	0.900	0.275
198	0.208	0.828	0.172
199	0.651	0.965	0.628
200	0.674	0.899	0.606
201	0.603	0.939	0.567
202	0.291	0.658	0.191
203	1.000	0.672	0.672
204	0.312	0.642	0.200
205	0.480	0.351	0.169
206	0.434	0.523	0.227
207	0.653	0.898	0.587
208	0.449	0.654	0.294
209	0.631	0.916	0.578
210	0.287	0.885	0.254
211	0.521	0.929	0.484
212	0.188	0.580	0.109
213	0.328	0.560	0.184
214	0.647	0.118	0.076
215	0.524	0.643	0.337

216	0.602	0.466	0.280
217	0.492	0.397	0.196
218	0.480	0.340	0.163
219	0.506	0.429	0.217
220	0.452	0.898	0.406
221	0.275	0.855	0.235
222	0.539	0.831	0.448
223	0.832	0.718	0.598
224	0.481	0.565	0.272
225	0.316	0.917	0.290
226	0.423	0.907	0.383
227	0.539	0.798	0.430
228	0.235	0.776	0.182
229	0.311	0.691	0.215
230	0.244	0.642	0.156
231	0.479	0.423	0.203
232	0.143	0.817	0.117
233	0.480	0.848	0.408
234	0.365	0.794	0.290
235	0.316	0.931	0.295
236	0.492	0.398	0.196
237	0.410	0.873	0.358
238	0.235	0.728	0.171
239	0.425	0.658	0.280
240	0.244	0.702	0.171
241	0.434	0.646	0.280
mean	0.412	0.745	0.298

Note: te = technical efficiency
ae = allocative efficiency = ce/te
ce = cost efficiency

Results from DEAP Version 2.1

Instruction file = medium.ins
Data file = medium.txt

Cost efficiency DEA

Scale assumption: VRS

EFFICIENCY SUMMARY:

firm	te	ae	ce
1	1.000	0.721	0.721
2	1.000	0.688	0.688
3	1.000	0.757	0.757
4	1.000	0.808	0.808
5	1.000	0.693	0.693
6	1.000	1.000	1.000
7	0.808	0.861	0.696
8	0.933	0.666	0.622
9	1.000	0.654	0.654

10	0.875	0.750	0.657
11	0.708	0.801	0.567
12	0.933	0.828	0.773
13	1.000	0.650	0.650
14	1.000	0.714	0.714
15	0.875	0.623	0.545
16	0.933	0.706	0.659
17	0.830	0.843	0.699
18	0.654	0.894	0.584
19	0.933	0.730	0.681
20	0.700	0.974	0.682
21	0.933	0.620	0.578
22	0.933	0.565	0.527
23	0.950	0.621	0.591
24	0.962	0.690	0.664
25	0.933	0.628	0.586
26	0.933	0.722	0.674
27	0.933	0.621	0.579
28	0.933	0.549	0.512
29	0.933	0.580	0.541
30	0.933	0.606	0.566
31	0.933	0.678	0.633
32	0.933	0.573	0.535
33	0.933	0.678	0.633
34	0.933	0.569	0.531
35	0.933	0.541	0.505
36	1.000	0.791	0.791
37	0.711	0.714	0.508
38	0.781	0.701	0.548
39	0.930	0.863	0.802
40	1.000	0.591	0.591
41	1.000	0.746	0.746
42	1.000	0.661	0.661
43	0.721	0.755	0.544
44	0.791	0.867	0.686
45	1.000	0.766	0.766
46	0.714	0.691	0.493
47	0.933	0.694	0.647
48	1.000	0.552	0.552
49	1.000	0.762	0.762
50	1.000	1.000	1.000
51	0.815	0.754	0.614
52	1.000	0.706	0.706
53	0.952	0.754	0.718
54	0.721	0.928	0.669
55	0.973	0.785	0.764
mean	0.914	0.721	0.656

Note: te = technical efficiency
ae = allocative efficiency = ce/te
ce = cost efficiency

