FARM-LEVEL ANALYSIS OF OFF-FARM INCOME AND FARM CAPITAL ACCUMULATION AMONG SMALL-SCALE FARMERS IN NORTH-CENTRAL NIGERIA

BY

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Title Page

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BEING THESIS PRESENTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS, FACULTY OF AGRICULTURE UNIVERSITY OF NIGERIA, NSUKKA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY (Ph.D) DEGREE IN AGRICULTURAL ECONOMICS OF THE UNIVERSITY OF NIGERIA, NSUKKA

JANUARY, 2015

Certification

This is to certify that Ogbanje, Elaigwu Christopher, a postgraduate student of the Department of Agricultural Economics, with registration number PG/Ph.D/11/58341 has satisfactorily completed the requirements for course and research work for the degree of Doctor of Philosophy (Ph.D.) in Agricultural Economics. The work embodied in this thesis is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

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Dedication

With a deep sense of gratitude, this work is dedicated to the ó*Agaba'* of the tribe of Judah for his exceeding grace and mercy. Because you, the *Ochinokwu*, lives, I can face tomorrow. I also dedicate the work to the memories of my late parents, and, indeed, Mama Nehi, Ms Janet Agbogo Ojoko.

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May the good Lord abundantly reward you all. Amen

Abstract

The study analysed off-farm income and farm capital accumulation among small-scale farmers at farm level in North Central Nigeria. Multistage sampling technique was used to select 360 respondents, comprising participants and non-participants in off-farm work. The participants were disaggregated into three main typology namely, agricultural wage, non-agricultural wage, and self-employments. Data for the study were obtained from primary source with the aid of standard questionnaire and analysed using descriptive and inferential statistics. Self-employment was the dominant (42.78%) off-farm work. Full-time participants were mainly (38.50%) in non-agricultural wage employment. Participants with off-farm work experience of 14–19 years were mostly (55.20%) in self-employment, while 61.50% of the farmers with off-farm work experience of 26–33 years were in agricultural wage employment. Off-farm income constituted 50.28% of total household income. The strongest and weakest predictors of enterprise diversification were funds for farm investment (0.65) and crop failure (0.36), respectively. The mean entropy of diversification was 0.67. Farm income ($p < 0.01$, $t = –10.237$) and off-farm income ($p < 0.01$, $t = 2.536$) significantly affected market labour supply. Self-employed participants had the highest average off-farm income (₦266,680.78). Farm capital differed significantly ($p < 0.05$) among off-farm work typology. Farm capital was unequally distributed among the respondents ($G = 0.56$). Causality ran from farm capital to off-farm income. Participants had significantly ($p < 0.01$) less total farm liabilities, debt-asset-ratio, and loan for farm production than non-participants. Participants significantly ($p < 0.01$) incurred more yam production costs and total variable costs than non-participants. Participants had significantly ($p < 0.01$) higher average technical efficiency estimates in yam and cowpea enterprises but less average profit efficiency estimates than non-participants. It was concluded that small-scale farmers had average reliance on off-farm income for the purposes of generating funds for farm investment and increasing farm capital. Although, self-employment generated higher off-farm income, farm capital was highest among farmers in agricultural wage employment. Thus, off-farm income was diverted to non-farm enterprises, signaling a gradual drift from core farm production. It was recommended that small-scale farm households should increase off-farm income's share invested in farming so as to raise production level, farm capital and obtain higher returns so that they could take full part in agribusiness; that IFAD and other stakeholders in rural development should encourage farmers in non-agricultural and self-employments to re-invest off-farm income in farming; and the Federal Government and IFAD should train farmers on the management of additional income from off-farm work. These measures would facilitate the development of the agribusiness sector and forestall dual farm structure from adversely affecting food production by small-scale farmers.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In sub-Saharan Africa, agriculture occupied a prominent position in national economies as the sector served as a key driver of growth, employment generation, wealth creation, food production, raw material supply, and poverty reduction (Ekpo & Olaniyi, 1995; Diaz-Bonilla & Gulati, 2003; Lawanson, 2005; Wankoye, 2008). Ajakaiye (1993), National Bureau of Statistics (2007), and Matthew (2008) attested to the potentials and indispensable roles of agriculture in Nigeriaôs economy. The recognition of the role of agriculture in Nigeriaôs economy informed the decisions of the Federal Government and donor and foreign agencies to marshal numerous interventions to the sector (Oyeyinka, Arowolo & Ayinde, 2012).

Some of the interventions, which aimed at mitigating financial constraints faced by farmers, included Family Economic Advancement Programme, Nigerian Agricultural Credit, Rural and Development Bank now called Bank of Agriculture, Agricultural Credit Guarantee Scheme Fund, Community Banks, Microfinance institutions, National Special Programme for Food Security and Fadama Development Programmes (Nweze, 1995; Ogbanje, Okwu & Saror, 2010). These efforts are justifiable given the importance of agriculture to both developed and developing countries of the world. For instance, it has been observed that the rapid growth of the newly industrialised economies of the Asian continent was directly associated with substantial growth of the agricultural sector (Kay, 2001). Wankoye (2008) was of the view that commercial agriculture is the most effective and sustainable catalyst that would lead to sustainable industrialisation. It follows that the need to increase farm income and agricultural productivity among small-scale farmers is *sine qua non*, if the farmers must maintain their national, though inadequately recognised role of feeding the nation.

In Nigeriaôs move towards agricultural renaissance, it is important to note that commercial farms are profitable only if they generate sufficient income (on and off-farm) and accumulate adequate capital for possible re-investment. In this direction, it is imperative for small-scale farmers to embrace farm diversification strategies as measures to curb declining farm and household incomes and to insure against agricultural production and marketing risks (Reardon, 1997; Amit & Livnat, 1988; Kijima, Matsumoto & Yamano, 2006; Matsumoto *et al.*, 2006; Hazell, Syed, Zupi & Miyazako, 2011).

Off-farm income is that portion of household income which is obtained off the farm. It includes non-farm wages and salaries, pensions, trading and interest on income earned by farm families (Matthews, 2004). Off-farm income doubles as risk minimisation and household income stabilisation strategies. In the United States, for instance, off-farm income accounted for over 90 percent of farm operatorsô household income (Sommer *et* al., 1997; Babcock, Hart, Adams & Westhoff, 2000; Briggeman, 2011). Ahearn and Lee (1991), Perry and Hoppe (1993), Blank, Erickson, Nehring & Hallahan (2009) and Briggeman (2011) asserted that several farms in the United States of America could not boast of favourable leverage ratio without off-farm income. In a developing country like Nigeria where agriculture has been relegated, and further worsened by flagrant diversion of agricultural intervention funds to unintended beneficiaries (Idachaba, 1993), off-farm activities deserve no less attention. Besides, Babatunde (2008) has shown that off-farm income supplements and boosts farm and total household incomes.

Off-farm work refers to activities from which farmers earn income apart from their own farm. In Mexico, De Janvry and Sadoulet (2001) clearly separated farmers into those who participated in off-farm work and those who did not. According to Babatunde, Olagunju, Fakayode and Adejobi (2010), the scenario, however, is different in rural Nigeria, where farmers engaged in several activities at the same time in a way that decisions to participate

are not mutually exclusive. Off-farm engagement is generally disaggregated into three components. These are agricultural wage employment (AWE) involving labour supply to other farms, non-agricultural wage employment (NAWE) including both formal and informal non-farm activities, and self-employment (SE) such as own businesses. This typology has been used by Babatunde *et al.* (2010) and Ibekwe *et al.* (2010).

Myyra, Pietola and Heikkila (2011) affirmed that besides generating annual income, a farm family might have a goal to accumulate wealth through capital gains from off-farm activities. This is especially relevant for the about 900 million extremely poor people who lived in rural areas of developing countries. But, with little income or collateral, poor farmers were hardly able to obtain loans from banks and other formal financial institutions (Ochi & Nnanna, 2007; Asogwa, Umeh & Ater, 2007). Access to rural financial services is worse among women (Audu, Otitolaiye & Edoka, 2009) even though, women often had the best credit ratings and were more actively involved in agricultural production (International Fund for Agricultural Development (IFAD), 2000, 2003, 2004; Adepoju, Umar & Agun, 2006; Audu *et al.*, 2009). The most effective way out of this contraption, according to IFAD (2004), is that the small-scale farmers need to be able to borrow, invest and save, and to protect their families against risk. According to Mellor (1962), Kibara (2007) and Petrick and Kloss (2012, rural financial capital improved agricultural productivity, food security and poverty profile. Osaka (2006) and Ogbanje (2010) noted that capital, including cash and other man-made farm assets that are required to carry out production, is usually accumulated through savings and investment.

Since formal credit facilities were unreliable, farmers have resorted to alternative measures to raise capital for farm investment. The two major alternative sources of farm capital for small-scale farmers were the numerous local savingsô schemes and involvement in off-farm activities (Adam & Agba, 2006; Alade, 2006; Ibekwe *et al.*, 2010). In some contexts, rural

off-farm activities are important sources of local economic growth (e.g. tourism, mining, and timber processing). Off-farm sector is of importance to the rural economy because of its production linkages and employment effects, while the income it provided to rural households could represent a substantial and sometimes growing share of farm capital (Alimba, 1995; Okorji, 1995; Okoye, 1995; Davis, 2003; Zeller, Schrieder, von Braun & Heidhues, 1997).

It has become widely accepted in academic and policy research that rural off-farm activities make up a significant component of rural livelihoods in developing countries (Chikwama, 2004; Bezabih, Gebreegziagher, GebreMedhin & Köhlin, 2010). Coupled with the increasing share of off-farm incomes, off-farm activities could no longer be considered as marginal. Relatedly, agricultural economies in transition are now gradually shifting toward a market economy and these shifts have been driven, in part, by push and pull factors (Vera-Toscano, Phimister. & Weersink, 2004). Reardon (1997) observed that households were pulled into off-farm activities when returns to off-farm employment were higher and less risky than in agriculture. Also, when farming became less profitable and more risky due to population growth and market failures, many households were pushed into non-farm activities. Nevertheless, many farm households in developing economies are yet to adopt market-oriented agricultural practices and, hence, are unable to enjoy the benefits of the market economy. As a supplementary measure, activities in the off-farm sector have witnessed a boom in the manufacturing, agro-based and service sectors (De Janvry, Fafchamps & Sadoulet, 1991; Ibekwe *et al.*, 2010).

In addition to providing the much needed investment capital for the farm, off-farm occupation has been seen by some researchers as a risk minimising strategy which is important, especially, to the small-scale farmers. This is, indeed, a sound safeguard against crop failure and market failure (Ellis & Freeman, 2004; Babatunde *et al.*, 2010). De Janvry

and Sadoulet (2001) and Ruben and Van den Berg (2001) have shown that farmers resorted to these sources to boost farm capital and investment.

McNamara and Weiss (2005) maintained that farmers faced a number of uncertain factors such as weather and market conditions that affected their household income. Since small-scale farmers are risk-averse, farm diversification is an efficient risk management mechanism which stabilises expected returns in an uncertain environment or enterprise such as agricultural production. For a developing country such as Nigeria, agricultural production enterprises of interest would be those that focus on the production of staple food crops which most households rely on. Kolawole (2006) and NFRA (2008) showed that common staples in Nigeria, and the North Central region in particular, included yam, cassava, rice, maize, sorghum, cowpea, soyabean, bambara nut, and sesame.

In recognition of the crucial roles of rural finance, the Federal Government of Nigeria in 2009, entered into partnership with the International Fund for Agricultural Development (IFAD) to build capacity for rural finance. The strategy includes efforts to strengthen access to credit and land; participation in decision-making; access to agricultural extension services; access to improved seeds and planting materials, farm inputs and tools; and encouragement of traditional thrift, savings and insurance schemes (World Bank, 2008). This partnership, as well as its strategies further attests to the indispensability of capital accumulation to farm firm growth.

Studies have reported the inadequacy of farm income and high prevalence of poverty among small-scale farmers resulting in their inability to meaningfully invest in farm business (Lambert & Bayda, 2005; Kwon, Orazem & Otto, 2006). Another group of literature has shown that farmersô resort to sourcing credit from financial intermediaries has not brought the much anticipated farm capital relief (Musser, White & McKissick, 1977; Bagachawa, 2000; Obike, Ukoha & Nwajiuba, 2007; Bage, 2011). Consequently, current research in

agricultural finance has beamed its searchlight on off-farm activities embarked upon by farmers as an alternative and sustainable source of farm capital. It is, thus, expedient to provide empirical content on the role of off-farm employment in farm capital accumulation.

1.2 Problem Statement

The move towards commercial agriculture in Nigeria has been consistently frustrated largely by limited capital and financial constraints (Awoyemi, 2005; Abiodun, 2011). A number of factors accounted for the capital constraints faced by small-scale farmers. The major factor was their ineligibility for formal credit which arose from the small-scale nature of their farm firms, the biological nature of the enterprise, vulnerability to shocks, indisposition to insurance policies, and restricted liquidity (IFPRI, 2007; Kimura & Thi, 2011).

Small-scale farmers belonged to the poorest segment of Nigeriaôs population and therefore could not make meaningful investment in farming (Asogwa, Umeh & Ater, 2007; Omonona, 2009; Rural Poverty Portal, 2012). In furtherance to this position, Onuk, Ibrahim, Bello and Patrick (2009) maintained that incidences of poverty and poor agricultural production were closely interwoven. Lack of income and poverty among small-scale farmers were consequences of lack of adequate finance. According to Oyeyinka *et al.* (2012), lack of capital inhibited the purchase of improved seeds and agrochemicals as well as constrained the acquisition of appropriate production technologies for enhanced productivity.

Poor access to formal financial services is due to inherent difficulties associated with such characteristics as low population density in rural areas where farmers reside, isolated markets, seasonality of products, and highly covariant risks such as widespread crop failures, commodity price fluctuations, and high post harvest losses (Yaron, 2004). Similarly, inadequate infrastructure in rural areas often dissuades profit-oriented formal financial institutions from entering this market, thereby affecting the profitability of agricultural

production (IFAD, 2004). Coupled with inadequate policies to attract formal financial intermediaries, small-scale farmers have become vulnerable to money lenders known for cut-throat loan terms.

Following the inefficiency and unreliability of formal financial intermediaries (Ajayi & Ojo, 1986; Folawewo & Osinubi, 2006; IFPRI, 2007; Ogunmuyiwa & Ekone, 2010), some farmers have resorted to farm diversification by sourcing for finance from off-farm enterprises (Adams, 2001; Reardon, Berdegue & Escobar, 2001; Jhingan, 2003). Participation in off-farm income generating activities, however, leads to tradeoff in time and labour utilisation. Tavernier, Temel and Li (1997), Mishra and Holthausen (2002) and Loening, Rijkers and Soderbom (2008) observed that off-farm activities constituted diversion of critical productive resources from the farm, thereby leading to reduction in specialisation and efficiency in farm production (Bojnec & Ferto, 2011) and, invariably, dual farm structure (Spitze & Mahoney, 1991; Phimister & Roberts, 2002).

In addition to these problems, there is dearth of literature on the effects, opportunities and constraints inherent in the off-farm sector of the rural economy in relation to farm firm capital accumulation in Africa and Nigeria. Loening, Rijkers and Soderbom (2008) affirmed that available evidence on off-farm enterprises in sub-Saharan Africa was fragmented and sparse. Ibekwe *et al.* (2010) admitted that very little was known about the role off-farm activities played in the income generation strategies of farm households in Nigeria as well as their contribution to farm capital. Similarly, farmers were faced with the dual problems of investment decision and level of investment (Kalachi, 1971; Harris, Blank, Erickson & Hallahan, 2010).