Results from DEAP Version 2.1

```
Instruction file = large.ins
Data file        = large.txt

 Cost efficiency DEA

 Scale assumption: VRS


 EFFICIENCY SUMMARY:

  firm     te     ae     ce
    1  0.960  0.892  0.857
    2  0.960  0.798  0.766
    3  1.000  0.840  0.840
    4  0.895  0.806  0.722
    5  0.923  0.925  0.854
    6  1.000  1.000  1.000
    7  0.578  0.727  0.420
    8  1.000  1.000  1.000
    9  1.000  0.687  0.687
   10  1.000  1.000  1.000
   11  0.997  0.745  0.743
   12  1.000  1.000  1.000
   13  1.000  0.729  0.729
   14  1.000  0.777  0.777
   15  1.000  0.762  0.762
   16  1.000  0.633  0.633
   17  1.000  0.944  0.944
   18  1.000  0.111  0.111
   19  1.000  0.687  0.687

 mean  0.964  0.793  0.765

Note: te = technical efficiency
      ae = allocative efficiency = ce/te
      ce = cost efficiency



{smcl}
{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\tobit-dea.smcl
  log type:  smcl
 opened on:   2 Dec 2011, 17:13:35

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\brod-data.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\tobit-dea.do"

. gen central = 1 if region ==1
(210 missing values generated)

. replace central = 0 if central >=.
(210 real changes made)
```

```
. gen south = 1 if region ==2
(210 missing values generated)

. replace south = 0 if south >=.
(210 real changes made)

. gen family = househn + housewmn

. global EFFECT (central south edulevel farme farmsi mtinf2 gendermf
years cropsv family)

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\brod-data.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\tobit-dea.do"

. gen central = 1 if region ==1
(210 missing values generated)

. replace central = 0 if central >=.
(210 real changes made)

. gen south = 1 if region ==2
(210 missing values generated)

. replace south = 0 if south >=.
(210 real changes made)

. gen family = househn + housewmn

.
. global EFFECT (central south edulevel farme farmsi mtinf2 gendermf
years cropsv family)

. tobit te central south edulevel farme farmsi mtinf2 gendermf years
cropsv family, ll(0)

Tobit estimates                                   Number of obs   =
315
                                                  LR chi2(10)     =
69.44
                                                  Prob > chi2     =
0.0000
Log likelihood =  99.043478                       Pseudo R2       =
-0.5397

{hline 13}{c TT}{hline 64}
          te       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central   -.1140999   .0286853    -3.98   0.000    -.1705461   -
.0576537
       south   -.1408338   .0305599    -4.61   0.000    -.2009687   -
.0806989
    edulevel   -.0035343   .0022051    -1.60   0.110    -
.0078733    .0008048
```

```
       farme   -.0035278   .0013093    -2.69   0.007    -.0061043   -
.0009513
      farmsi    .0065323   .0062519     1.04   0.297    -
.0057701    .0188346
      mtinf2   -.0524818   .0276984    -1.89   0.059     -
.106986    .0020224
    gendermf   -.0106908   .0207836    -0.51   0.607    -
.0515881    .0302065
       years    .0015602   .0012496     1.25   0.213    -
.0008987    .0040191
      cropsv   -.0243465     .02373    -1.03   0.306    -
.0710416    .0223487
      family    -.000573   .0019092    -0.30   0.764    -
.0043299     .003184
       _cons     .531489   .0567352     9.37
0.000      .419847     .643131

         _se    .1766893   .0070395           (Ancillary parameter)

  Obs. summary:        315     uncensored observations


. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .39943175

variable {col 17}dy/dx{col 26}Std. Err.{col 40}z{col 45}P>|z|{col
52}[    95% C.I.   ]{col 75}X

central*  -.1140999      .02869   -3.98   0.000  -.170322 -
.057878   .333333
   south*  -.1408338      .03056   -4.61   0.000   -.20073 -
.080937   .333333
edulevel   -.0035343      .00221   -1.60   0.109  -.007856  .000788
7.12381
   farme   -.0035278      .00131   -2.69   0.007  -.006094 -.000962
16.1571
  farmsi    .0065323      .00625    1.04   0.296  -.005721  .018786
2.0547
  mtinf2*  -.0524818       .0277   -1.89   0.058   -
.10677  .001806   .273016
gendermf*  -.0106908      .02078   -0.51   0.607  -
.051426  .030044   .511111
   years    .0015602      .00125    1.25   0.212  -.000889  .004009
41.6857
  cropsv*  -.0243465      .02373   -1.03   0.305  -
.070856  .022163   .726984
  family    -.000573      .00191   -0.30   0.764  -.004315  .003169
10.2476
{hline 9}{c BT}{hline 68}
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
. tobit ae central south edulevel farme farmsi mtinf2 gendermf years
cropsv family, ll(0)

Tobit estimates                                   Number of obs   =
315
                                                  LR chi2(10)     =
67.47
                                                  Prob > chi2     =
0.0000
Log likelihood =  145.25578                       Pseudo R2       =
-0.3025

{hline 13}{c TT}{hline 64}
          ae       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central    .0900343   .0247712     3.63
0.000     .0412903    .1387783
       south     .091769   .0263899     3.48
0.001     .0398396    .1436984
    edulevel   -.0007866   .0019042    -0.41   0.680    -
.0045336    .0029604
       farme   -.0021773   .0011307    -1.93   0.055    -
.0044022    .0000476
      farmsi   -.0272448   .0053988    -5.05   0.000    -.0378684   -
.0166211
      mtinf2    .0861655   .0239189     3.60
0.000     .0390985    .1332324
    gendermf     .009302   .0179476     0.52   0.605    -
.0260148    .0446188
       years    .0010229   .0010791     0.95   0.344    -
.0011005    .0031463
      cropsv   -.0197161    .020492    -0.96   0.337    -
.0600396    .0206074
      family    .0006402   .0016487     0.39   0.698     -
.002604    .0038845
       _cons    .7019568   .0489936    14.33
0.000     .6055485     .798365

         _se    .1525797   .0060789           (Ancillary parameter)

  Obs. summary:        315     uncensored observations


. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .72894286
{hline 9}{c TT}{hline 68}
variable {col 17}dy/dx{col 26}Std. Err.{col 40}z{col 45}P>|z|{col
52}[    95% C.I.   ]{col 75}X

 central*   .0900343      .02477    3.63
0.000   .041484  .138585   .333333
   south*    .091769      .02639    3.48
0.001   .040046  .143492   .333333
```

```
edulevel   -.0007866       .0019   -0.41   0.680  -.004519  .002946
7.12381
   farme   -.0021773      .00113   -1.93   0.054  -.004393  .000039
16.1571
  farmsi   -.0272448       .0054   -5.05   0.000  -.037826 -.016663
2.0547
  mtinf2*   .0861655      .02392    3.60
0.000   .039285  .133046   .273016
gendermf*    .009302      .01795    0.52   0.604  -
.025875  .044479   .511111
   years    .0010229      .00108    0.95   0.343  -.001092  .003138
41.6857
  cropsv*  -.0197161      .02049   -0.96   0.336   -
.05988  .020447   .726984
  family    .0006402      .00165    0.39   0.698  -.002591  .003872
10.2476
{hline 9}{c BT}{hline 68}
(*) dy/dx is for discrete change of dummy variable from 0 to 1
. tobit ce central south edulevel farme farmsi mtinf2 gendermf years
cropsv family, ll(0)

Tobit estimates                                   Number of obs   =
315
                                                  LR chi2(10)     =
31.31
                                                  Prob > chi2     =
0.0005
Log likelihood =  136.98099                       Pseudo R2       =
-0.1291

{hline 13}{c TT}{hline 64}
          ce       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
{hline 13}{c +}{hline 64}
     central   -.0129745   .0254305    -0.51   0.610    -
.0630159    .0370669
       south    -.049092   .0270924    -1.81   0.071    -
.1024036    .0042196
    edulevel   -.0020566   .0019549    -1.05   0.294    -
.0059033    .0017901
       farme   -.0039153   .0011608    -3.37   0.001    -.0061994   -
.0016311
      farmsi   -.0074973   .0055425    -1.35   0.177    -
.0184037    .0034091
      mtinf2   -.0001245   .0245556    -0.01   0.996    -
.0484443    .0481952
    gendermf   -.0078071   .0184253    -0.42   0.672    -
.0440639    .0284497
       years    .0024542   .0011078     2.22
0.027     .0002743    .0046341
      cropsv   -.0403913   .0210374    -1.92   0.056    -
.0817881    .0010054
      family    -.000312   .0016926    -0.18   0.854    -
.0036427    .0030186
       _cons     .334926   .0502977     6.66
0.000     .2359517    .4339004
```

```
        _se     .156641   .0062407           (Ancillary parameter)

  Obs. summary:        315     uncensored observations
```

```
{smcl}

{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\process3.smcl
  log type:  smcl
 opened on:  12 Feb 2012, 13:42:13

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\process3.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\tobit-process3.do"

. gen gender  = 1 if  gendermale1female2 ==1
(164 missing values generated)

. replace gender = 0 if gender >=.
(164 real changes made)

. gen family =  householdnumber

. gen working =  householdworkingmembersno

. gen edu =  educationallevelyears

. gen farmer = 1 if  occupationfarming1trading2servic == 1
(49 missing values generated)

. replace farmer = 0 if farmer >=.
(49 real changes made)

. gen central = 1 if  regiondeltacentral1deltasouth2de ==1
(179 missing values generated)

. replace central = 0 if central >=.
(179 real changes made)

. gen south = 1 if  regiondeltacentral1deltasouth2de ==2
(182 missing values generated)

. replace south = 0 if south >=.
(182 real changes made)
```

```
. tobit te central south edu farmep farmsi farmer extc training working
credit gender, ll(0)

Tobit estimates                                   Number of obs   =
276
                                                  LR chi2(11)     =
86.09
                                                  Prob > chi2     =
0.0000
Log likelihood =  148.54387                       Pseudo R2       =
-0.4080

          te       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central   -.0924932   .0233286    -3.96   0.000    -.1384261   -
.0465603
       south   -.1149123   .0297365    -3.86   0.000    -.1734623   -
.0563624
         edu    .0005363   .0019138     0.28   0.780    -
.0032319    .0043045
      farmep   -.0005728   .0008286    -0.69   0.490    -
.0022043    .0010587
      farmsi    .0323479   .0053182     6.08
0.000     .0218765    .0428193
      farmer   -.0170378   .0242026    -0.70   0.482    -
.0646915     .030616
        extc   -.0568976   .0276417    -2.06   0.041    -.1113228   -
.0024723
    training    -.029022    .031706    -0.92   0.361    -
.0914496    .0334056
     working    .0007658   .0032293     0.24   0.813    -
.0055925    .0071242
      credit    .0282692   .0204868     1.38   0.169    -
.0120685    .0686069
      gender    .0244246   .0181724     1.34   0.180    -
.0113561    .0602054
       _cons    .5752099   .0373118    15.42
0.000     .5017446    .6486751
         _se    .1412617   .0060125          (Ancillary parameter)


  Obs. summary:        276     uncensored observations

. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .54911957

                 Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

 central*  -.0924932      .02333   -3.96   0.000  -.138216  -
.04677   .351449
   south*  -.1149123      .02974   -3.86   0.000  -.173195  -
.05663   .347826
```

```
     edu    .0005363      .00191    0.28   0.779  -.003215  .004287
6.86522
  farmep   -.0005728      .00083   -0.69   0.489  -.002197  .001051
16.3297
  farmsi    .0323479      .00532    6.08   0.000   .021924  .042771
2.06931
  farmer*  -.0170378       .0242   -0.70   0.481  -