Information asymmetry with respect to off-farm income is prevalent in rural areas. This is a pointer to the relevance of human capital as critical determinants of the successful combination of farm with off-farm income enterprises (Kurosaki, 2001) especially with

respect to the management of tradeoff in market labour supply (Newman & Gertler, 1994; Hitt, Ireland & Hoskisson, 2001; Sonoda, 2006). According to Harris *et al.* (2010), human capital is implicated in off-farm income and investment in farm assets, thereby necessitating in-depth investigation.

Since farm and off-farm works compete for critical productive resources, off-farm work could affect farm efficiency. The effect could be more adverse among small-scale farmers who are resource-constrained. In economies where off-farm work is a major determinant of the well-being of farm households, there could be increased investment in non-farm assets (Reardon, Crawford, Kelly, 1994; Andersson *et al.,* 2005). Kurosaki (2001) observed that households were bound to respond to the new economic opportunities offered by off-farm work by adjusting labour allocation. In doing this, farm households would be left with little or no time to acquire and optimally utilise technologies that could improve efficiency of their enterprises. The impact of off-farm income on farm performance was investigated in Slovenia (Bojnec & Ferto, 2011) and among Norwegian farm households (Bjornsen & Mishra, 2012). In these studies, cost and profit efficiencies were excluded. Besides, there was no control group. Nehring and Fernandez-Cornejo (2005) have observed that the role of off-farm income has been largely neglected in empirical analyses of farm structure and economic performance. In addition, Smith (2002) has argued that increased reliance on off-farm employment could reduce on-farm efficiency.

Some studies focused on off-farm activities, income and wage variability. Examples include those of Ahituv and Kimhi (2002) that examined the role of heterogeneity and state dependence of off-farm work and capital accumulation decisions of farmers over the life-cycle; Briggeman (2011) assessed the importance of off-farm income in servicing farm debt in Kansas City; Davis (2003) analysed rural non-farm economy, livelihoods and their diversification; Ji, Zhong and Yu (2011) evaluated machinery investment decision and off-

farm employment in rural China; and Mishra and Holthausen (2002) determined the effect of farm income and off-farm wage variability on off-farm labour supply in India. Others were Harris *et al.* (2010) which examined the double-hurdle approach to off-farm income and investment in farm assets; Bojnec and Ferto (2011) which determined the impact of off-farm income on farm efficiency; and Kwon *et al.* (2006) which examined off-farm labour supply responses to permanent and transitory farm income. These studies did not segregate off-farm work into three typology, neither did they measure and decompose farm capital between participants and non-participants. Furthermore, the studies did not evaluate farm efficiency in relation to off-farm work.

In Nigeria, Babatunde *et al.* (2010) analysed the determinants of participation in off-farm employment among small-holder farming households in Kwara State. Ibekwe *et al.* (2010) evaluated the determinants of non-farm income among farm households in southeast Nigeria. None of these studies effectively represented North Central Nigeria. Furthermore, the effect of the tradeoff on farm efficiency (technical efficiency, profit efficiency, and cost efficiency) and farm financial management has not been determined. These constituted the research gaps, among others, that this study was designed to fill, so as to provide empirical information that would facilitate the formulation of relevant policies that would forestall the emerging dual farm structure from adversely affecting food crop production. Hence, the study addressed the following research questions:

i. what were the characteristics of off-farm work in relation to off-farm work typology?;
ii. what was the off-farm incomeôs share of household income that was invested in farming by respondents who participated in off-farm work?;
iii. what were the factors that influenced enterprise diversification among small-scale farmers?;
iv. what was the degree of off-farm diversification among the respondents?;

v. how did farm and off-farm income jointly affect market labour supply?;

vi. was there any difference in off-farm income among off-farm work typology?;

vii. what was the level of farm capital accumulation among off-farm work typology?;

viii. what was the level of concentration of farm capital among small-scale farmers?;

ix. what was the direction of causality between off-farm income and farm capital?;

x. was there any difference in farm capital between participants and non-participants in off-farm work?;

xi. what were the farm financial characteristics of the respondents?; and

xii. what was the level of farm efficiency (technical, cost and profit) in common staple food crops in North Central Nigeria?

1.3 Objectives of the Study

The broad objective of this study was to conduct farm-level analysis of off-farm income and farm capital accumulation among small-scale farmers in North Central Nigeria. The specific objectives were to:

i. examine the characteristics of off-farm work in relation to off-farm work typology;

ii. evaluate off-farm incomeôs share of household income;

iii. identify the factors that influenced enterprise diversification among small-scale farmers;

iv. ascertain the degree of off-farm diversification among the respondents;

v. determine the joint effect of farm and off-farm income on market labour supply;

vi. evaluate the difference in off-farm income among the main typology;

vii. analyse the level of farm capital among off-farm work typology;

viii. assess the concentration of farm capital among small-scale farmers;

ix. determine the direction of causality between off-farm income and farm capital;

x. determine the difference in farm capital between participants and non-participants in off-farm work;

xi. describe the farm financial characteristics of the respondents; and

xii. determine the level of farm efficiency (technical, cost and profit) in common staple food crops in North Central Nigeria.

1.4 Hypotheses for the Study

The following null hypotheses were formulated to guide the study:

i. socioeconomic and farm financial characteristics of farmers have no significant effect on the probability of investment and amount of off-farm incomeôs share of household income invested in farming;

ii. socioeconomic characteristics of farmers have no significant effect on off-farm diversification;

iii. there is no significant difference in farm capital among off-farm work categories;

iv. there is no significant relationship between off-farm incomeôs share and farm capital;

v. there is no significant difference between farm capital quartile and the decision to participate in off-farm employment;

vi. there is no significant difference in farm capital between male and female-headed households; and

vii. there is no significant difference in farm efficiency estimates in staple crops between farmers who engaged in off-farm enterprises and those who did not.

1.5 Justification of the Study

The results of this study would be of great relevance to stakeholders in rural economy. This is because the results would facilitate an in-depth comprehension of structural change imminent in the agricultural sector as the sector reacts to persistent farm investment capital constraint. As noted by Lambert and Bayda (2005), reliance on external funds could affect farm production decisions. In particular, off-farm diversification and debt financing influence factor usage, farm cost, and farm efficiency. Thus, the extent to which the emerging dual farm structure affected farm firm was demonstrated and could be important for policy formulation on sustainable farm production.

Andreu, Featherstone, Langemeier and Grunewald (2006) and Chen, Huffman and Rozelle (2009) noted that, in spite of recent advances in technology such as improved and high performance seeds, farm businesses faced an increasingly competitive market from global demand for food. Therefore, the findings of this study would guide farm operators on the need to make appropriate financial decisions in order to be economically successful and provide sufficient food for the teeming Nigeria population. This is because financial variables, especially debt incurred to purchase inputs, and the availability of capital deeply affect the structure and organisation of farm production (Lagerkvist, Larsen & Olson, 2006). Also, recognising the endogeneity of capital stock in the analysis of off-farm income is particularly important in a period of structural change in the agricultural sector. Similarly, the findings of this study would guide stakeholders in rural and agricultural finance in the formulation of policies that would reduce rigidity in off-farm work adjustments.

Ji *et al.* (2011) have noted that capital markets were less competitive in developing economies, hence off-farm income could facilitate capital accumulation, especially where agricultural households were subjected to borrowing constraints, as is the case among small-scale farmers in Nigeria. Current literature has pointed out that the linkages between off-farm

labour market and farmsô capital investment has important policy implications. Zeller (2000) noted that over the last 30 years, microfinance has had an enormous impact on rural development. Groundbreaking institutions and models have emerged that are expanding financial services in new directions, using technology and innovations to serve more clients in increasingly remote communities, and offering them an ever-wider range of products. In a changing global economy and in the context of financial crises, volatile food and agricultural commodity prices, and the perils of climate change, rural finance studies have become more imperative than ever before. A pointer to this fact is the commitment of approximately $800 million worth of investments in rural finance by IFAD (Wenner, 2002; IFAD, 2004). As such, the findings of this study would complement the ongoing rural finance building capacity programme of the IFAD/FGN collaboration by providing more empirical basis for effective financial intervention.

Understanding the opportunities and constraints in rural off-farm enterprise sector is of crucial importance since, according to Amao (2008), the economy remains highly dependent on the performance of the agricultural sector, while ongoing population growth increases the need for income diversification strategies. Promotion of off-farm enterprise activity is considered to be a promising catalyst for the development of agriculture (Loening, Rijkers & Soderbom, 2008). In this direction, the findings of this study would draw the attention of relevant stakeholders to off-farm sector with the view to making appropriate policies that would mitigate financial constraints and improve capital accumulation among farmers and consequently enhance farm-firm growth.

The farmerôs endowment of time is fixed. This is the time he allocates to farm work, off-farm work, and leisure. In this time constraint scenario, empirical evidence from this study would guide farmers on optimal time (invariably labour) allocation among competing enterprises. This is further underscored by the position of researchers that labour is a critical productive

input, especially in small-scale farming (Akinpelu & Ogbonna, 2005; Ezedinma, Okarter, Asumugha & Nweke, 2006; Shehu, Tashikalma & Gabdo, 2007; Okoye, Onyeaweaku, Ukoha & Asumugha, 2008; Iheke, 2009).

The measurement of efficiency remains an important area of research in both developing and developed countries. An understanding of the relationship in efficiency measurement would provide policy makers with information to design programmes that would make food production effectively resistant to the adverse impact of dual farm structure (Nganga, Kungu, de Ridder & Herrero, 2010).

1.6 Limitations of the Study

The major constraint encountered in the course of this study was the basis for separating farmers into participants and non-participants as well as off-farm work typology. After extensive literature review, the researcher settled down for 75% labour allocation as the basis for the demarcation. Another limitation was the large capital outlay required for the field work. The mitigation measure adopted here was confinement of the study to three states and three dominant staple food crops in the region. Furthermore, there was language barrier, which was resolved by using village extension agents who were resident in the selected or nearby communities as enumerators. The problem of apprehension from farmers was resolved through moral suasion and guarantee of anonymity. Finally, the study had to contend with time and financial requirement, especially, for the large-scale data analysis. This made the researcher to acquire relevant analytical software, underwent tutorial, and sought for the cooperation of colleagues who were well versed in some analytical methods which the researcher was not earlier familiar with. In the end, the limitations did not adversely affect the outcome of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Characteristics of Off-farm Work

According to Babatunde *et al.* (2010), off-farm income has become an important component of livelihood strategies among rural households in most developing countries. Reardon (1997) and Ellis and Freeman (2004) advanced declining farm income and the desire to insure against agricultural production and market risk as reasons for participating in off-farm employment. For instance, when farming becomes less profitable and more risky due to population pressure as well as crop and market failures, farm households would be pushed into off-farm activities (a case of distress-push diversification). On the other hand, when returns to off-farm employment become higher and less risky than on-farm employment, farm households would be pulled into off-farm work (a case of demand-pull diversification).

Both scenarios of distress-push and demand-pull diversification have been recognised by researchers. However, some studies have assumed that distress-push effects were dominant, citing shrinking per capita land availability as the major reason for increasing off-farm activities (Reardon, Berdegue & Escobar, 2001; van den Berg & Kumbi, 2006). Babatunde *et al.* (2010), in contrast, held that land was not the most limiting factor. Off-farm income had been found to contribute significantly to total household income (Shorrocks, 1983; Bjornsen & Mishra, 2012). These findings indicated that complementary relationship existed between farm income and off-farm income.

According to Reardon (1997) and Winters *et al.* (2009), the traditional image of farm households in developing countries has been that they focused almost exclusively on farming and undertook little rural non-farm (RNF) activity. This image persisted and was widespread. Policy debate still tended to equate farm income with rural incomes, and rural-urban relations with farm-non-farm relations. There has been a tendency even among agriculturists and those

interested in rural development to neglect the RNF sector. Nevertheless, there is a mounting evidence that RNF income is an important resource for farm and other rural households, including the landless poor as well as rural and urban residents.

There are four basic reasons why the promotion of RNF activity could be of great interest to developing country policy-makers. First, available evidence showed that RNF income is an important factor in household economies and, therefore, in food security, since it allowed greater access to food. This source of income might also prevent rapid or excessive urbanisation as well as natural resource degradation through over-exploitation. Second, in the face of credit constraints, RNF activity affects the performance of agriculture by providing farmers with cash to invest in productivity-enhancing inputs. Third, the development of RNF activity in the food system (including agro-processing, distribution and the provision of farm inputs) might increase the profitability of farming by increasing the availability of inputs and improving access to market outlets. In turn, better performance of the food system would increase rural incomes and lower urban food prices. Fourth, the nature and performance of agriculture, affected by agricultural policies, could have important effects on the dynamism of the RNF sector to the extent that the latter is linked to agriculture. The RNF sector grows fastest and most equitably where agriculture is dynamic ï where farm output is available for processing and distribution, where there are inputs to be sold and equipment repaired and where farm cash incomes were spent on local goods and services (Reardon, 1997).

Lagerkvist *et al.* (2006) noted that analyses of off-farm labour supply included proxies for personal and household characteristics to estimate structural farm household models in a reduced methodology. Ahituv and Kimhi (2002), McNamara and Weiss (2005) and Benjamin and Kimhi (2006) have reported that younger farmers were more likely to work off-farm. Mishra and Goodwin (1997) and Mishra and Holthausen (2002) also reported that farming experience was negatively related to off-farm work, and that farm households with younger

children were more inclined to seeking off-farm work. Lagerkvist *et al.* (2006) opined that a larger farm household might be more likely to rely on off-farm income because the family could operate the farm as well as have one or more family members left to work off-farm. This could be induced by higher living expenses associated with large household size.

Ahituv and Kimhi (2002) and Benjamin and Kimhi (2006) found negative relationship between farm size and off-farm labour decisions. Goodwin and Bruer (2003) explained that farm households operating larger farms might be less likely to seek off-farm income as the time required to operate large farms could be enormous. Mishra and Holthausen (2002) found that off-farm work participation was negatively related to the degree of farm ownership. Furthermore, Ahearn, El-Osta and Dwebre (2006) found negative relationship between government payments and off-farm employment. Lagerkvist *et al.* (2006) conclusively remarked that many part-time farm households operating smaller farm units, to a large extent, relied on off-farm income compared to full-time operators or larger farm units.

In a study of off-farm employment in Austria, Weiss (1997) estimated that on more than 50% of farms, the husband and wife worked less than 50% of their working time on the farm. These findings might seem surprising since it was generally presumed that full-time farm operations were more efficient than part-time farms. Full-time operations had the advantage of scale efficient technology and lower costs of credit.

2.2 Off-farm and Household Incomes

According to Kwon *et al.* (2006), farm households faced large fluctuations in farm income due to weather and price shocks. In order to mitigate the effects of these fluctuations, or lessen exposure to such risks, farm households often adopted such principles as futures market, forward contracts, or insurance market. Unfortunately, these approaches were not within the reach of small-scale farmers in rural areas of developing countries. Kwon *et al.*

(2006) were also of the view that government intervention in farm gate prices through price supports or loan deficiency payments could moderate the magnitude of the fluctuations. Efficient farm credit administration has also been suggested as a measure to minimise risks associated with farm production. However, the efficiency of government interventions, supports and credit supplies in Nigeria leaves so much to be desired. Hence, variability in farm-level net income and capital has persisted with attendant consequences.