.064474  .030398   .826087
    extc*  -.0568976      .02764   -2.06   0.040  -.111074 -
.002721   .358696
training*   -.029022      .03171   -0.92   0.360  -
.091165  .033121    .09058
 working    .0007658      .00323    0.24   0.813  -.005563  .007095
4.47101
  credit*   .0282692      .02049    1.38   0.168  -
.011884  .068423   .311594
  gender*   .0244246      .01817    1.34   0.179  -
.011193  .060042    .40942

(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
. tobit ae central south edu farmep farmsi farmer extc training
working credit gender, ll(0)
```

```
Tobit estimates                                   Number of obs   =
276
                                                  LR chi2(11)     =
198.74
                                                  Prob > chi2     =
0.0000
Log likelihood =  51.644249                       Pseudo R2       =
2.0821
```

```
          ae       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central   -.0960776   .0331402    -2.90   0.004    -.1613292   -
.0308259
       south   -.1198954   .0422433    -2.84   0.005    -.2030705   -
.0367203
         edu    .0029088   .0027187     1.07   0.286    -
.0024442    .0082619
      farmep    .0012688   .0011771     1.08   0.282    -
.0010488    .0035865
      farmsi    .1098442    .007555    14.54
0.000      .0949687    .1247197
      farmer   -.0218497   .0343818    -0.64   0.526     -
.089546    .0458465
        extc   -.0975642   .0392673    -2.48   0.014    -.1748798   -
.0202485
    training    -.062088    .045041    -1.38   0.169    -
.1507718    .0265957
```

```
     working    .0015974   .0045875     0.35   0.728    -
.0074352      .01063
      credit    .0051429   .0291033     0.18   0.860    -
.0521602     .062446
      gender   -.0078705   .0258155    -0.30   0.761        -
.0587    .0429591
       _cons    .0330198   .0530045     0.62   0.534    -
.0713438    .1373834

         _se    .2006777    .008541           (Ancillary parameter)


  Obs. summary:        276     uncensored observations

. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .17239493


             Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]

 central*  -.0960776      .03314   -2.90   0.004  -.161031 -
.031124   .351449
   south*  -.1198954      .04224   -2.84   0.005  -.202691   -
.0371   .347826
     edu    .0029088      .00272    1.07   0.285   -.00242  .008237
6.86522
  farmep    .0012688      .00118    1.08   0.281  -.001038  .003576
16.3297
  farmsi    .1098442      .00756   14.54   0.000   .095037  .124652
2.06931
  farmer*  -.0218497      .03438   -0.64   0.525  -
.089237  .045537   .826087
    extc*  -.0975642      .03927   -2.48   0.013  -.174527 -
.020602   .358696
training*   -.062088      .04504   -1.38   0.168  -
.150367  .026191    .09058
 working    .0015974      .00459    0.35   0.728  -.007394  .010589
4.47101
  credit*   .0051429       .0291    0.18   0.860  -
.051898  .062184   .311594
  gender*  -.0078705      .02582   -0.30   0.760  -
.058468  .042727    .40942

(*) dy/dx is for discrete change of dummy variable from 0 to 1

. tobit ce central south edu farmep farmsi farmer extc training working
credit gender, ll(0)

Tobit estimates                                   Number of obs   =
276
                                                  LR chi2(11)     =
201.84
                                                  Prob > chi2     =
0.0000
```

```
Log likelihood =  121.31616                      Pseudo R2       =
-4.9473


          ce       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central    -.080709   .0257458    -3.13   0.002    -.1314014   -
.0300165
       south   -.1012437   .0328178    -3.09   0.002    -.1658605   -
.0366269
         edu    .0003603   .0021121     0.17   0.865    -
.0037984    .0045189
      farmep    .0000558   .0009145     0.06   0.951    -
.0017447    .0018564
      farmsi    .0889124   .0058693    15.15
0.000      .077356    .1004688
      farmer   -.0209629   .0267104    -0.78   0.433    -
.0735545    .0316287
        extc   -.0597805   .0305059    -1.96   0.051    -
.1198452    .0002843
    training   -.0458284   .0349913    -1.31   0.191    -
.1147247    .0230679
     working   -.0007222   .0035639    -0.20   0.840    -
.0077394     .006295
      credit    .0138682   .0226097     0.61   0.540    -
.0306493    .0583856
      gender    .0059774   .0200554     0.30   0.766    -
.0335109    .0454657
       _cons    .0339273    .041178     0.82   0.411    -
.0471503     .115005

         _se    .1559079   .0066349           (Ancillary parameter)


  Obs. summary:        276     uncensored observations

. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .11834783

                 Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

 central*   -.080709      .02575   -3.13   0.002   -.13117 -
.030248   .351449
   south*  -.1012437      .03282   -3.09   0.002  -.165565 -
.036922   .347826
     edu    .0003603      .00211    0.17   0.865  -.003779    .0045
6.86522
  farmep    .0000558      .00091    0.06   0.951  -.001736  .001848
16.3297
  farmsi    .0889124      .00587   15.15   0.000   .077409  .100416
2.06931
```

```
  farmer*  -.0209629      .02671   -0.78   0.433  -
.073314  .031389   .826087
    extc*  -.0597805      .03051   -1.96   0.050  -.119571  9.9e-
06   .358696
training*  -.0458284      .03499   -1.31   0.190   -
.11441  .022753    .09058
 working   -.0007222      .00356   -0.20   0.839  -.007707  .006263
4.47101
  credit*   .0138682      .02261    0.61   0.540  -
.030446  .058182   .311594
  gender*   .0059774      .02006    0.30   0.766  -
.033331  .045285    .40942
{hline 9}{c BT}{hline 68}
(*) dy/dx is for discrete change of dummy variable from 0 to 1

.
end of do-file

. edit
- preserve

. exit, clear
```