These scenarios have given rise to, sustained or even increased the tempo of farm household diversification into off-farm income activities in order to raise farm capital and stabilise farm income (De Janvry & Sadoulet, 2001; Ruben & van den Berg, 2001). Mishra and Sandretto (2001) found that off-farm income lowered total variability in household income. In addition, the marginal propensity to consume out of non-farm income is larger than the propensity to consume out of farm income (Carriker, Langemeier, Schroeder & Featherstome, 1993). This is consistent with the potential role of off-farm income as a short-term supplement to farm income, thereby allowing for re-investment or expansion of farm capital base.

Ahituv and Kimhi (2002) reported that off-farm income constituted between 20 percent and 70 percent of total household income, emphasising the role of capital investments in the development process and in the transition from rural to industrial society. According to the Department of Agriculture and Rural Development (DARD) (2012), farm diversification afforded households the following range of benefits: increased revenue, adaptability, food and income security, sustenance in valued farming tradition, and development of new skills that would facilitate the expansion of business networks. Finally, diversification offered considerable scope for improving the economic viability of many farm businesses and, in turn, reducing their dependence on the production of primary agricultural commodities (Department for Environment, Food and Rural Affairs, 2012).

Technological change has been acknowledged as a critical component of productivity and economic growth (Griliches, 1970). The rapid adoption and diffusion of new technologies in U.S. agriculture has sustained growth in agricultural productivity and ensured abundance of food and fiber (Huffman & Lange, 1989). Technological innovations and their adoption have also changed the way farm households regarded employment choices. Labour-saving technologies, in particular, have allowed farm household members to increase income by seeking off-farm employment (Mishra & Holthausen, 2002). While profitability (i.e. the extent of yield increases and or reduction in input costs from an innovation relative to the costs of adoption and current management practices played a key role in technology adoption. Most studies acknowledged that heterogeneity among farms and farm operators often explained why not all farmers adopted an innovation in the short or long run (Feder, 1985; Feder & Feeny, 1991).

The effect of non-farm employment on overall income inequality could be analysed through the relationship between non-farm income, on the one hand, and farm income and or landholdings, on the other. The implicit view was often that the two moved in opposite directions, so that non-farm and farm incomes essentially offset each other. In other words, smaller farms have higher non-farm incomes than large farms, or at least the share of non-farm income in total income declined as total household income increased. Rural Non-farm activities did not necessarily improve rural income distribution. In reality, however, evidence regarding the relationship between the share of non-farm income in total household income and the level of total income and or the size of landholdings was very mixed. In the selection of different patterns of relationships between non-farm income shares and levels and total household income or landholdings, the selection tended to be representative of the spectrum of patterns found in the different regions. At one extreme, there was evidence of a strong negative and linear relationship between the non-farm share in income and total household

income or landholding. At the other extreme, however, there were cases of a strong positive and linear relationship. Reardon (1997) also found that on average, the share of non-farm income in total income was twice as much in upper-income tercile households as in those of lower terciles. Other cases fell between these two extremes.

These results focused on the share of non-farm income among income and landholding classes. Evidence showed that, in many cases, the ratio of the absolute levels of non-farm earnings between the highest and lowest income strata was much higher (i.e. more skewed) than the ratio of shares. Not only that, there were even cases where declining shares of non-farm income for higher-income levels were nevertheless still associated with increasing absolute levels of non-farm incomes. Lagerkvist *et al.* (2006) found that farm size and farm capital had negative impact on the off-farm incomeôs share and that the impact of farm capital was stronger than that of farm size. They also found negative relationship between farming experience and off-farm incomeôs share. Finally, these researchers found that positive and significant relationship existed between off-farm incomeôs share and farm tenure security.

A key factor behind the above findings was likely to be the existence of substantial entry barriers (e.g. licence fees, equipment purchase or rental, skills acquisition) to activities with high returns to labour. Hence, low-asset households could spend a large share of their time in non-farm employment, but the wage (hence, the level of off-farm income) they could receive was low.

Conversely, higher-income households might spend the same or a lower share of their resources in non-farm activities but earn much higher returns per unit of resources invested. It was, indeed, common in situations with this type of pattern to find large differences in the nature and labour returns of the typical set of non-farm activities undertaken by the poor and rich, or by small- and large-scale farmers. Activities that were intensive in skilled labour and

or physical capital (e.g. cottage manufacturing, transport requiring the use of a vehicle, shop commerce and salaried jobs) had the highest labour returns, as expected, and were undertaken by the wealthiest household strata. The poor (i.e. those with limited assets and/or skills) tended to undertake activities that were intensive in unskilled labour (such as farm wage labour, market porter jobs, wood gathering and unskilled factory jobs). Between 2002 and 2006, the share of off-farm income rose from 55% to 61.8% in Canada (Nantel, Freshwater, Beaulieu & Katchova, 2010).

2.3 Enterprise Diversification

Babatunde *et al.* (2010) defined off-farm employment as activities other than own farm work from which the farmer earned income. The activities could be agricultural wage jobs on other peoplesô farms, non-agricultural wage employment, or self employment in commerce, mining, manufacturing, construction/building, transport and services. The involvement of farm households in activities other than those of own farm activities led to the concept of farm diversification. Conceptualising farm as a business unit, the Department of Agriculture and Rural Development (2012) viewed diversification as a process involving the broadening of the activities of a business into other new potential income earning ventures. By taking on new activities, a firm could supplement what it had traditionally done and increased the likelihood of a successful future. Thus, farm diversification is when a farm branches out from traditional farming by adding new set of activities aimed at earning additional income.

Farm diversification is broadly seen as the entrepreneurial use of farm resources for non-agricultural purposes aimed at commercial gain (Department for Environment, Food and Rural Affairs, 2012). Farm resources include land, capital and labour. This definition implied that diversification reflects reduced dependence of farmers on agriculture as the major source of income. This definition highlighted the concept of tradeoffs in labour supply to farm and

off-farm activities by the same household. It also led to the substitution effects, involving capital and labour.

Farm diversification could be on-farm and off-farm. On-farm diversification focuses on multiple crop farming as a measure against crop failure, multiple farming systems, raising more types of farm animals. Off-farm diversification involved delving into economic activities outside traditional farm occupation in order to raise income to supplement farm capital, and to minimise fluctuations in farm income arising from natural factors that are beyond the control of farm households.

Agricultural diversification is an important mechanism for economic growth. It could be facilitated by technology development, changes in consumer demand, government policy or in trade arrangements, and by development of irrigation facilities, roads, and other types of infrastructure. Agricultural diversification could also reduce risks in agriculture and generate more stable household incomes within different farm enterprises. However, it depends on opportunities for diversification and on farmersô responsiveness to opportunities. It could also be impeded by risks in markets and prices and in crop management practices, by degradation of natural resources, and by conflicting socio-economic requirements (Singh, Kumar & Woodhead, 2002). Mainstream economics argued in favour of diversification when it prescribed that profit maximising firms should not forgo profitable opportunities, and even unprofitable ones, if financial markets were not perfect and bankruptcy was costly (Heidhues, 1995; Rondi & Vannoni, 2002).

Economists have long recognised that a major source of U.S. productivity growth and economic mobility in the first part of the 19th century was the growth in the quality of the workforce, which was ascribed in turn to the rise in educational attainment among workers (Becker, 1995; Carneiro & Heckman, 2003). The recent decline in the growth in the quality of the workforce attributed to a large extent to the deceleration in the growth in the

educational attainment among cohorts of American workers born since 1950 had serious implications for growth in aggregate real wages (Heckman, 2005). The slowing of real wage growth, in turn, could have an adverse impact on the economic well-being of households (El-Osta, 2011).

In rural areas of contemporary developing countries, non-farm activities were becoming more important in determining the welfare of households. Rural households responded to new economic opportunities by adjusting their labour allocation, considering returns to human capital, which might differ from activity to activity (Kurosaki, 2001). The author investigated the effects of education on farm and non-farm productivity, using micro panel data of rural households in the North-West Frontier Province (NWFP), Pakistan. In the estimation results for the first stage multinomial logit model, variables in vector *Xi* (individual characteristics that affected market wage) included age, age squared, and educational achievement dummies (Model A) or schooling years (Model B). The coefficients on education dummies in Model A suggested a pattern with accelerating probability of joining non-farm wage markets as the education level went up. However, only the coefficient on a dummy for education up to high or higher school was significant.

In Model B, only the squared term for male schooling years was significant for joining non-farm wage markets. None of the education variables was significant in determining the participation in labour markets. These suggested that the probability of joining non-farm wage markets increased with education at an increasing rate.

Age and age-squared had opposite signs that showed an inverted U shape, both for farm and non-farm markets. Point estimates indicated that the participation probability was maximised at an earlier age for non-farm work than for farm work, although the difference might not be significant, considering the large standard errors of coefficients on linear terms. Variables in vector *Xh* (household characteristics that affected wage market participation) included

household asset variables and dummies for farm types. These variables served as identifying variables for the second stage wage equation. Estimation results showed that households with less land and more adult male members were more likely to send their labour force to outside employment. The coefficients on the dummy variables for farms were significantly negative. These results implied that the necessity of family labour on family farms was an important determinant for whether or not a household sent its members to wage jobs.

In the second stage wage equation was estimated for non-agricultural wage earners, the results showed that there were significantly positive effects of education on the wage level. A worker with primary education was expected to be paid 15% higher than a non-literate worker (reference group); with middle school education, 25% higher; and with high and higher school education, 43% higher (Model A). These parameters implied the following Mincerian rates of returns: 3.0% for education up to the primary level, 3.1% for education up to the middle level, and 3.6% for education up to the secondary and higher level; or 3.1% for additional middle education after primary education and 4.6% for additional higher education after middle education. This range was consistent with the estimates in earlier studies on the returns to schooling in rural non-farm activities in Pakistan (Fafchamps & Quisumbing, 1999; Alderman, Behrman, Ross & Sabot, 1996). When the schooling year and its quadratic term were included as education variables (Model B), only the positive coefficient on the quadratic term was statistically significant. These results suggested a possibility that return to education increased with education at an increasing rate, which was consistent with results for labour market participation.

According to Morduch (1995) and Reardon (1997), decisions made by rural households concerning the form and extent of their involvement in rural non-farm activities (either starting enterprises or entering the wage labour market) generally depended on two main factors ï the incentives offered, such as the relative profitability and risk of farm and RNF

activities; and the householdôs capacity (determined by education, income and assets and access to credit.) to undertake such activities. Households could be motivated to undertake rural non-farm activities by either pull or push factors. In the case of enterprises set up by households, the choice of technologies and products would be determined by similar conditions. When opting to undertake RNF activities, farm households might be motivated by pull factors, such as better returns in the non-farm sector relative to the farm sector; and push factors, which included, in particular: an inadequate farm output, resulting either from temporary events (e.g. a drought) or longer-term problems (e.g. land constraints); absence of or incomplete crop insurance and consumption credit markets (to use as ex post measures for harvest shortfalls); the risks of farming, which induced households to manage income and consumption uncertainties by diversifying and undertaking activities with returns that have a low or negative correlation with those of farming; and absence or failure of farm input markets or input credit markets, compelling households to pay for farm inputs with their own cash resources.

Reardon (1997) explored the motives for rural household income diversification into the rural non-farm sector as a function of related incentives and capacity. The factors were:

2.3.1 Responsiveness to relative prices.

Field studies showed that rural households were responsive to differential returns to activities in the farm and non-farm sectors (although this responsiveness was manifested only where the household had the capacity to participate), given the similar risk profiles of activities in the two sectors. This belied the traditional image of peasant households not being market-oriented, especially with respect to labour market opportunities. Households allocated labour to the non-farm sector either because relative returns were better and or more stable in that sector, or because farm output was inadequate (because of short-term shocks, such as drought, or longer-term constraints, such as lack of land). This allocation could either be a

long-term strategy (to manage agricultural risk, compensate for land constraints or take advantage of profitable opportunities off-farm) or a short-term strategy to cope with harvest shortfalls and to smooth incomes over the years where there was a failure in or absence of the crop insurance or credit market.

2.3.2 Credit markets.

Households could be pushed by underdeveloped or constrained credit markets to earn income off-farm so as to pay for farm inputs and capital. A possible pattern emerged in evidence from case studies in Kenya, Mali, Mexico and the Philippines that credit market failure drove farm households to undertake local non-farm and farm investments in two steps: i) rural households migrated to earn cash, returning to rural areas to reinvest the cash in farm capital, cattle, education and housing; ii) with their skills ï perhaps learned or honed in migration ï and education, they set up local non-farm enterprises (with relatively high capital entry barriers, such as carpentry). Moreover, given the frequent inadequacy of land to serve as collateral for agricultural loans in informal and formal credit markets, steady pay in the non-farm labour market was used by creditors as substitute for loan collateral. Hence, non-farm earnings allowed preferential access to local credit sources, and these non-farm and farm strategies converged to accumulate capital (Heidhues, 1995; Reardon, 1997).

2.3.3 Education.

Education was a significant determinant of rural non-farm business sector success, wage levels and productivity and it was, therefore, important for creating a more egalitarian income distribution. Its importance as a determinant of rural non-farm business success, wage levels and productivity is widely recognised. Studies of rural industrialisation in Asia have emphasised the importance of skill acquisition for a more even distribution of rural non-farm employment, again contrasting Taiwan Province of China and the Republic of Korea in this regard. Given the strong incentive for poor households to diversify their income sources, it is

no wonder that one of the first major investments of farmers in cash-cropping zones was education. More equitable access to education, access to urban wage employment and scale-neutral agricultural innovation (i.e. that could be adopted by both small and large-scale producers) achieved the equal distribution of development. Off-farm income (especially migration income from government employment) was channeled into agriculture. As productivity-increasing innovations were scale-neutral and, thus, independent of farm size, investment generated with off-farm and migration income (of which education was a strong determinant) caused productivity increases for poor and rich households alike, thereby further enhancing the equalising effects of access to off-farm employment. Access to off-farm income permitted poorer households to be involved in investments in tree crops (with a long gestation period) and hybrid livestock (sometimes with a high mortality rate) (Stefanou & Madden, 1987; Alvarez & Arias, 2003). Such investments gave higher returns but also posed greater risks.

2.4 Farm Income, Off-farm Income and Market Labour Supply.

Labour, as a factor of production, describes the efforts of human beings, their families and hired workers exerted in the process of production (Ugwu, 2007). In peasant agriculture, the bulk of the labour force comes from household sources. There is also the use of hired labour and borrowed capital to augment family supplies (Olayide & Heady, 2006). Low labour productivity has been identified as a major constraint in subsistent agriculture (Ogundari & Ojo, 2005; Ojo, 2004; Okoye, Onyenweaku, Ukoha & Asumugha, 2008). Labour productivity is further worsened by the ageing trend of farmers and rural-urban migration of youth (Audu *et al.*, 2009). A basic characteristic of human labour is its fixed nature. It was on this basis that a lifetime constraint equation was developed which held that a farmer allocates his endowed time (labour) among farm work hours, market hours and leisure hours

(Huffman, 1980; Newman & Gertler, 1994). Holding leisure in this model constant, labour allocation between farm and off-farm works would be influenced by the level of returns. This notion corresponds with distress-push and demand-pull diversifications. Thus, labour allocation decision between farm and off-farm works might not be static, especially among small-scale farmers.

Following Huffmanôs (1980) pioneering empirical work on farm household employment participation, off-farm work has become an effective strategy for dealing with income fluctuations and risk associated with agriculture. Farmersô time allocation across farm enterprise options and off-farm labour choice is a signal of their risk aversion.

Since rural non-agricultural sectors started to develop in the mid 1980s, an important source of income for rural households has accrued from wage work, or market work. According to the Chinese Household Income Project surveyed in 2002, rural households with more market workers tended to have much higher per capita income. Nonetheless, the survey also showed that 55% of household heads in rural areas participated in the labour market and that the average market participant worked about 1,200 hours a year (Li, 2002; Sonoda, 2006).

Mishra and Goodwin (1997) noted that farm income was more variable than non-farm income because of the riskiness of the farming business. Due to the risk-aversive tendency of small-scale farmers, coupled with the need to supplement farm household income, they often resorted to off-farm work. Relatedly, Mishra and Goodwin (1997) and Vergara, Coble, Patrick, Knight and Baquet (2004) observed that increased farm income variability induced farm families to seek off-farm employment (market labour supply) to reduce variance in household income, assuming that off-farm wages were fixed. Taking riskiness in both farm and off-farm works into consideration in labour allocation decision of farm households, Mishra and Holthausen (2002) found that market labour supply by farmers increased as the variability of farm income increased and as the variability of off-farm wage decreased. Thus,

whenever both farm income and off-farm wages are uncertain, a risk-averse farmer might choose to work more or less hours on the farm than a risk-neutral farmer. Since small-scale farmers are risk-averse (Olayide & Heady, 2006), market labour supply would depend on the relative sizes of the variability in farm and off-farm works (Rios, Masters & Shively, 2008).

According to Bagamba, Burger and Kuyvenhoven (2007), understanding the factors that influence labour allocation decision between farm and non-farm sectors was crucial to formulating policies that would improve on the welfare of smallholder farmers. Reardon, Berdegue and Escobar (2001) cited high income from non-farm sector as the motivation for entering the labour market by rural farm households. Age, education, farm assets, cash receipts and off-farm employment opportunities have been found to significantly influence the amount of market labour hours spent by broadacre farmers (Lim-Applegate, Rodriguez & Olfert, 2002). McNamara and Weiss (2001) found that the degree of on-farm diversification, as well as the probability of off-farm diversification, was significantly related to farm characteristics (farm size and past farm growth), operator characteristics (age, education) and regional economic characteristics.

On the other hand, households might fail to join the non-farm sector due to high entry costs, low education levels, and limited access to information (Bagamba, Burger & Kuyvenhoven, 2007). To Kwon *et al.* (2006), farm households facing large fluctuations in farm income due to weather and price shocks could use insurance markets to lessen their exposure to price or yield risk, futures markets or forward contracts. The magnitude of fluctuations could, also, be moderated by the intervention of the government in farm gate prices through price supports or loan deficiency payments. Furthermore, households that could not avoid large swings in farm income could minimise large fluctuations in consumption by consuming from current income more than permanent income.

Studies have shown that, in developing countries, evidence abound on farm households adjustment of labour supply in response to unforeseen income shocks. In rural areas of contemporary developing countries, non-farm activities have become important in determining household welfare. In this direction, households would respond to new economic opportunities by adjusting their labour allocation. It has been generally suggested that farm households could alter their consumption of leisure in order to smoothen shocks to farm income (Skoufias, 1993; Jacoby & Skoufias, 1997; Kurosaki, 2001; Skoufias & Parker, 2002).

The situation is not different in developed countries. For instance, Kwon *et al.* (2006) reported Iowa farm householdsô increasing reliance on off-farm income to supplement the returns to their farming operations. Mishra and Sandretto (2001) found that off-farm income served to lower total variability in farm household income. Abdulai and Regmi (2000) noted that family labour acted as an intermediary or buffer between vagaries of public policies and family welfare. Mishra and Goodwin (1997) also found that off-farm labour responded positively to higher probability of farm income shocks.

McNamara and Weiss (2005) attributed the post World War II prosperity in industrialised countries to the reallocation of labour from agricultural to non-agricultural activities. This transition was the consequence of restructuring in agriculture, which led to increased specialisation and concentration in agricultural production, and increased labour productivity which led to dramatic decline in the sectorôs labour requirements.

Labour supply in quantity and quality, which depends on family size and composition, health, and education, is critically important. *Ceteris paribus*, cheaper and more available labour drives farmers to substitute labour for land or capital. In some cases, farmers with off-farm opportunities actually wanted farm labour-saving technologies so as to free labour for off-farm work (Reardon, Crawford, Kelly & Diagana, 1996). The quality of labour, according the

authors, included farmerôs education, training, technical knowledge, and health. These qualities could facilitate the farmerôs labour allocation and investment decisions. This is because farm and non-farm sectors compete for the farmerôs labour allocation and farm investment. In Burkina Faso, better off-farm returns have been found to decrease farm investments (Christensen (1989) in Reardon, Crawford, Kelly & Diagana, 1996). This happened when farmers invested off-farm income in non-farm assets.

Examining the tradeoff between market work hours and farm profitability, it has been observed that whenever the household head tried to increase market labour supply, he might take less effort to collect information about farm production technology, or optimise resource utilisation. Conversely, increased farm profitability would increase more allocation to farm production and reduced market labour supply (Goodwin & Mishra (2004) in Sonoda, 2006).

2.5 Farm Capital

It has been suggested that RNF employment and, thus, the microenterprise promotion programmes designed to stimulate the off-farm sector, would reduce rural income inequality and, as a result, social and political tensions. This position was typically presented as a hypothesis that non-farm activity reduced the inequality of total income in rural areas and, hence, had an equalising effect. Such an assertion, however, ignored the possibility that the income generated by such activities might be even more unequally distributed in favour of the wealthy and mighty, thereby, actually worsening income distribution, even in spite of increasing income levels in all population strata. Furthermore, in this type of reasoning, non-farm income was treated independently of farm income and considered more as an income transfer, i.e. non-farm income compensated for a bad harvest or insufficient land. In other words, for a given household, with a given level of farm income, an increase in non-farm income clearly raised total income by the same amount, enriching the household and

smoothing income by compensating a drop in agricultural production (Reardon, Crawford, Kelly & Diagana, 1996; Reardon, 1997; Mokyr, 2003).

Capital is that part of wealth, other than free gifts of nature, which could be used for further production or generation of income. The basic characteristic features of capital are that it is the result of human labour; a passive factor of production; more mobile than other factors of production; and is subject to depreciation. The formation of capital is crucial to every type of economy. It is the process of consciously producing or accumulating means of further production. Saving and investment are essential to this process. Within the context of this study, farm capital referred to the current value of farm assets and the values of crops (sold and unsold). Its accumulation was contextualised to be improved or declined by income from off-farm employment.

It is evident that farmersô access to scarce farm assets, such as land, and access to attractive terms of financing for the preferred strategies, plays a major role in agricultural development. Hence, the true evaluation of economic success should be based on the wealth accumulation of the farm household (Hill, 2000 in Myyra *et al.*, 2011). Accumulated assets enabled farms to secure credit and smooth the consumption expenditures in times of income shortfall. Studies explaining wealth accumulation on agricultural holdings are sparse (Vercammen, 2007).

Some researchers have highlighted some explanatory variables for asset accumulation in agriculture (Mishra & El-Osta, 2005: Lagerkvist *et al.*, 2007). Mishra and El-Osta (2005) pointed out the importance of land. Intermediate and large farms tended to have greater wealth. However, it was not only farm size that mattered. Farms located in sparsely populated rural areas appeared to have fewer business opportunities and they also faced a lower increase in land prices than farms located in neighbourhoods close to metropolitan areas. Mishra and El-Osta (2005) additionally confirmed a classical U-shaped wealth and age profile, where

disinvestments in productivity-increasing agricultural assets occurred among young and aged farmers. The finding was that the disinvestment strategy started at an earlier age among those farmers whose wealth primarily originated from agriculture as compared to farmers who also had other wealth sources. This tendency somehow indicated that off-farm income might significantly contribute to farm capital. Aged farmers working off-farm might, at least, required higher labour productivity in agriculture and, thus, substituted labour with capital, even if these investments did not increase the total factor productivity of the farm.

Vercammen (2007) showed that time horizon was important in farm investments, but the discount rates as well as the borrowing and savings rates also had a major influence on farmersô decisions when considering the opportunity cost of capital and, in particular, investing in agriculture as against withdrawing the profits for consumption. Thus, rate of time preferences indicated how much farmers discounted the utility of consuming in the next period relative to the utility of consuming now. The rate of time preference was an important determinant in dynamic modelling of investments because the returns and costs occurred over time and alternative streams must be compared. Farm capital efficacy measures were found to be significant in explaining capital accumulation. Lagerkvist *et al.* (2006) found that the coefficients of operating margin and asset turnover were positive and negative, respectively in explaining farm capital.

2.6 Off-farm Income and Farm Capital Accumulation

The association between off-farm labour markets and farm capital has important policy implications. According to Ahituv and Kimhi (2002), labour market policy tended to spill to the farm sector, while agricultural policy affected both rural urban labour markets. It is, thus, important to recognise the endogeneity of capital stock in empirical analysis of off-farm work, especially with regards to developing countries. In those economies, the agricultural

sector suffered neglect in spite of its strategic economic importance. Also, capital markets were less competitive and farm capital was determined more by life-cycle accumulation and less by intergenerational transfers. Reardon (1997) illustrated that off-farm income was the most viable option for increasing farm capital accumulation where the farm family faced stiff borrowing constraints. The implication was that increasing opportunities for members of farm households to obtain jobs that guaranteed adequate return to labour might lead to increase in the capital intensity of agricultural investments.

Juvancic and Erjavec (2003) noted that intensive outflow of labour from agriculture, a general economic trend, could be attributed to two mutually related processes. One, was the restructuring of agricultural production, which was reflected in growing specialisation and concentration. Two, was technical progress, which constantly reduced labour force requirement (McNamara & Weiss, 2005). Eurostat (2000) observed that adaptational strategies of agricultural households to this trend were often associated with off-farm employment of family labour. It has been pointed out that motives and interests for off-farm employment differed and could be influenced by transfer of excessive family labour, satisfaction of income expectations, or personal preferences.

According to Juvancic and Erjavec (2003), a country in transition period has highly fragmented land ownership structure, agricultural policy discriminating against smallholders, and increasing demand for farm caused by unattractiveness of farm production and heightened rural-urban migration. This is the case with Nigeria. Entering the period of transition towards a full market economy with uncompetitive agricultural sector characterised by diseconomies of size and inefficient labour allocation (Audu *et al.*, 2009), one would expect a reactionary outflow of labour from agricultural sector coinciding with the need to intensively consolidate existing farms.

According to Kada (1992), farm labour and farm capital were substitutes in Japanese rice farms. This result was most applicable in land-scarce agricultural societies or where land tenure system imposed constraint on cultivable land expansion. In a transitional economy, it has been suggested that returns to labour in off-farm employment was an important strategy in ameliorating farm capital constraints. Mishra and Goodwin (1997) have demonstrated that farmersô off-farm labour responded positively to higher probability of farm income shocks. According to Vera-Toscano, Phimister and Weersink (2004), rural workers were more likely to transit into periods of underemployment and back into adequate employment than their urban counterparts. This cyclical pattern of labour supply was necessitated by the need of households for additional income to offset down cycles in farm income (Kwon *et al.*, 2006). Adopting a two-person household model to analyse off-farm labour supply, Kwon *et al.* (2006), found that the probability of working off-farm declined with increase in farm income. Thus, farm households used reductions in the consumption of leisure to replace income lost from adverse shocks to farm income. This, also, showed that farm households were not perfectly insured against transitory farm income fluctuations.

Juvancic and Ejavec (2003) observed that labour allocation decision in agricultural household was a dynamic process influenced by various factors ï external and internal. External factors included macroeconomic conditions, local conditions affecting labour market, and agricultural-related conditions. Internal factors included individual household members, entire household, and agricultural holding. These factors interacted to determine the allocation of labour between off-farm employment and on-farm work. All these culminated in aggregate farm household income which could be used for own consumption, on one hand, and investment in farm holding and capital, on the other hand.

In the case of transition economies, like Slovenia and Nigeria, it has been suggested that the decision of a farm household on continuation, diversification, or cessation of farm work

could depend on adaptation to favaourable situation on off-farm labour markets (synonymous with demand-pull factors). Similarly, continuation of low-paid farm work could be an individualôs survival strategy in the face of rigidity in off-farm labour markets (synonymous with distress-push factors) (Davis & Pearce, 2000). These factors and scenarios constituted potential entry barriers, constraints and opportunities to off-farm work by certain household types (Babatunde *et al.*, 2010). The foregoing is a pointer to the fact that households could use migratory labour market to break the vicious cycle of low farm capital and inability to earn non-farm income locally. Farm households could also use migration remittances and skills learned through migration to start non-farm businesses, improve farm businesses, and raise or increase farm capital (Reardon, 1997).

Examining the changing sources of household income and poverty reduction in rural Asia, Otsuka and Estudillo (2007) found that rural households shifted away from farm to non-farm activities remarkably in response to the rising returns to labour in the non-farm sector. As an additional source of income, families relied on non-farm employment to meet farm or family needs (Lim-Applegate *et al.*, 2002). In North America, Simpson and Kapitany (1983) found that non-farm earnings assisted young couples in financing their farm investment requirements. In line with the life earnings cycle hypothesis, the result of Lim-Applegate *et al.* (2002) suggested that young farmers tended to be more willing to do non-farm work to finance additional assets. In contrast, established older farmers were likely to be less willing to do non-farm work because they might have sufficient income from other sources such as investment income or might not possess the necessary skills.

The farm household encompassed a complex set of inter-relationships between and among a variety of internal and external factors involving consumption, investment, and income-earning activities. For example, farm households often received a substantial part of their income from non-farm sources such as wage and salary jobs and non-farm businesses (Harris

et al., 2010). Other studies documenting the importance of off-farm income were Davis (2003), Huffman (1991), Weiss (1999) and Zeller (2010).

Studies have indicated that mid-sized farms were squeezed out as the size structure of farms settled to a bi-modal distribution where farms were either large full-time operations or small part-time activities (Weiss, 1999). In general, off-farm work provided a mechanism for maintaining income parity with other groups in the society (Gardner, 1992). Gardner (1992) also noted that the integration of farm and non-farm labour markets had slowed the overall rate of decline in the number of farms. Many people were commuting to non-farm jobs while they remained on the farm. Gardner (1992) further indicated that small farms were flourishing to an extent that no one guessed two or three decades earlier. Presumably, off-farm income had contributed to reducing the riskiness of the income stream facing the farm household. However, if part-time farms were less economically efficient, then lower rates of returns on total assets should lead to their exit if the farm was viewed as a source of income.

There are a number of economic theories as to why off-farm income might affect farm investment (OôBrien & Hennessy, 2005). The agricultural household production model suggested that it was economically rational for farmers that worked off the farm to invest in farming if the farm investment allowed them to maintain or increase farm output with less farm labour. In effect, farmers that worked off the farm might maximise their total income by using some of their off-farm income to invest in the farm. The presence of off-farm income might also relax the budget constraints in the farm household. Farm households that depended only on farm income had to use a larger proportion of farm profit to satisfy the consumption demands of the household. In households where additional income was present, the budgetary constraints were relaxed, thereby making more of the farm profit available for reinvestment.