APPENDIX E: PROCESSING DEA TOBIT REGRESSION RESULTS

```
{smcl}
{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\process3.smcl
  log type:  smcl
 opened on:  12 Feb 2012, 13:42:13

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\process3.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\tobit-process3.do"

. gen gender  = 1 if  gendermale1female2 ==1
(164 missing values generated)

. replace gender = 0 if gender >=.
(164 real changes made)

. gen family =  householdnumber

. gen working =  householdworkingmembersno

. gen edu =  educationallevelyears

. gen farmer = 1 if  occupationfarming1trading2servic == 1
(49 missing values generated)

. replace farmer = 0 if farmer >=.
(49 real changes made)

. gen central = 1 if  regiondeltacentral1deltasouth2de ==1
(179 missing values generated)

. replace central = 0 if central >=.
(179 real changes made)

. gen south = 1 if  regiondeltacentral1deltasouth2de ==2
(182 missing values generated)

. replace south = 0 if south >=.
(182 real changes made)


. tobit te central south edu farmep farmsi farmer extc training working
credit gender, ll(0)


Tobit estimates                                   Number of obs   =
276
                                                  LR chi2(11)     =
86.09
                                                  Prob > chi2     =
0.0000
```

```
Log likelihood =  148.54387                       Pseudo R2       =
-0.4080

          te       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central   -.0924932   .0233286    -3.96   0.000    -.1384261   -
.0465603
       south   -.1149123   .0297365    -3.86   0.000    -.1734623   -
.0563624
         edu    .0005363   .0019138     0.28   0.780    -
.0032319    .0043045
      farmep   -.0005728   .0008286    -0.69   0.490    -
.0022043    .0010587
      farmsi    .0323479   .0053182     6.08
0.000     .0218765    .0428193
      farmer   -.0170378   .0242026    -0.70   0.482    -
.0646915     .030616
        extc   -.0568976   .0276417    -2.06   0.041    -.1113228   -
.0024723
    training    -.029022    .031706    -0.92   0.361    -
.0914496    .0334056
     working    .0007658   .0032293     0.24   0.813    -
.0055925    .0071242
      credit    .0282692   .0204868     1.38   0.169    -
.0120685    .0686069
      gender    .0244246   .0181724     1.34   0.180    -
.0113561    .0602054
       _cons    .5752099   .0373118    15.42
0.000     .5017446    .6486751
         _se    .1412617   .0060125           (Ancillary parameter)


  Obs. summary:        276     uncensored observations


. mfx compute

Marginal effects after tobit

      y  = Fitted values (predict)
         =  .54911957

                 Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

 central*  -.0924932      .02333   -3.96   0.000  -.138216   -
.04677   .351449
   south*  -.1149123      .02974   -3.86   0.000  -.173195   -
.05663   .347826
     edu    .0005363      .00191    0.28   0.779  -.003215   .004287
6.86522
  farmep   -.0005728      .00083   -0.69   0.489  -.002197   .001051
16.3297
  farmsi    .0323479      .00532    6.08   0.000   .021924   .042771
2.06931
```

```
  farmer*  -.0170378       .0242   -0.70   0.481  -
.064474  .030398   .826087
    extc*  -.0568976      .02764   -2.06   0.040  -.111074 -
.002721   .358696
training*   -.029022      .03171   -0.92   0.360  -
.091165  .033121   .09058
 working    .0007658      .00323    0.24   0.813  -.005563  .007095
4.47101
  credit*   .0282692      .02049    1.38   0.168  -
.011884  .068423   .311594
  gender*   .0244246      .01817    1.34   0.179  -
.011193  .060042   .40942

(*) dy/dx is for discrete change of dummy variable from 0 to 1


. tobit ae central south edu farmep farmsi farmer extc training
working credit gender, ll(0)


Tobit estimates                                   Number of obs   =
276
                                                  LR chi2(11)     =
198.74
                                                  Prob > chi2     =
0.0000
Log likelihood =  51.644249                       Pseudo R2       =
2.0821


         ae       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

    central   -.0960776   .0331402    -2.90   0.004    -.1613292   -
.0308259
      south   -.1198954   .0422433    -2.84   0.005    -.2030705   -
.0367203
        edu    .0029088   .0027187     1.07   0.286    -
.0024442    .0082619
     farmep    .0012688   .0011771     1.08   0.282    -
.0010488    .0035865
     farmsi    .1098442    .007555    14.54
0.000     .0949687    .1247197
     farmer   -.0218497   .0343818    -0.64   0.526     -
.089546    .0458465
       extc   -.0975642   .0392673    -2.48   0.014    -.1748798   -
.0202485
   training    -.062088    .045041    -1.38   0.169    -
.1507718    .0265957
    working    .0015974   .0045875     0.35   0.728    -
.0074352      .01063
     credit    .0051429   .0291033     0.18   0.860    -
.0521602     .062446
     gender   -.0078705   .0258155    -0.30   0.761       -
.0587    .0429591
```

```
       _cons    .0330198   .0530045     0.62   0.534    -
.0713438    .1373834

         _se    .2006777    .008541           (Ancillary parameter)


  Obs. summary:        276     uncensored observations




. mfx compute


Marginal effects after tobit
      y  = Fitted values (predict)
         =  .17239493


             Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]

 central*  -.0960776      .03314   -2.90   0.004  -.161031 -
.031124   .351449
   south*  -.1198954      .04224   -2.84   0.005  -.202691   -
.0371   .347826
     edu    .0029088      .00272    1.07   0.285   -.00242  .008237
6.86522
  farmep    .0012688      .00118    1.08   0.281  -.001038  .003576
16.3297
  farmsi    .1098442      .00756   14.54   0.000   .095037  .124652
2.06931
  farmer*  -.0218497      .03438   -0.64   0.525  -
.089237  .045537   .826087
    extc*  -.0975642      .03927   -2.48   0.013  -.174527 -
.020602   .358696
training*   -.062088      .04504   -1.38   0.168  -
.150367  .026191    .09058
 working    .0015974      .00459    0.35   0.728  -.007394  .010589
4.47101
  credit*   .0051429       .0291    0.18   0.860  -
.051898  .062184   .311594
  gender*  -.0078705      .02582   -0.30   0.760  -
.058468  .042727    .40942

(*) dy/dx is for discrete change of dummy variable from 0 to 1



. tobit ce central south edu farmep farmsi farmer extc training
working credit gender, ll(0)


Tobit estimates                                   Number of obs   =
276
```

```
                                                  LR chi2(11)     =
201.84
                                                  Prob > chi2     =
0.0000
Log likelihood =  121.31616                       Pseudo R2       =
-4.9473


          ce       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

     central    -.080709   .0257458    -3.13   0.002    -.1314014   -
.0300165
       south   -.1012437   .0328178    -3.09   0.002    -.1658605   -
.0366269
         edu    .0003603   .0021121     0.17   0.865    -
.0037984    .0045189
      farmep    .0000558   .0009145     0.06   0.951    -
.0017447    .0018564
      farmsi    .0889124   .0058693    15.15
0.000      .077356    .1004688
      farmer   -.0209629   .0267104    -0.78   0.433    -
.0735545    .0316287
        extc   -.0597805   .0305059    -1.96   0.051    -
.1198452    .0002843
    training   -.0458284   .0349913    -1.31   0.191    -
.1147247    .0230679
     working   -.0007222   .0035639    -0.20   0.840    -
.0077394     .006295
      credit    .0138682   .0226097     0.61   0.540    -
.0306493    .0583856
      gender    .0059774   .0200554     0.30   0.766    -
.0335109    .0454657
       _cons    .0339273    .041178     0.82   0.411    -
.0471503     .115005

         _se    .1559079   .0066349           (Ancillary parameter)


  Obs. summary:        276     uncensored observations

. mfx compute

Marginal effects after tobit
      y  = Fitted values (predict)
         =  .11834783

                 Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

 central*   -.080709      .02575   -3.13   0.002   -.13117 -
.030248   .351449
   south*  -.1012437      .03282   -3.09   0.002  -.165565 -
.036922   .347826
     edu    .0003603      .00211    0.17   0.865  -.003779    .0045
6.86522
```

```
  farmep    .0000558      .00091    0.06   0.951  -.001736  .001848
16.3297
  farmsi    .0889124      .00587   15.15   0.000   .077409  .100416
2.06931
  farmer*  -.0209629      .02671   -0.78   0.433  -
.073314  .031389   .826087
    extc*  -.0597805      .03051   -1.96   0.050  -.119571  9.9e-
06   .358696
training*  -.0458284      .03499   -1.31   0.190   -
.11441  .022753   .09058
 working   -.0007222      .00356   -0.20   0.839  -.007707  .006263
4.47101
  credit*   .0138682      .02261    0.61   0.540  -
.030446  .058182   .311594
  gender*   .0059774      .02006    0.30   0.766  -
.033331  .045285    .40942
{hline 9}{c BT}{hline 68}
(*) dy/dx is for discrete change of dummy variable from 0 to 1

.
end of do-file

. edit
- preserve

. exit, clear
```