The transition from full-time to part-time farming could often be perceived as a first step out of farming and, therefore, farmers that worked off the farm might not be expected to reinvest in farming and increase farm capital base. A number of studies, as reviewed by Hennessy and Hennessey and Rehman (2007), showed that farmers that worked off the farm typically operated more extensive and less profitable farms. Glauben, Tietje and Weiss (2004) conducted a review of studies that investigated these issues. They cited a number of studies that presented empirical evidence that farmers that worked off the farm had lower expectations of continuing the farm business and were less likely to have a successor and, as a consequence, they were less likely to invest in their farms. It followed then that farmers who worked off the farm might be less likely to reinvest in the farm business. Furthermore, a study conducted by Andersson *et al.* (2005), using farm data from the U.S., showed that an increase in off-farm income increased the investment in non-farm assets relative to farm assets.

Mishra and El-Osta (2005) noted that off-farm income and assets contributed to investments in agricultural assets. Lagerkvist *et al.* (2007) tested whether farm capital was endogenous to off-farm income. The data they used rejected exogeneity and suggested a significant connection between off-farm income and farm assets. Thus, not only agricultural markets, production decisions and agricultural policy affected the accumulation of farm assets, but also the surrounding business and employment opportunities defined by the overall economic activities in the area.

In Lagerkvist *et al.* (2006), off-farm income share accounted for 82% of the variation in capital stock of sampled farm operations. The researchers expected a negative relation, which would imply that off-farm income did not increase farm capital accumulation if farm households were subjected to borrowing or capital constraints. Conversely, a positive effect

would have implied that funds earned outside of farm operation were re-invested in the farm enterprise.

2.7 Farm Financial Characteristics

Financial characteristics often provide indications of success or failure of enterprises. According to Black, Fitzpatrick, Guttmann and Nicholls (2012), financial characteristics indicate the vulnerability or resistance of small firms to distress. These characteristics are also relevant in agricultural enterprises. As noted by Black, Fitzpatrick, Guttmann and Nicholls (2012), volatility in farm production and prices was a big challenge particularly because output growth in the farm sector is, on average, over eight times more volatile than non-farm output growth. Examples of financial characteristics ranged from operating margin, total assets and liabilities, debt-to-asset ratio, depreciation, cost and return on production, net worth, to gross margin (Arene, 2002; Pandey, 2010; Brealey, Myers & Allen, 2011).

Debt-asset-ratio, a measure of the financial leverage of the firm indicates the extent of dependence of the enterprise on debt financing. The intention of this capital structure is to earn more return on the fixed-charge funds than their cost. The operating margin of the firm is the ratio of the value of farm asset to the value of farm production. The ratio indicates how much asset is generated from one unit of product or produce sales. Farm liabilities measure the total debt of an enterprise. High farm liabilities indicate an enterpriseôs inability to meet its short obligations. Net worth measures the difference between the total farm asset and total farm liabilities of a firm. High net worth indicates favourable position of the equity of the owner of the business (Arene, 2002; Pandey, 2010).

Lagerkvist *et al.* (2006) explained that financial characteristics were significant in capital accumulation studies, especially from the viewpoint of capital intensiveness of farm operations. For instance, they found that debt-to-asset ratio was negatively significant in

explaining the variations in farm capital. The implication was that more capital intensive farm operations had lower leverage than less capital intensive farm operations. Lagerkvist *et al.* (2006) also found that interest rate burden (capital input) on farm liabilities positively and significantly affected farm capital intensity. The predictive measure of financial distress, which was positively related to capital stocks in Lagerkvist *et al.* (2006), suggested that larger farms (measured by the size of farm capital) were more financially vulnerable.

A farmerôs total assets include land, other fixed assets and total current assets. Only assets in farmer ownership could be taken into account, excluding leased machinery, for example. These indicators were based on the value of the various assets at closing valuation. For those assets that depreciated, the depreciation rates could usually be decided by farmers up to certain upper bounds that were imposed locally, e.g. through taxation regulations separately for each asset class, such as machinery and buildings. Farmers could choose the preferred depreciation rates according to various factors, which depended for the most part on the particular conditions of the region, the intensity of asset use, and also on the expected degree of technical progress. The amount of annual depreciation might be calculated according to the linear or diminishing balance method. Flexible depreciation rates raised questions about the possibility of manipulating the value of assets. Total assets on a farm changed over time for two reasons. First, the balance of gross investments and depreciation, i.e. the net investments, defined whether capital accumulated or decayed at given (fixed) prices. Second, the asset values could be re-evaluated to account for inflation and market price movements. Re-evaluation of asset values could have a strong and, sometimes, predominant influence on the value of total assets (Barkaszi, Keszhelyi, Kis-Csatári & Pesti, 2009; Myyra *et al.*, 2011).

2.8 Off-farm Income and Farm Efficiency

Off-farm income has increased as a proportion of total household income even in developed countries (Woldehanna, Oude-Lansink & Peerlings 2000; Lien,Kumhakar & Hardaker, 2010). According to Bojnec and Ferto (2011), income diversification of rural households is driven by such determinants as higher returns to labour and capital in off-farm economy as well as by risks relating to farm input market imperfections. These affected farm performance. Dries and Swinnen (2002) and Hertz (2009) have provided evidence on a positive association between off-farm income and farm efficiency. Thus, farm performance could be proxied by technical efficiency, cost efficiency, and allocative efficiency.

Bojnec and Ferto (2011) used stochastic frontier analysis model to determine the impact of off-farm income on farm efficiency in Slovenia, using time series data. In their preliminary results, the share of farms with off-farm income varied by type of farming (field crop, horticulture, livestock and mixed farming). Using the translog functional form in preference to Cobb Douglasô as indicated by the likelihood ratio, they found that real total intermediate consumption reduced technical efficiency, while total utilised agricultural area and total labour input increased technical efficiency at various levels of probability.

The variance parameter, ɔ, which lies between 0 and 1, indicated that technical inefficiency was stochastic and that it was relevant to obtaining an adequate representation of the data. The value of ɔ picked up the part of the distance to the frontier explained for the inefficiency. In their estimation, the value of the variance parameter ɔ was 0.98. That meant that the variance of the inefficiency effects was a significant component of the total error term variance and that, farmsô deviations from the optimal behaviour were not due to random factors only. Thus, the stochastic frontier was a more appropriate representation than the standard ordinary least square estimation of the production function (Hung-Jen, 2002).

Stochastic frontier time-varying decay inefficiency model indicated a positive and significant association of the stochastic frontier time-varying decay inefficiency in terms of real total output, which was used as the dependent variable, with the traditional agricultural inputs, i.e., total utilised agricultural area and total labour input, respectively. Negative association was found with real total fixed assets, whose regression coefficient was insignificant, and real total intermediary consumption, which was significant, but at 10% significance level. Except for total labour input, all regression coefficients for the squared explanatory variables were of a positive sign and significant. The regression coefficients for the interaction effects of the explanatory variables were mixed. A positive and significant association was found for the regression coefficient of the interaction effect of the real total fixed assets and total labour input, while negative sign and statistical significance were found for the regression coefficient of two interaction effects: real total intermediate consumption and real total fixed assets, and total utilised agricultural area and total labour input. These results indicated that the more agricultural area and labour input the farm employed, the more inefficient it was, and vice versa for intermediate consumption and to a lesser extent for total fixed assets. Farm inefficiency was mitigated in a combination of intermediate consumption and fixed assets, and agricultural area and labour input, and vice versa for fixed assets and labour input (Bojnec & Ferto, 2011).

By type of farming, other grazing livestock farms were the least technically efficient. Among the less technically efficient were also mixed farms and field crops farms. Close to average technical efficiency were other permanent crops farms and milk farms. Horticultural farms were found to have the highest technical efficiency scores. Among the more technical efficiency were also wine farms and livestock farms using cereals (pigs and poultry farms). Horticultural farms and livestock farms using cereals (pigs and poultry) experienced the greatest similarity in technical efficiency with the smallest differential between the least

minimum and the most maximum technically efficient farms. This differential was particularly large for other grazing livestock farms, field crops farms, other permanent crop farms and mixed farms.

2.9 Theoretical Framework

In this section, underlying theories relevant to the work were examined. The theories were those of labour supply, labour allocation, wage determinants, human capital, and optimal time allocation.

2.9.1 Labour supply theory

The determinants of labour allocation decisions of rural households often rely on the neoclassical assumptions of perfectly competitive factor markets and complete information, where the level of employment is simply determined by the intersection of the aggregate labour supply and aggregate labour demand. Also, the competitive market assumptions hold that labour market equilibrium is generated automatically as an efficient allocation where workers and firms find each other (Bailey *et* al., 2009; Tocco, Davidova & Bailey, 2012). Huffman (1980) viewed labour supply decisions of farm household members as the result of household utility maximisation, subject to constraints on time, income, and farm production. Household members are assumed to receive utility from a vector of membersô leisure (L), a vector of purchased goods (Y_1), and a vector of factors exogenous to current household consumption decisions (Y_2) ï membersô age, education and household size. The utility function is assumed to be ordinal and strictly concave. The differential equation of utility with respect to leisure (L) and purchased goods (Y_1) is as follows:

$$U = U(L, Y_1, Y_2); U_L = \frac{\partial U}{\partial L} > 0, U = L, Y_1 \quad (2.1)$$

Kurosaki (2001) adopted another approach to the theory of labour allocation at the household level. The theory assumes a unitary decision making process at the household level with respect to labour allocation, following the model by Newman and Gertler (1994). A risk-neutral household allocates labour from household members (i = 1, ...,N), from which it obtains disposable income, y. From leisure enjoyed by household members, the household obtains utility, $v(l_1, l_2, ..., l_N)$, where $v(.)$ is a concave function, which is separable from utility from income, y. This specification implicitly assumes that the household uses a two-stage decision making process with respect to consumption of non-leisure goods ð in the first stage, it allocates resources between household consumption and leisure; it allocates household consumption among members in the second stage based on the level of y, which is treated as a *num´eraire* so that net returns to labour are denoted in real terms.

The household faces a budget constraint and N time constraints, one for each member. Each member can potentially enter into M economic activities, each of which yields a net return to labour f_j . More formally, the householdôs optimisation is expressed as:

□ □□□□ □ + □□□, □, ... □ □ (2.2)

subject to budget constraint

□ + □ □□□□□□□, □□, ... □□; □ = □, (2.3)

time constraints

□ □□□□□ + □ = □, □ = □, ... , □, (2.4)

and non-negativity conditions for labour allocation variables, where y_0 is a non-labour income including the sum of returns to household assets, L_{ij} is hours of work by individual i in activity j, which is constrained as non-negative, X_j is a vector of semi-fixed enterprise inputs such as land, fixed capital, household human capital composition, etc., and T_i is the

time endowment for individual *i*. The first order conditions for the optimisation consist of the following ($M \times N$) equations:

$$\frac{\partial Y_i}{\partial X_{ij}} - \frac{w}{p_y} \leq 0, \quad X_{ij}\left(\frac{\partial Y_i}{\partial X_{ij}} - \frac{w}{p_y}\right) = 0. \qquad (2.5)$$

This expression shows that the household allocates labour according to a comparative advantage principle, which is determined by the marginal returns to labour $\frac{\partial Y_i}{\partial X_{ij}}$. For example, when a household member can earn more as a non-agricultural employee than in self-employed farming or than in household work, the household allocates him/her to the non-agricultural employment even if the absolute level of his/her marginal contribution to self-employed farming is higher than those of other household members. Therefore, what is needed to investigate empirically is the actual shape of $\frac{\partial Y_i}{\partial X_{ij}}$ as a function of human capital.

The economic activities available to the household members ($j = 1, \ldots, M$) are assumed to be exogenous. It is assumed that all the adult persons can potentially enter wage labour markets, both agricultural and non-agricultural. On the other hand, self-employment jobs are available, by definition, only to those household members belonging to a household with a farm or a non-farm business. Although the status of a household to have a farm or non-farm enterprise is endogenously determined in the long-run, the household status is treated as exogenous since the focus of this paper is on the short-run determinants of labour returns and labour allocation.

2.9.2 Theory of wage determination

Wage jobs are defined as those works which are paid for by outside employers. Assuming wage labour markets to be exogenous to household decisions, the returns-to-labour function becomes a linear one whose coefficient on working hours is a unit wage. The unit wage is a function of the human capital of the employee, *Xi*, which is a vector of individual *i*ôs

characteristics that affects his/her market wage, such as age, age squared, sex and education. Once these individual characteristics are controlled, household characteristics should not directly affect workersô wage in the exogenous market (Jacoby, 1993; Kurosaki, 2001; El-Osta, 2011).

Two econometric issues are of importance here. The first is sample selection. With the assumption that all the adult persons can potentially enter wage labour markets, a classic problem of sample selection occurs from the fact that wages are observed only for those who choose to work in outside labour markets. To be consistent with the theoretical model above, a multinomial logit model was adopted for the selection mechanism (Maddala, 1983), in which individual i either works for non-agricultural wages (j = 1), or works for agricultural wages (j = 2), or otherwise (j = 0).

Then the first stage multinomial logit model becomes

$$\text{[illegible]} = \text{[illegible]} = \frac{\text{[illegible]}}{\text{[illegible]}}, \quad \text{[illegible]} \quad (2.6)$$

where z_{it} is an indicator variable denoting the choice for individual i with respect to j in year t, X_h is a vector of household $h$ôs characteristics that affect individual $i$ôs participation into wage work, such as household wealth and production assets according to the first order condition (4); j_1 and j_2 are vectors of coefficients to be estimated, associated with choice j. Vector X_h serves as an identifying restriction for the second stage wage regression. Equation (2.6) can be estimated by a maximum likelihood method. From estimation results, a sample selection correction term, β_{ijt}, is calculated for each individual.

Another econometric issue is unobserved characteristics that affect wages received by those who work in the wage sector. An example is workerôs ability that is known to the household but not observable to the econometrician. To minimize the bias from omitting these unobservable variables, a household specific effect, β_h, is added to the wage regression. With

household panel data, one can control β_h by either fixed or random effect specification. Since the fixed effect specification may exaggerate measurement error problems, the random effect specification is adopted as long as Hausman test cannot reject at 1% level the null hypothesis that X and β_h are uncorrelated (Jacoby, 1993; Kurosaki, 2001; Wilson, 2001). Following the standard literature on wage regression models, the wage function is specified as a log-linear form, namely,

$$\ln\left(\frac{W_{ijt}}{W_{ijt}}\right) = \ln W_{ijt} = \beta_{0j} + \beta_j X_{it} + \beta_{hj} + \beta_{ijt}, \quad \beta = 0, \quad (2.7)$$

where W_{ijt} is the wage level, X_{it} is the same as before, βj is a vector of coefficients to be estimated, which represents returns to human capital for an activity j, βj controls the selectivity bias, and β_{ijt} is a zero mean random error term. Household specific effects β_{hj} also control for the possibility of segmented labour markets among the three survey villages.

2.9.3 Human capital theory

The human capital theory was reconstructed by El-Osta (2011). Following closely and adapting the human capital model presented by Wilson (2001), the economic decisions of the ith individual (referred to henceforth as the farm operator) are characterized by the following objective:

$$\max U_i = U(C_i, E_i, \varepsilon_i) \quad (2.8)$$

where U is a separable utility function, C is lifetime discounted stream of consumption, E is utility received from schooling (referred to here as education consumption good), Bc is the weight of consumption in utility, e is amount of schooling, and $\mathring{U}e$ is an education-conditioned random utility term. The consumption good, Ei, which is the net effect of the utility benefits (e.g., pleasure received by ith farm operator from social contacts and from learning) and costs

(e.g., perceived negative externalities of schooling such as classroom restrictions and time spent on homework), is depicted in the following production function:

$$E_i = g(x_i, \varepsilon_i) \quad (2.9)$$

where *xi* is a vector of inputs (e.g., family background, neighborhood and school characteristics) that affect the net utility of being schooled, and *g*(.) is the technology that transforms *xi* into *Ei*. Maximisation of equation (2.9) by the *i*th farm operator is subject to the following budgetary constraints:

$$Y_i = \beta(Q_i)E_i + \varepsilon_i \quad (2.10)$$

$$Y_i \geq C_i \quad (2.11)$$

where *Yi* is lifetime discounted income stream which would always equate with or exceed the lifetime discounted stream of consumptionβ is the returns to schooling, *Qi* is a vector of variables that affect the returns to schooling (e.g., family characteristics such as parental education, family structure during childhood, family income, neighborhood and school factors, etc.), and ε_i is the random component of income. Also, $\beta(Q_i)$ transforms the schooling of the *i*th farm operator into income. Accordingly, if the *i*th operator chooses to have the same amount of schooling as the *j*th operator when both of these operators are also similar in terms of the characteristics that affect income (i.e., *Qi* = *Qj*), then operator *i* will expect his or her income to be the same as operator *j* as described in the following (Wilson, 2001); otherwise, the incomes among these two operators are expected to vary:

$$\partial E(Y_i)/\partial E_i, \varepsilon_i = \varepsilon_i = \beta(Q_i) \text{ and } \varepsilon_i = \varepsilon_i \quad (2.12)$$

Substituting equations (2.9)ï (2.11) into equation (2.8) yields the following maximisation of expected utility for the *i*th farm operator:

$$U(E_i, \varepsilon_i) + \lambda[\beta(Q_i)E_i - C_i] \quad (2.13)$$

The optimisation problem described in equation (2.12), when solved, yields the following:

$$\frac{\partial Y}{\partial E} = \frac{\frac{\partial U}{\partial E}}{\frac{\partial U}{\partial C}} \qquad (2.14)$$

As described by Wilson (2001), the left-hand side of equation (2.14) is the marginal rate of transformation of educational attainment to income. For the *i*th farm operator, a change in the level of schooling will be associated with a Ŭ(*Qi*) change in expected income. The right-hand side describes the relative utility of schooling and marginal utility of consumption for the *i*th operator, or when stated differently, is the marginal rate of substitution of consumption of good *E* and the marginal rate of substitution of consumption. Based on equation (2.14), the *i*th operator will continue to seek higher levels of schooling until the marginal utility benefits equal the marginal utility costs.

2.9.4 Theory of optimal time allocation

This theory incorporates farm production and off-farm earnings in order to provide a framework for assessing the interplay between work choices and farm capital investments. It is analysed as modified by Ahituv and Kimhi (2002). For simplicity, intra-household time allocation is ignored while a single-person household is assumed. Skoufias (1996) formulated such a model with more than one family member. A farmer is assumed to maximize lifetime income, derived from two sources: farm profits and off-farm labour earnings. He has one unit of time in each period to divide between off-farm work (L) and farm work (1_L). Farm production is a positive function of farm work, intrinsic ability (A), farm-specific human capital (hf), physical capital (K), fixed inputs (including land), purchased inputs (including hired workers), and a stochastic productivity shock, *h*. This shock is exogenous to the farm and is showed up at the beginning of each period. The assumption of fixed land is supported by evidence from developing countries, and by the fact that farmland transactions were not allowed in Israel. Elastic supply of hired labour is assumed, which is not a perfect substitute for own labour.

Although, several authors (Pitt & Rosenzweig, 1986; Benjamin, 1992) were not able to reject the perfect substitution hypothesis, others believed that it was unreasonable and found evidence against it (Eswaran & Kotwal, 1986; Jacoby, 1993; Frisvold, 1994; Fafchamps & Quisumbing, 1999). Off-farm income is a function of intrinsic ability (A), off-farm (per unit of human capital) wage rate (wc), off-farm-specific human capital (hc), and off-farm work time (L). Thus, the maximisation problem of the farmer is to choose the values for *Kt* and *Lt* for t=1,. . .,T to:

(2.15)

subject to the three asset accumulation equations:

$$K_{t+1} = I_t + (1 - \delta)K_t \quad (2.16)$$

(2.17)

(2.18)

and initial conditions:

(2.19)

Et is the expectation of an operator conditional on the information set at time *t*, *r* is the real interest rate, *pt* is the price of farm output, *d* is the depreciation rate of physical capital, It is capital investments, and ptI_t is the price of investment goods. For simplicity, it was assumed that the stock of sector-specific human capital was identical to accumulated experience with no depreciation. Using the first order conditions with respect to sequences/constraints {K1,. . .,KT,L1,. . .,LT}, allowance was made for corner solutions with respect to time allocation: some farmers might choose to work only on the farm (L = 0), while othersð only off the farm (L = 1). The first-order conditions were:

$$\text{[illegible]} \qquad (2.20)$$

and

$$\text{[illegible]}$$

$$= \text{[illegible]} \quad \text{where } 0 < \text{[illegible]} < 1. \qquad (2.21)$$

Equation (21) is the condition for optimal time allocation. The upper expression represents the marginal contribution to income from working off the farm, and the lowerð from working on farm. Thus, equation (21) showed that the values of the marginal unit of time spent in each activity were equalised. These first order conditions were very useful for assessing which exogenous factors increased the likelihood that the farmer chose to be in one of the two possible corners (Ahituv & Kimhi, 2002).

By using a specific production function, it is straightforward to solve analytically the lifecycle earnings path of each farmer. Since analysing the properties of such analytical solutions was outside the scope of this study, emphasis was laid on the effects of exogenous variables on capital investments and on time allocation decisions. Equation (2.21) indicated how prices and shocks affected the shadow price of farm capital. Holding everything else constant, an increase in either the real interest rate, the depreciation rate, or an overall rise in the schedule of $\{ pt_I \}$, reduced the optimal level of physical capital, while an increase in the price of farm output or the productivity shock increased the optimal level.

It is important to note that the farmerôs ability plays an important role in his time allocation decision. However, since ability was presumed to affect farm and off-farm income in the same direction, its effect on the likelihood of off-farm work was ambiguous. Second, in periods in which off-farm wages were high, more farmers would participate in off-farm work. The opposite would occur when farm profits were high (e.g. high price or technology shock).

Third, the model suggested that past decisions affected present decisions through the accumulation of sector-specific human capital, and, thus, a person who worked off the farm in the past was more likely to do so in the current period (persistence). Finally, time allocation and capital investments were interrelated, and the sign of the relation was ambiguous.

2.10 Analytical Framework

In this section, the fundamental basis and theories underlying major analytical tools proposed for analysing the data for the study were examined. The models include Heckmanôs two-stage selection model, human capital model, discriminant function analysis, index of diversification, one-way analysis of variance (ANOVA), multiple regression, Kruskal-Wallis (H) test, the Gini index, farm efficiency models, and simultaneous equation.

2.10.1 Heckman's two-stage selection model

Limited dependent variables are common in social and health data. The primary characteristics of such variables are censoring and truncation (Vance, 2006). Truncation, which is an effect of data gathering rather than data generation, occurs when sample data are drawn from a subset of a larger population of interest. Thus, a truncated distribution is the part of a larger, untruncated distribution. For instance, assume that an income survey was administered to a limited subset of the population (e.g., those whose incomes are above poverty threshold). In the data from such a survey, the dependent variable will be observed only for a portion of the whole distribution. The task of modeling is to use that limited informationð a truncated distributionð to infer the income distribution for the entire population. Censoring occurs when all values in a certain range of a dependent variable are transformed to a single value. Using the above example of population income, censoring differs from truncation in that the data collection may include the entire population, but

below-poverty-threshold incomes are coded as zero. Under this condition, researchers may estimate a regression model for a larger population using both the censored and the uncensored data. Censored data are ubiquitous.

The central task of analysing limited dependent variables is to use the truncated distribution or censored data to infer the untruncated or uncensored distribution for the entire population. In the context of regression analysis, it is typically assumed that the dependent variable follows a normal distribution. The challenge, then, is to develop moments (mean and variance) of the truncated or censored normal distribution. Theorems of such moments have been developed and can be found in textbooks on the analysis of limited dependent variables. In these theorems, moments of truncated or censored normal distributions involve a key factor called the inverse Mills ratio, or hazard function, which is commonly denoted as λ. Heckmanôs sample selection model uses the inverse Mills ratio to estimate the outcome regression.

The Heckmanôs model essentially just applies the moments of the incidentally truncated bivariate normal distribution to a data generating process. The basic selection equation in Heckmanôs model is stated as follows:

$$z_i^* = \gamma w_i + u_i \tag{2.22}$$

$$z_i = \begin{cases} 1 & \text{if } z_i^* > 0 \\ 0 & \text{if } z_i^* \leq 0 \end{cases} \tag{2.23}$$

The basic outcome equation is as follows:

$$y_i = \begin{cases} \beta x_i + \varepsilon_i & \text{if } z_i^* > 0 \\ \text{not observed} & \text{if } z_i^* \leq 0 \end{cases} \tag{2.24}$$

According to Harris *et al.* (2010), the investment decision could be viewed as a binary one, i.e. to invest or not, and thus can be analysed using a dichotomous choice model. However, farmers are also faced with the decision of how much to invest. According to Cragg (1971)

and Smith (2002), two hurdles are involved in the process of investment decisions, which can be determined separately or simultaneously. In order to observe a positive level of investment, two separate hurdles must be passed.

Ahituv and Kimhi (2002) proposed an empirical strategy for the joint analysis of farmersô decisions to participate in off-farm labour market, and their investment in farm capital. These two significant decisions determined the growth of the farmerôs earnings by determining his life-cycle paths in terms of both human and physical capital. At the macro level, the decisions taken by many individual farmers were essential to the overall development of the agricultural sector and the economy as a whole, with the resulting major policy implications. They formulated and estimated a finite-horizon life-cycle model that incorporated the major features of those factors influencing these decisions such as returns to ability, experience, and investments, and the effects of farm size and location. The authors illustrated this strategy with panel data on Israeli farmers from 1970 to 1981. The primary dependent variable in the research was the farm operatorôs off-farm work status (no work, part-time work, or full-time work). The secondary dependent variable was the value of the farmôs capital stock (buildings, machines, equipment and livestock).

In both years, the levels of farm capital were inversely related to the extent of off-farm work. However, the distribution of farm capital across off-farm work status in 1981 was much more unequal than in 1971, which pointed to the importance of the interrelation between these two variables over the life cycle. The highest relative rise was in farms in which the operators did not work off the farm in 1981. The lowest relative rise was in farms that moved from no off-farm work in 1971 to positive off-farm work in 1981. This pointed to a situation in which farm capital was a gross complement to farm labour input. In addition, the 1971 levels of farm capital were inversely related to the extent of off-farm work in 1981, which hints to the existence of life-cycle joint planning of capital investments and off-farm work. Their findings

also showed that those who work off the farm have more years of schooling, whereas farm size and capital stock are inversely related to the extent of off-farm work.

Juvancic and Erjavec (2003) observed that most studies on employment choice typically used cross section data and, thus, implicitly assumed a steady state relationship between the variables of interest. There is, however, a growing consensus that this implicit assumption failed to take sufficiently into account employment decisions of individuals at different points of time (Weiss, 1997). Little econometric work was yet available for labour allocation in transition economies. Nevertheless, due to profound changes in the political and macroeconomic environment, resulting also in intensive adjustment of the agricultural sector, the standard cross-sectional model might be particularly unrealistic for a transition economy like Slovenia. Hence, Juvancic and Erjavec (2003) attempted to test the extent to which an individuals' employment decisions were influenced by their previous employment status (state dependence) and by other reasons and preferences (heterogeneity).

Available empirical findings about intertemporal analysis of employment choice (Nakamura & Nakamura, 1985; Gould & Saupe, 1989; Weiss, 1997; Corsi & Findeis, 2000) agreed that individuals with previous off-farm employment record were more likely to participate on the off-farm labour market than those who had not (and vice versa). However, the authors advocated different assumptions about the influence of individual's previous employment status. As a result, two different sets of empirical specifications were used in econometric analysis of employment decisions.

2.10.2 Econometric representation of human capital model

Building upon the income-generation process inherent in the human capital model for the farm operator, the econometric representation of such a process for the ith (i = 1, é , n) farm household is depicted by the following linear regression model as articulated by El-Osta (2011):

$$\square_{\square} = \square_{\square} + \square^{\square}_{\square\square\square\square\square\square\square\square\square\square} + \square_{\square} \quad (2.25)$$

where *Y* denotes the total income earned by the operator and by all other members of the household from all farm (except for income from farm program payments) and off-farm sources, *Xj* is the *j*th explanatory variable, and Ů is an error term. The income-generation process that underlies the analysis predicts a positive impact of education on the incomes of farm households. To the extent that government payments are excluded from *Y*, this variable is referred to, henceforth, as adjusted farm household income. Conventional methods of inference and prediction based on the linear regression model hinge on the requirement that the basic assumptions of the normality of distributions and the constancy of error variances are being met.

2.10.3 Discriminant function analysis

The discriminant function analysis undertakes a similar task as multiple linear regression by predicting an outcome. Whereas the multiple regression is limited to cases where the dependent variable is measured at an interval level, discriminant analysis is adaptable to cases where the dependent variable is categorical. The assumptions of discriminant analysis are as follows:

i. the observations are a random sample;

ii. each predictor variable is normally distributed;

iii. there must be, at least two groups or categories;

iv. the groups must be defined before the commencement of data collection;

v. the basic assumption is that the variance-co-variance matrices are equivalent;

vi. there should be significant differences between groups on each independent variable using groups means and analysis of variance;

vii. the square of the canonical correlation suggests the proportion of variation in the grouping variable that the function explains, while the Wilksô lambda indicates the proportion of total variability unexplained;

viii. the relative importance of the predictors is obtained using the structure matrix table;

ix. the cut-off point between important and less important predictors is 0.30

x. the attributes used to separate the groups should discriminate quite clearly between the groups, or category overlap is minimal.

The aim of the discriminant analysis is to combine the variable scores in such a way that a single composite variable, the discriminant score, is produced. Discriminant analysis involves the determination of a linear equation that will predict which groups the case belongs to. Implicitly, discriminant analysis is stated as follows:

$$D = v_{1i}x_{1i} + v_{2i}x_{2i} + é \ .+ v_n x_n \quad (2.26)$$

Where:

D = discriminate function,

v = discriminant coefficient,

x = respondentôs score for the variable, implying that the predictors should be weighted,

a = constant, and

i = number of predictor variables.

2.10.4 Entropy measure of diversification

According to Zunckel (2011), entropy is known as a measure of dispersion in a distribution or degree of diversification. Computed as complement of the sum of the squared turnover portions (in %) of all independent ranges of an enterprise, it is assumed that entropy of the probability distribution of the final value of the portfolio is a natural measure of diversification known as weighted entropy (*Ei*). One way to interpret portfolio weights is to

see them as the probability of a randomly chosen currency unit to be invested in a certain asset. One could then argue that the entropy difference between these probabilities and the uniform distribution is a measure of information content and diversification. The corresponding measure is the weighted entropy

$$-\sum_{i} w_i \log(w_i) \qquad (2.27)$$

This measure also has an intriguing sub-division property, which relates the overall entropy to the entropy of sub-portfolios and the weights of the sub-portfolios.

$$E = -\sum w_i \log(w_i) + \sum w_i E_i \qquad (2.28)$$

where w_i are the portfolio weights and E_i are the entropies of the sub-portfolios.