APPENDIX F

PROCESSING ANOVA TABLES

Gari Quantity

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	1.030 1.343 1.353	1 313 314	1.030 42898133.22	2.401	1.22

Years

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	2.522 1.328 1.353	2 312 314	1.261 42557360.15	2.963	0.53

Group 1 & 2

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	.861	.354	.936	291	.350
Equal Var. Not assumed			.885	199.265	.377

t-Test for Years Groups (Group 2 & 3)

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	6.886	.009	-3.034	184	.003
Equal Var. Not assumed			-2327	.029	

Farming years of experience

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	2.272 1.330 1.353	3 311 314	75731060.98 42774639.77	1.770	.153

Year's level of Education

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	87186210.19 1.344 1.353	3 311 314	29062070.06 43224822.96	.672	.570

t-Test (Group 1 and 2)

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	.305	.581	.544	173	.587
Equal Var. Not assumed			.565	172.910	.573

Group 2 and 3

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	1.958	.168	-1.188	206	.236
Equal Var. Not assumed			-1.181	196.189	.239

Group 3 and 4 t- Test for Independent Sample test

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	3.576	.061	1.027	138	.306
Equal Var. Not assumed			1.487	106.691	.106

Household Size ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	78888493.44 1.345 1.353	2 312 314	39444246.72 43112877.11	.915	.402

t –Test for Group 1 and 2

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	.299	.585	.320 .320	291 241.006	.749 .750

Group 2 and 3 t- Test for Independent Sample test

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	7.444	.007	-1.689 -1.206	167 23.536	.093 .240

Marital Status ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	3.581 1.317 1.353	3 311 414	1.194 42353777.67	2.818	.039

Credit Facility Provision ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups	10288459.61	1	10288459.61	.238	.626
Within Groups	1.352	313	43194305.72		
Total	1.353	314			

Extension Contacts ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups	1.156	1	1.156	2.697	.102
Within Groups	1.341	313	42857895.92		
Total	1.353	314			

Training Provision ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups	15576303.01	1	1557630.01	.361	.549
Within Groups	1.351	313	43177411.65		
Total	1.351	314			

Farm Size ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups	5.761	2	2.881	115.691	.000
Within Groups	7.769	312	24899823.64		
Total	1.353	314			

Enterprise CRT quantity

	Sum of Square	df	Mean Square	F	Sig
Between Groups	3.081	3	1.027	30312	.000
Within Groups	1.037	306	33882904.41		
Total	1.345	309			

Quantity of CRT output to Gari yield relationship

Region	CRT Quantity Group	Mean	Standard Div
Delta Central	1.00	2364.84	1562.96
	2.00	5721.53	3134.87

Region	CRT Quantity Group	Mean	Standard Div
	3.00	8911.53	5688.12
	4.00	23879.14	7124.49
	Total	6167.33	6854.95
Delta South	1.00	2590.20	3298.22
	2.00	4630.34	1652.64
	3.00	9000.00	1412.80
	4.00	0000.00	0000.00
	Total	3360.81	-
Delta North	1.00	4059.73	9952.49
	2.00	5327.73	4343.86
	3.00	5777.23	7188.19
	4.00	6113.43	6259.86
	Total	4661.99	8463.52
Total	1.00	3052.34	6325.66
	2.00	5291.99	3082.81
	3.00	6709.49	6473.72
	4.00	17217.00	11064.45
	Total	4735.34	6597.38

Significant @ .000

Processor ANOVA Table

	Sum of Square	df	Mean Square	F	Sig.
TE					
Between Groups	1.980	11	.180	8.611	.000
Within Groups	5.559	266	.021		
Total	7.538	277			
AE					
Between Groups	11.071	11	1.006	22.684	.000
Within Groups	11.802	266	.044		
Total	22.873	277			
CE					
Between Groups	7.315	11	.665	26.621	.000
Within Groups	6.644	266	.025		
Total	13.959	277			

PROCESSING ANOVA TABLES

Gari Quantity

	Sum of Square	df	Mean Square	F	Sig
Between Groups	1.030	1	1.030	2.401	1.22
Within Groups	1.343	313	42898133.22		
Total	1.353	314			

Years

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	2.522 1.328 1.353	2 312 314	1.261 42557360.15	2.963	0.53

Group 1 & 2

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	.861	.354	.936	291	.350
Equal Var. Not assumed			.885	199.265	.377

t-Test for Years Groups (Group 2 & 3)

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed	6.886	.009	-3.034	184	.003
Equal Var. Not assumed			-2327	.029	

Farming years of experience

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	2.272 1.330 1.353	3 311 314	75731060.98 42774639.77	1.770	.153

Year's level of Education

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	87186210.19 1.344 1.353	3 311 314	29062070.06 43224822.96	.672	.570

t-Test (Group 1 and 2)

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	.305	.581	.544 .565	173 172.910	.587 .573

Group 2 and 3

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	1.958	.168	-1.188 -1.181	206 196.189	.236 .239

Group 3 and 4 t- Test for Independent Sample test

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	3.576	.061	1.027 1.487	138 106.691	.306 .106

Household Size ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	78888493.44 1.345 1.353	2 312 314	39444246.72 43112877.11	.915	.402

t –Test for Group 1 and 2

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	.299	.585	.320 .320	291 241.006	.749 .750

Group 2 and 3 t- Test for Independent Sample test

	Levene's Test for Equality of Variance		t-test for equality of means		
	F	Sig.	t	df	Sig. (2-tailled)
Qty Equal Var assumed Equal Var. Not assumed	7.444	.007	-1.689 -1.206	167 23.536	.093 .240

Marital Status ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	3.581 1.317 1.353	3 311 414	1.194 42353777.67	2.818	.039

Credit Facility Provision ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	10288459.61 1.352 1.353	1 313 314	10288459.61 43194305.72	.238	.626

Extension Contacts ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	1.156 1.341 1.353	1 313 314	1.156 42857895.92	2.697	.102

Training Provision ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	15576303.01 1.351 1.351	1 313 314	1557630.01 43177411.65	.361	.549