Entropy of diversification is also measured as:

$$\sum_{i} = \sum_{i} \log \frac{1}{} \qquad (2.29)$$

Where:

Zi = proportion of firmôs total sales in line of business *i*

If the firm is exclusively in one line of business, E = 0; the more *Ei* tends to 1, the more diversified is the total enterprise (Sambharya, 2000; Lindgren, Persson & Greeve, 2005; PonArul, 2012).

2.10.5 One-way analysis of variance

One-way analysis of variance (ANOVA) is a parametric statistic which can be used in determining the nature and scope of variances existing within and between three or more samples. The tool is used to determine whether there is any significant difference in a variable applicable to the samples under study. A significant F-ratio suggests the rejection of the null hypothesis (Emaikwu, 2007). Given k-samples with sizes of n_1, n_2, n_3é n_k respectively, the steps involved are as outlined:

i. Evaluate of sample totals (T_1)

ii. Calculate the grand total (T);

iii. Square of sample totals (T_1^2)

iv. Sum of values T_1^2/n_1 and $\Sigma(T_1^2)/n_1$

v. Sum of squares of original x values Σx^2

vi. Calculate SS_T and SS_B

vii. Determine SS_w as a difference between SS_T and SS_B

viii. Determine the value of F-statistics

2.10.6 Multiple regression

Multiple regression analysis provides the opportunity for measuring the effect of numerous independent variables (X_i) on a single dependent variable (Y_i). The implicit form of the model is:

$Y_i = \breve{U}_0 + b_{1i}x_{1i} + b_{2i}x_{2i} + é\ ..+ b_nx_n + ei$ (2.30)

Where:

Y_i = dependent variable

X_i = independent variables

B_i = coefficients of the explanatory variables

2.10.7 Kruskal-Wallis (H)

Kruskal-Wallis (H) is a test of meansô difference among three or more samples when the test variable is measured on ordinal scale. It is a rank-sum test which is used to test the null hypothesis that *k* random samples come from identical populations against the alternative hypothesis that the means of these populations are equal (Udofia, 2006; Emaikwu, 2007). In the Kruskal-Wallis (H) test, the data are ranked jointly from low to high as though they constitute a single sample. The model is based on the statistic H such that:

$$\square = \frac{\square\square}{\square\square\square\square\square}\square\left(\frac{\square^{\square}_{\square}}{\square_{\square}} + \frac{\square^{\square}_{\square}}{\square_{\square}} + \frac{\square^{\square}_{\square}}{\square_{\square}}\right) - \square\square\square + \square\square \quad (2.31)$$

Where:

H = Kruskal-Wallis statistic which approximates to chi-square statistic,

N = sample size,

R = Ranks.

2.10.8 The Gini index

Gini coefficient (G) is generally used to estimate income inequality. The Gini coefficient is usually defined mathematically based on the Lorenz curve, which plots the proportion of the total income of the population (y-axis) that is cumulatively earned by the population represented in x-axis (Figure 2.1). The line at 45 degrees thus represents perfect equality of incomes. The coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve (marked *A* in the diagram) over the total area under the line of equality (marked *A* and *B* in Figure 1) (Sadras & Bongiovanni, 2004; Berg & Ostry, 2011). Thus G is a ratio of A to (A + B).

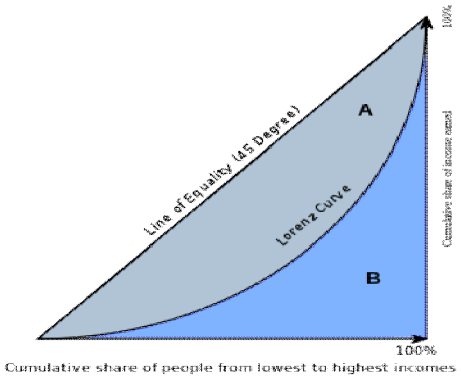

Figure 2.1: Lorenz Curve representation of Gini coefficient

Assuming every member of the population obtains non-negative income, the Gini coefficient theoretically ranges from 0 to 1. It is sometimes expressed as a percentage ranging between 0 and 100. In practice, both extreme values are not quite reached. If negative values are possible (such as the negative wealth of people with debts), then the Gini coefficient could

theoretically be more than 1. Normally the mean (or total) is assumed positive, which rules out a Gini coefficient less than zero. A low Gini coefficient (< 0.5) indicates a more equal distribution, with 0 corresponding to complete equality, while higher Gini coefficients (Ó0.5) indicate more unequal distribution, with 1 corresponding to complete inequality (Bellù & Liberati, 2006; Hillebrand, 2009).

When decomposed into different components and correlated with income distribution, the decomposition form of Gini coefficient shows the contribution of sources of income to overall income stability or inequality, where the correlation coefficients do not differ significantly. In this study, the overall Gini coefficient will be decomposed into five components corresponding with off-farm income employments and two farm incomes sources including crop and livestock enterprises. In line with the notation of Shorrocks (1983), it is assumed that total income (*Y*) consists of income from *k* sources, namely, $y_1, y_2, \ldots\ldots, y_k$. Total income *Y* is thus given as:

$$Y = \sum_{k=1}^{n} y_k \qquad (2.32)$$

The Gini coefficient of total income (*G*) is expressed as:

$$G = \sum_{k=1}^{n} S_k G_k R_k \qquad (2.33)$$

Where:

G = Gini coefficient,

S_k = share of income source k in total income,

G_k = Gini coefficient of income from source k,

R_k = correlation coefficient between income from source k and total income Y.

G_kR_k = pseudo-Gini coefficient of income source k.

The contribution of income source *k* to total income inequality is given as:

$\frac{\square_{\square}\square_{\square}\square_{\square}}{\square}$, (2.34)

while the relative concentration coefficient of income source *k* in total income inequality is expressed as:

$\square_{\square} = \frac{\square_{\square}\square_{\square}}{\square} \leq \square$ (2.35)

Equation (2.35) implies that income sources that have a relative concentration coefficient greater than one contribute to increasing total inequality, while those with a relative concentration coefficient less than one contribute to decreasing total inequality, invariably farm household income stability. The source elasticity of inequality, indicating the percentage effect of a 1% change in income from source *k* on the overall Gini coefficient, is expressed as:

$\frac{\square_{\square}\square_{\square}\square_{\square}}{\square} - \square_{\square}$ (2.36)

2.10.9 Farm efficiency

2.10.9.1 Technical efficiency function

The technical efficiency function for this study will be developed after the work of Bojnec and Ferto (2011), using stochastic frontier function. The implicit form of the technical efficiency function is stated as follows:

$Yi = f(x_i)\exp(v_i - u_i)$ (2.37)

The logarithmic form is:

$\ln Y_i = \beta x_1 + (v_i - u_i)$ (2.38)

Where:

Yi = output of i_{th} farm firm,

Xi = vector of inputs used in the production process,

vi = pure random error term,

ui = non-negative error term denoting systematic departures from the frontier, and

ϐ = vector of parameters to be estimated.

The output orientated technical efficiency (TE) is actually the ratio between the observed output of farm firm *i* to the frontier, i.e. the maximum possible output using the same input mix *xi*. Arithmetically, technical efficiency is equivalent to:

$$TE = \frac{y_i}{y_i^*} = \frac{\text{observed output of farm firm } i}{\text{maximum possible output of farm firm } i} = \exp(-u_i),\ u \geq 0 \quad (2.39)$$

Contrary to the non-parametric Data Envelopment Analysis (DEA) approach, where all production TE scores are located on, or below the frontier, in Stochastic Frontier Analysis, they are allowed to be above the frontier, if the random error *v* is larger than the non-negative *u*. Applying the Stochastic Frontier Analysis methods requires distributional and functional form assumptions. First, because only the $w_i = v_i - u_i$ error term can be observed, one needs to have specific assumptions about the distribution of the composing error terms. The random term *vi*, is usually assumed to be identically and independently distributed and drawn from the normal distribution, independent of *ui*. The production function coefficients (ϐ) and the inefficiency model parameters (ŭ) will be estimated by maximum likelihood together with the variance parameters:

$$\sigma_s^2 = \sigma_v^2 + \sigma_u^2 \quad \gamma = \frac{\sigma_u^2}{\sigma_s^2} \quad (2.40)$$

Technical efficiency either increases (ɖ>0), decreases (ɖ<0) or it is constant over time, i.e. invariant (ɖ=0).

2.10.9.2 Profit efficiency function

The stochastic profit frontier for this study will be patterned after the works of Ali and Flinn (1989), Ali, Parikh, and Shah (1994), Adesina and Djato (1996), Berger and Mester (1997), Maudos, Pastor, Perez and Quesada (2002) and Kolawole (2006). The standard profit function assumes that markets for outputs and inputs are perfectly competitive. Given the

input (W) and output price vectors (P), the firm maximizes profits by adjusting the amount of inputs and output. Thus, the profit function can be expressed implicitly as:

´ = f(P,W;V,U) (2.41)

In logarithms terms, the function is specified as:

ln (´ + d)lnf(P,W) + (V ï U) (2.42)

Where:

d = a constant added to the profit of each enterprise in order to attain positive values, so that the factors could be treated logarithmically. The exogenous nature of prices in this concept of profit efficiency assumes that there is no market power on the farmersô side. If instead of taking price as given, the farmers assume the possibility of imperfect competition, given only the output vector and not that of price. Thus, alternative profit function is:

´ = f(Y,W,V,U) (2.43)

in which the quantity of output (Y) produced replaces the price of output (P) in the standard profit function. Profit efficiency in this study is defined as profit gain from operating on the profit frontier, taking into consideration farm-specific prices and factors. The actual normalized profit function, which is assumed to be well behaved, could be derived as:

Farm profit is measured in terms of Gross Margin (GM) which equals the difference between the Total Revenue (TR) and Total Variable Cost (TVC).

GM(´) = Ł(TR ï TVC) = Ł(PQ ï Wx_i) (2.44)

To normalize the profit function, gross margin is divided on both sides of the equation above by *P,* which is the market price of the output of an enterprise. Thus:

$$\frac{\pi^*(P,W)}{P} = \frac{\pi(P,W)}{P} = \frac{TR - TVC}{P} = Q - \sum_{i=1}^{n} x_i \frac{W_i}{P} \quad (2.45)$$

Where:

TR = total revenue,

TVC = total variable cost,

P = price of output (Q),

X = the quantity of optimized input used,

Z = price of fixed inputs used,

P_i = W/P which represents normalized price of input Xi,

f(Xi,Z) = production function.

As prescribed by Meeusen and van den Broeck (1997), the Cobb-Douglas profit function, in implicit form, which specifies production efficiency of the farmers is expressed as follows:

$\pi_i = f(p_i,z)\exp(V_i - U_i),\ i = 1,2,\ldots n$ (2.46)

The *Vis* are assumed to be independent and identically distributed random errors, having normal $N(0,\sigma^2 v)$ distribution, independent of the *Uis*. The *Uis* are profit inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution $N(0,\sigma^2 v)$

The profit efficiency is expressed as the ratio of predicted actual profit to the predicted maximum profit for a best-practiced operator. This is represented as:

$$Profit\ efficiency\ (E_\pi) = \frac{\pi}{\pi^{max}} = \frac{f(p_i,z)\exp(V_i - U_i)}{f(p_i,z)\exp(V_i)} \quad (2.47)$$

Firm specific profit efficiency is also the mean of the conditional distribution of *Ui,* which is given by

$$E_n = E\left[\frac{\exp(-U_i)}{\varepsilon_i}\right] \quad (2.48)$$

E_n takes the value between 0 and 1. If $U_i = 0$ (on the frontier), potential maximum profit is obtainable, given the price it faces and the level of fixed factors and is, thus, efficient. If $U_i > 0$, the farm firm is inefficient, losing profit as a result of inefficiency. In this study, Battese and Coelli (1995) and Coelli and Batesse (1996) models were used to specify the stochastic frontier function with behaviour inefficiency components and to estimate all parameters together in one-step maximum likelihood estimation. Socio-economic variables will be

included in the model to indicate their possible effect on the efficiency of the farmers. The variance of the random errors, $\mathring{u}^2v$ that of the inefficiency effect $\mathring{u}^2u$ and overall variance of the model $\mathring{u}^2$ will measure the total variation from the frontier which would be attributed to inefficiency. The parameter ɔ represents the share of inefficiency in the overall residual variance with values in interval 0 and 1. A value of 1 suggests the existence of a deterministic frontier, whereas a value of 0 will be seen as evidence in the favour of OLS estimation (Coelli, 1996; Ajibefun & Daramola, 1998; Ajibefun, Battese, & Daramola, 2002; Wang & Wailes, 1996; Wang, 2002).

2.10.9.3 Cost efficiency function

Tauer and Mishra (2005) decomposed the total unit cost curve into frontier and efficiency components since there may be determinants not associated with fixed cost which may impact the frontier cost and cost efficiency. This is because most producers would like to minimise total cost per unit in a competitive market, regardless of whether those costs are variable or fixed. Separately, the fixed cost of production could be estimated, decomposed into frontier and efficiency components to determine factors impacting fixed cost of production. An average or total or fixed cost curve for a farm is estimated as a function of a covariate set *Xi*, an error term *vi*, and an efficiency term *u*,

ci = f(Xi,ƃ) + vi + u(Zi,ŭ), u(Zi,ŭ)Ó0, (2.49)

Where:

ci = cost of production for farm i,

Xs = covariates which impact costs, and

vi = error term, which is independent of *Xi*, *Zi* and *u*.

The efficiency term, *u*, is specified as a function of a set of covariates *Zi*, which may overlap with the covariate set *Xi*. The β vector is the coefficients for the frontier cost curve, while the δ vector is the coefficients for the efficiency cost curve. The error term, *vi*, is modeled as a

normal distribution, N (0,ů2), while the efficiency term, *u*, is modeled as a truncated positive half-normal distribution specified as N+ (g(Zi), ů2). This allows the error term for an individual farm observation to be either negative or positive, but the efficiency term *u*, which would be equal to or greater than zero, would shift with covariates *Zi*. It follows that a change in those variables would impact cost in two ways ï shift in the frontier curve or change in efficiency. The impact from the frontier cost curve is the first derivative of the frontier cost curve with respect to the variable *xk* as:

Ötf(Xi,ƀ)/Öxk (2.50)

(Aigner, Lovell, & Schmidt, 1977; Wang, 2002; Wang & Schmidt, 2002).

2.10.10 Simultaneous equation

The central issue is to determine the interrelationship between off-farm reliance and farm capital accumulation. The model specification follows Maddala (1983) in Gilligan (2012) for a simultaneous equation model state in continuous dependent variables. In order to allow for the endogeneity of off-farm income in the formation of farm capital as well as the endogeneity of farm capital in the off-farm income model, a two-step maximum likelihood procedure was applied. In this process, an instrumental variable ï residuals ï were generated from the first step and used as an explanatory variable in the second step.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in the North Central geo-political region of Nigeria. The region comprised six states, namely, Benue, Kogi, Nasarawa, Plateau, Kwara and Niger, with a total land mass of 296,898 km^2 and total population of 20.36 million people. The region is bounded in the north by Bauchi, Kaduna, Zamfara, and Kebbi States; in the south by Cross-River, Ebonyi, Enugu, Edo, Ondo, Ekiti, Osun and Oyo States; in the east by Taraba State and Cameroon; and in the west by the Republic of Benin. Situated between latitudes $6^0$30ò N and $11^0$20ò N and longitudes 7^0E and 10^0 E, the region has average annual rainfall that ranges from 1,500 mm to 1,800 mm, with average annual temperature varying between 20^0C and 35^0C. North Central Nigeria has 6.6 million hectares of land under cultivation, with rain-fed agriculture accounting for about 90 percent of the production systems (National Bureau of Statistics, 2008). Majority of the populace are in agriculture, with farm size ranging from 0.4 to 4.0 ha (Food and Agriculture Organisation, 2002; National Food Reserve Agency, 2008).