Farm Size ANOVA

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	5.761 7.769 1.353	2 312 314	2.881 24899823.64	115.691	.000

Enterprise CRT quantity

	Sum of Square	df	Mean Square	F	Sig
Between Groups Within Groups Total	3.081 1.037 1.345	3 306 309	1.027 33882904.41	30312	.000

Quantity of CRT output to Gari yield relationship

Region	CRT Quantity Group	Mean	Standard Div
Delta Central	1.00	2364.84	1562.96
	2.00	5721.53	3134.87
	3.00	8911.53	5688.12
	4.00	23879.14	7124.49
	Total	6167.33	6854.95
Delta South	1.00	2590.20	3298.22
	2.00	4630.34	1652.64
	3.00	9000.00	1412.80
	4.00	0000.00	0000.00
	Total	3360.81	-

Delta North	1.00	4059.73	9952.49
	2.00	5327.73	4343.86
	3.00	5777.23	7188.19
	4.00	6113.43	6259.86
	Total	4661.99	8463.52
Total	1.00	3052.34	6325.66
	2.00	5291.99	3082.81
	3.00	6709.49	6473.72
	4.00	17217.00	11064.45
	Total	4735.34	6597.38

Significant @ .000

Processor ANOVA Table

	Sum of Square	df	Mean Square	F	Sig.
TE					
Between Groups	1.980	11	.180	8.611	.000
Within Groups	5.559	266	.021		
Total	7.538	277			
AE					
Between Groups	11.071	11	1.006	22.684	.000
Within Groups	11.802	266	.044		
Total	22.873	277			
CE					
Between Groups	7.315	11	.665	26.621	.000
Within Groups	6.644	266	.025		
Total	13.959	277			

APPENDIX G

MARKETING RESULTS

```
{smcl}
{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing.smcl
  log type:  smcl
 opened on:  17 Feb 2012, 18:58:09

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketingF.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing1.do"

. gen central = 1 if region ==1
(66 missing values generated)

. replace central = 0 if central >=.
(66 real changes made)

. gen south = 1 if region ==2
(65 missing values generated)

. replace south = 0 if south >=.
(65 real changes made)

. gen fees = mcof+maf+mscf+mcouncilc

. gen utility = mutilityco+scost+othersmc

. gen loading = mlderst

. gen transport = transpt

. gen rent = mrent+mstoragc

. gen edu1 = edulevel+0.0001

. gen sthgm1 = gmsth+0.0001

. gen rootqty =  crttlpur+0.0001

. gen gariqty =  gartlpur+0.0001

. gen tapioqty =  tapdtlp+0.0001

. gen gmgari1 = gmgari+0.0001

. gen lngarigm = ln(gmgari1)
(1 missing value generated)

. gen lnfees = ln(fees)

. gen lnutility = ln(utility)
```

```
. gen lnloading = ln(loading)

. gen lntransport = ln(transport)

. gen lnrent = ln(rent)

. gen lnage = ln(years)

. gen lnedu = ln(edu1)

. gen lnfamily = ln(familys)

. gen lnmktexp = ln(mrktexp)

. gen lnsthgm = ln(sthgm1)

. gen lngariqty = ln(gariqty)

. gen lnrootqty = ln(rootqty)

. gen lntapioqty = ln(tapioqty)

. gen lntm = ln(tmc)

. gen lngmtapd = ln(gmtapd)
(30 missing values generated)


. drop if gmgari<1
(14 observations deleted)

.
. regress lngarigm lngariqty lnfees lnutility lntransport lnloading
lnedu lnrent central south lnage

      Source         SS       df       MS              Number of obs =
91
                                                     F( 10,    80) =
36.54
       Model   112.479805    10  11.2479805            Prob > F      =
0.0000
    Residual   24.6294358    80  .307867948            R-squared     =
0.8204
                                                     Adj R-squared =
0.7979
       Total   137.109241    90  1.52343601            Root MSE
=  .55486


    lngarigm       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]

   lngariqty    1.228794   .0694422    17.70   0.000       1.0906
1.366988
      lnfees    1.319736   .6536448     2.02   0.047     .0189419
2.620531
```

```
   lnutility   -.5823354   .3559085    -1.64   0.106    -
1.290616     .125945
 lntransport   -.0347835   .3009237    -0.12   0.908    -
.6336407    .5640737
   lnloading   -.1393784   .1265559    -1.10   0.274    -
.3912326    .1124758
       lnedu   -.0096496   .0144969    -0.67   0.508    -
.0384994    .0192002
      lnrent    .3776722   .3050836     1.24   0.219    -
.2294636    .9848079
     central    .2598232   .1725391     1.51   0.136    -
.0835406     .603187
       south    .2698138   .1517153     1.78   0.079    -
.0321094    .5717369
       lnage    -.431478   .1932295    -2.23   0.028    -.8160169    -
.046939
       _cons   -3.012308     4.9878    -0.60   0.548    -12.93835
6.91373

. {smcl}
{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing.smcl
  log type:  smcl
 opened on:  19 Feb 2012, 15:07:39

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketingF.dta", clear

. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing1.do"

. gen central = 1 if region ==1
(66 missing values generated)

. replace central = 0 if central >=.
(66 real changes made)

. gen south = 1 if region ==2
(65 missing values generated)

. replace south = 0 if south >=.
(65 real changes made)

. gen fees = mcof+maf+mscf+mcouncilc

. gen utility = mutilityco+scost+othersmc

. gen loading = mlderst

. gen transport = transpt

. gen rent = mrent+mstoragc

. gen edu1 = edulevel+0.0001

. gen sthgm1 = gmsth+0.0001
```

```
. gen rootqty =  crttlpur+0.0001

. gen gariqty =  gartlpur+0.0001

. gen tapioqty =  tapdtlp+0.0001

. gen gmgari1 = gmgari+0.0001

. gen gmroot = gmcrt+0.0001

. gen lngarigm = ln(gmgari1)
(1 missing value generated)

. gen lnfees = ln(fees)

. gen lnutility = ln(utility)

. gen lnloading = ln(loading)

. gen lntransport = ln(transport)

. gen lnrent = ln(rent)

. gen lnage = ln(years)

. gen lnedu = ln(edu1)

. gen lnfamily = ln(familys)

. gen lnmktexp = ln(mrktexp)

. gen lnsthgm = ln(sthgm1)

. gen lngariqty = ln(gariqty)

. gen lnrootqty = ln(rootqty)

. gen lntapioqty = ln(tapioqty)

. gen lntm = ln(tmc)

. gen lngmtapd = ln(gmtapd)
(30 missing values generated)

. gen lngmroot = ln(gmroot)

 . sum gmgari fees utility loading transport rent years edulevel
familys gender
```

Variable	Obs	Mean	Std. Dev.	Min	Max
gmgari	105	68779.79	72622.85	-7330	287000
fees	105	422.9524	41.48503	320	570
utility	105	519.8095	89.06546	300	780
loading	105	2100	1081.754	1000	5000
transport	105	3445.81	568.498	1000	5000
rent	105	465.8095	101.0025	300	800
years	105	42.12381	12.85174	17	76

```
    edulevel         105     6.12381    4.223777          0          14
     familys         105    5.838095    2.253731          1          13
      gender         105    .3809524      .48795          0           1

.
. drop if gmcrt<1
(16 observations deleted)

. regress lngmroot lnrootqty lnfees lnutility lntransport lnloading
lnedu lnrent central south lnage

      Source        SS       df       MS              Number of obs =
89
          F( 10,    78) =    5.91
       Model 56.0884152    10  5.60884152           Prob > F      =
0.0000
    Residual 73.966755    78  .948291731   R-squared     =  0.4313
Adj R-squared =  0.3584
       Total 130.05517    88  1.47789966           Root MSE
=   .9738

    lngmroot       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
   lnrootqty    .8318862   .2200095     3.78   0.000     .3938809
1.269892
      lnfees   -.0521306    1.12632    -0.05   0.963    -2.294461
2.1902
   lnutility   -.6360933   .6314194    -1.01   0.317    -
1.893153    .6209661
 lntransport   -.6188874   .5292944    -1.17   0.246    -
1.672632    .4348567
   lnloading    .0819003   .2137365     0.38   0.703    -
.3436164    .5074169
       lnedu    .0617899   .0259681     2.38
0.020     .0100913    .1134884
      lnrent   -.1481488   .5459525    -0.27   0.787    -
1.235057     .938759
     central   -.7954748   .3074339    -2.59   0.012    -1.407529   -
.1834209
       south   -.4830888   .2766444    -1.75   0.085    -
1.033845    .0676679
       lnage    .3462572   .3473454     1.00   0.322    -.3452544
1.037769
       _cons    11.98715   8.989296     1.33   0.186    -5.909167
29.88346


{smcl}
{sf}{ul off}{.-}
       log:  d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing.smcl
  log type:  smcl
 opened on:  19 Feb 2012, 15:07:39

. use "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketingF.dta", clear
```

```
. do "d:\Local Data\srahman\SANZID-PLYMOUTH\PROJECT-PhD\BRODRICK
AWERIJE1\marketing1.do"

. gen central = 1 if region ==1
(66 missing values generated)

. replace central = 0 if central >=.
(66 real changes made)

.
. gen south = 1 if region ==2
(65 missing values generated)

. replace south = 0 if south >=.
(65 real changes made)

.
. gen fees = mcof+maf+mscf+mcouncilc

. gen utility = mutilityco+scost+othersmc

. gen loading = mlderst

. gen transport = transpt

. gen rent = mrent+mstoragc

. gen edu1 = edulevel+0.0001

. gen sthgm1 = gmsth+0.0001

. gen rootqty =  crttlpur+0.0001

. gen gariqty =  gartlpur+0.0001

. gen tapioqty =  tapdtlp+0.0001

. gen gmgari1 = gmgari+0.0001

. gen gmroot = gmcrt+0.0001

. gen lngarigm = ln(gmgari1)
(1 missing value generated)

. gen lnfees = ln(fees)

. gen lnutility = ln(utility)

. gen lnloading = ln(loading)

. gen lntransport = ln(transport)

. gen lnrent = ln(rent)

. gen lnage = ln(years)

. gen lnedu = ln(edu1)
```

```
. gen lnfamily = ln(familys)

. gen lnmktexp = ln(mrktexp)

. gen lnsthgm = ln(sthgm1)

. gen lngariqty = ln(gariqty)

. gen lnrootqty = ln(rootqty)

. gen lntapioqty = ln(tapioqty)

. gen lntm = ln(tmc)

. gen lngmtapd = ln(gmtapd)
(30 missing values generated)

. gen lngmroot = ln(gmroot)

. drop if gmtapd<1
(30 observations deleted)

. regress lngmtapd lntapioqty lnfees lnutility lntransport lnloading
lnedu lnrent central south lnage

      Source        SS       df       MS              Number of obs =
75
           F( 10,    64) =   12.58
       Model 36.974401    10   3.6974401           Prob > F      =
0.0000
    Residual 18.8130889    64  .293954514            R-squared     =
0.6628
                             Adj R-squared =  0.6101
       Total 55.7874899    74  .753884999            Root MSE
=  .54218

    lngmtapd       Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
  lntapioqty    .8787672   .0878349    10.00   0.000     .7032969
1.054238
      lnfees     1.04944   .6653602     1.58   0.120    -.2797703
2.378649
   lnutility     .041407   .4165377     0.10   0.921    -
.7907226    .8735367
 lntransport    .0194306   .3310021     0.06   0.953    -
.6418221    .6806832
   lnloading    .3142258   .1405505     2.24
0.029     .0334439    .5950077
       lnedu   -.0110747   .0145597    -0.76   0.450     -
.040161    .0180116
      lnrent    .1356587   .3635038     0.37   0.710    -
.5905237     .861841
     central   -.6213885   .1932261    -3.22   0.002    -1.007402   -
.2353749
       south   -.3844118   .1911036    -2.01   0.048     -.766185   -
.0026385
```

```
       lnage   -.3501614   .2124807    -1.65   0.104     -
.7746404    .0743175
       _cons   -2.525079   5.253664    -0.48   0.632    -13.02048
7.970321
```