The region features prominently in national agricultural production statistics. For instance, Benue and Kogi States were among the states of the federation that cultivated over 200,000 ha of cassava in 2007, with over two million metric tonnes of cassava output. For yam, Benue and Niger States cultivated over 200,000 ha and harvested over two million metric tonnes. Niger State was among the states that cultivated over 300,000 ha of maize and sorghum, with output of over 400,000 metric tonnes. Niger, Benue and Kwara States were among the states that cultivated over 100,000 ha of rice with an output of over 200,000 metric tonnes. For legumes (cowpea, soyabean, bambara nut, and sesame), Niger, Benue and Kogi States ranked among the highest producers in the country (National Food Reserve Agency, 2008).

3.2 Sampling Technique and Sample Size

With survey design approach, multistage sampling technique was used to select respondents for the study. In stage one, Benue, Kogi and Niger States were randomly selected from the region. In stage two, two agricultural zones were randomly selected from each state namely, zones A and C from Benue State, zones B and D from Kogi State, and zones A and B from Niger State. In stage three, two local government areas (LGAs) were randomly selected from each agricultural zone. In Benue State, the LGAs were Ukum and Katsina-Ala from zone A, and Otukpo and Oju from zone C. In Kogi State, the LGAs were Dekina and Bassa from zone B, and Ofu and Olamaboro from zone D. In Niger State, the LGAs were Shirorro and Paikoro from zone A, and Gbako and Lavun from zone B. In stage four, three farming communities were randomly selected from each LGA. Finally, 10 small-scale farmers (five participants and non-participants in off-farm work) were randomly selected from each farming community giving a total sample size of 360 respondents (Table 3.1).

3.3 Data Collection

Data for the study were collected from primary source with the aid of structured and pretested questionnaire designed in a way to elicit responses or generate data that would adequately achieve the objectives and hypotheses of the study. Examples of data that were collected included socioeconomic characteristics of the respondents, types of off-farm enterprises, labour allocation to off-farm activities, productivity, off-farm income, data on off-farm diversification, quantities and costs of farm inputs, and farm capital among others. Data were also collected on the productivity of several crops.

Analysis, however, focused on yam, cowpea and rice. The reason was that there were the crops which were common to all the farmers.

Table 3.1: Sampling Plan and Sample Size

S/No	State	Zone	LGA	Farming community	Number of respondents
1	Benue	Zone A	Ukum	Ukuka	10
				Tse-Mom	10
				Agune	10
			Katsina-Ala	Ataka	10
				Ukungu	10
				Tse-Anwange	10
		Zone C	Otukpo	Akpa	10
				Obotu	10
				Adoka-Icho	10
			Oju	Oboru-Oye	10
				Okpokpo	10
				Oju central	10
2	Kogi	Zone B	Dekina	Anyigba	10
				Agbegi	10
				Dekina town	10
			Bassa	Agodo	10
				Nyampo	10
				Gboloko	10
		Zone D	Ofu	Ofoke	10
				Aloji	10
				Ejule	10
			Olamaboro	Imane	10
				Okpo	10
				Ogugu	10
3	Niger	Zone A	Shirorro	Daza	10
				Fuka	10
				Guduma	10
			Paikoro	Adunu	10
				Ishau	10
				Amale	10
		Zone B	Gbako	Kedigi	10
				Edozhigi	10
				Ndagi-Ladan	10
			Lavun	Sachi	10
				Kotungi	10
				Chanchaga	10
Total		6	12	36	360

3.3.1 Validity and reliability of instrument

Content validity was used to determine the adequacy and relevance of the instrument. In the process, the instrument was thoroughly examined by appropriate experts independently. The experts gave their critical opinions on the adequacy and relevance of the instrument to the objectives and hypotheses for the study. The observations were harmonized and necessary corrections effected on the instrument before the field survey commenced. This was done in line with the recommendations of Kerlinger (1973).

Test-retest method was used to ascertain the reliability of the instrument. In this method, five copies of the research instrument were administered to the respondents at two weeksô intervals. Pearson Product Moment Correlation coefficient (r_{xy}) was then used to test the ability of the instrument to measure the same thing over time. In the test, the results of critical parameters of some tests were subjected to bivariate correlation analysis. The result showed that the correlation coefficient was 0.87, and this was significant at the 0.01 level (2-tailed). Thus, the research instrument for this study was adjudged highly reliable. Afterwards, the full scale data collection was embarked upon.

3.4 Data Analysis

Data for the study were analysed with descriptive and inferential statistics. These statistical tools were specified as follows.

3.4.1 Descriptive statistics

Objectives i, ii and vii were realised with descriptive statistics such as frequency distribution, mean and standard deviation.

3.4.2 Discriminant function analysis

Objective iii was achieved with the use of multiple discriminant function analysis. The model was specified as follows:

$$D = v_1 X_1 + v_2 X_2 + \cdots + v_{16} X_{16} + a$$

(3.1)

Where:

D = discriminate function; the groups were agricultural wage employment, non-agricultural wage employment, and self-employment (off-farm work typology),

v = discriminant coefficient or weight for the variable,

X_1 = respondentôs score for fund for farm investment,

X_2 = respondentôs score for fund for household needs,

X_3 = respondentôs score for hospital,

X_4 = respondentôs score for pipe borne water,

X_5 = respondentôs score for inadequate farm land,

X_6 = respondentôs score for drought,

X_7 = respondentôs score for crop failure,

X_8 = respondentôs score for electricity,

X_9 = respondentôs score for tarred road,

X_{10} = respondentôs score for market,

X_{11} = respondentôs score for increased household,

X_{12} = respondentôs score for inefficient input market,

X_{13} = respondentôs score for unstable farm income,

X_{14} = respondentôs score for poor produce price,

X_{15} = respondentôs score for risky farm production,

X_{16} = respondentôs score for farmland ownership,

X_{17} = respondentôs score for government payment,

X_{18} = respondentôs score for credit market,

X_{19} = respondentôs score for inadequate farm income,

X_{20} = respondentôs score for higher off-farm income,

X_{21} = respondentôs score for main occupation,

X_{22} = respondentôs score for shares received, and

a = constant.

3.4.3 Entropy measure

Objective iv was achieved with the use of entropy index of diversification (D_E) as indicated by Mishra and El-Osta (2002), Weiss and Briglauer (2002) and McNamara and Weiss (2005). The model is specified as follows:

$$\square_{\square} = \sum_{\square\square\square}^{\square} \square_{\square} \square\square\square \square\frac{\square}{\square_{\square}}\square \quad (3.2)$$

Where:

D_E = entropy index of diversification, the value of which ranges from 0 to 1,

S_j = proportion of firmôs income, and

n = total number of off-farm firms.

The iterative procedure for computing D_E was developed as follows:

Income of the firm, *qi*, i = 1,2,3,é .,180 (3.3)

Summation of *qi* for the industry (farm household), Q_i = q1 + q2 +é .+ q17 (3.4)

Proportion of firmôs income $\square_{\square} = \frac{\square_{\square}}{\square}$ (3.5)

Reciprocal of S_j, $\frac{\square}{\square_{\square}} = \square \div \frac{\square_{\square}}{\square} = \frac{\square}{\square_{\square}}$ (3.6)

Logarithm of reciprocal of S_j, $\square\square\square\ \square\frac{\square}{\square_{\square}}\square$ (3.7)

Entropy index for the i^{th} household, $D_{Ei} = P_i \times \log \frac{P_i}{Q_i}$ (3.8)

Overall entropy index, $D_E = D_{E1} + D_{E2} + \text{é} .+ D_{E180}$ (3.9)

3.4.4 Multiple regression

Multiple regression analysis was used to realise objective v. Three functional forms were fitted to the model namely, linear, quadratic and double-log. The choice of the lead equation was based on econometric criteria such as highest coefficient of determination (R^2), largest F-statistic, more significant independent variables, and more favourable variance inflation factor (VIF) for the explanatory variables. Variance inflation factor is measure of the presence of multicollinearity among the explanatory variables, where VIF > 10 indicates the presence of multicollinearity. The models were specified as follows:

Linear function

$$Y = b_0 + b_1x_1 + b_2x_2 + e_i \quad (3.10)$$

Quadratic function

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_1^2 + b_4 x_2^2 + e_i \quad (3.11)$$

Double-log function

$$\log y = b_0 + b_1\log x_1 + b_2\log x_2 + e_i \quad (3.12)$$

Where:

Y = labour supply to farm work (mandays),

X_1 = farm income (₦), and

X_2 = off-farm income (₦).

3.4.5 One-way analysis of variance

Descriptive statistics and one-way analysis of variance were used to attain objective vi. In the model, the dependent variable was off-farm income and the factor was off-farm work

typology namely, agricultural wage employment, non-agricultural wage employment, and self-employment.

3.4.6 Gini coefficient

Objective viii was realised using Gini coefficient decomposition. The iterative procedure for computing Gini coefficient was developed by Bellù & Liberati (2006). In line with Iheanacho & Mshelia (2004), Gini coefficient was specified as follows:

GC = 1 ï ÆXY (3.13)

Where:

GC = Gini coefficient (GC Ó 0.5 indicates inequality in farm capital, while GC < 0.5 indicates equality in farm capital among the respondents),

X = percentage of farmers based on farm capital classes, and

Y = cumulative percentage of farmersô farm capital.

3.4.7 Causality test

Causality test was used to realise objective ix. This was done with the aid of simultaneous equations, specified in line with Besley (1995) and Twerefou, Osei-Assibey and Agyire-Tettey (2011). The first equation was used to determine the effect of farm capital on farm income. In the second-stage equation, the generated residual from the first equation was used as an explanatory variable. The significance of the coefficient of off-farm incomeôs share residual (*k*) indicated the presence of simultaneity bias. The models are presented as follows:

The off-farm share model:

$y_{1i} = Ŭ + ɓ_i y_{2i} + e_i$ (3.14)

The farm capital model was stated as:

$y_{2i} = Ŭ + ɓ_i y_{1i} + ke_i + e_{2i}$ (3.15)

Where:

y_{1i} = off-farm incomeôs share of farm household income,

y_{2i} = farm capital represented by the value of farm assets or total farm investment,

e_i = off-farm income's share residuals, and

k = coefficient of off-farm income's share residuals.

3.4.8 Test of means' difference

Objective x was achieved using test of means' difference which is specified as follows:

$$\square = \frac{\square_{\square}\square\square_{\square}}{\square\sqrt{\frac{\square\square_{\square}^{2}}{\square\square_{\square}}+\frac{\square\square_{\square}^{2}}{\square\square_{\square}}}} \qquad (3.16)$$

$\square = \square - \square\square\square\square\square\square\square\square$

X_1 = farm capital of participating farm households (₦),

X_2 = farm capital of non-participating farm households (₦),

$\square\square_{\square}^{2}$ = standard deviation of participating farm households,

$\square\square_{\square}^{2}$ = standard deviation of non-participating farm households,

NX_1 = sample size of participating farm households, and

NX_2 = sample size of non-participating farm households.

3.4.9 Financial measures and ratios

Financial measures and ratios were used to attain objective xi. The ratios were estimated as:

Total farm revenue (TFR) = crop revenue + livestock revenue (sold and unsold) (₦),

Total variable cost (TVC) = cost of inputs used in farm production (₦),

Total fixed cost (TFC) = cost of capital inputs + cost of machineries (₦),

Gross margin (GM) = Total Revenue ï Total variable cost (₦),

Farm capital (asset) = original value of all farm machineries, equipments, implements, and tools less depreciation + total farm revenue (₦) (Mokyr, 2003),

Farm liabilities = all claims against the farm (₦),

Net worth = total farm asset ï total farm liabilities (₦),

Depreciation was calculated using straight line method as follows:

$$D = \frac{P - S}{n} \quad (3.17)$$

Where:

D = depreciation,

P = purchase price (₦),

S = in line with Pebrian and Yahaya (2012), salvage value (₦) was determined as the ratio of purchase price to useful life of asset, and

n = useful life of asset (years).

[illegible] (3.18)

[illegible] (3.19)

[illegible] (3.20)

[illegible] (3.21)

(Arene, 2002; Nelson, 2011).

3.4.10 Stochastic frontier analysis

Objective xii was realised using the Cobb-Douglas functional form of the stochastic frontier analysis for technical, cost, and profit efficiency functions.

3.4.10.1 Empirical model for technical efficiency

The technical efficiency was run for three different major crops produced by small-scale farmers in the study area. The explicit Cobb-Douglas functional form of the stochastic frontier analysis for estimating technical efficiency for yam, cowpea and rice, was specified as follows:

$$\ln y = \ln\beta_0 + \beta_1\ln X_1 + \beta_2\ln X_2 + \beta_3\ln X_3 + \beta_4\ln X_4 + \beta_5\ln X_5 + \beta_6\ln X_6 + \beta_7\ln X_7 + \beta_8\ln X_8 + \beta_9\ln X_9 + \beta_{10}\ln X_{10} + (v_i + u_i) \quad (3.22)$$

Where:

Y = total output (tons),

x_1 = farm size (ha),

x_2 = farm family labour (man-days),

x_3 = hired farm labour (man-days),

x_4 = farm income (₦),

x_5 = fertiliser (kg),

x_6 = seed (kg),

x_7 = herbicide (l),

x_8 = pesticide (l),

x_9 = depreciation (₦),

x_{10} = capital input (₦),

i = farmer 1, 2, é 360, and

j = farm enterprise 1, 2, 3, 4 and 5.

The technical inefficiency model (*Ui*) was defined by:

$$Ui = ŭ_0 + ŭ_1z_1 + ŭ_2z_2 + ŭ_3z_3 + ŭ_4z_4 + ŭ_5z_5 + ŭ_6z_6 + ŭ_7z_7 + ŭ_8z_8 + (v_i - u_i) \quad (3.23)$$

Where:

z_1 = age (years),

z_2 = sex (1 = male, 0 = female),

z_3 = formal education (years),

z_4 = household size,

z_5 = farming experience (years),

z_6 = amount of credit obtained (₦),

z_7 = number of times visited by extension agent, and

z_8 = membership of farm association (1 = member, 0 otherwise).

3.4.10.2 Empirical model for cost efficiency

Following the works of Tauer and Mishra (2005), Okoye and Onyenweaku (2007) and Kim, Brorsen and Kenkel (2008), the stochastic cost frontier, using Cobb-Douglas cost functional form, was specified as follows:

$$\ln C = \ln ƃ_0 + ƃ_1 \ln X_1 + ƃ_2 \ln X_2 + ƃ_3 \ln X_3 + ƃ_4 \ln Y^* + ƃ_5 \ln X_5 + ƃ_6 \ln X_6 + (v_i + u_i) \quad (3.24)$$

Where:
lnC = farm firm cost (₦),

x_1 = farm size (ha),

x_2 = average input price of enterprise 1 (₦),

x_3 = average input price of enterprise 2 (₦),

x_4 = average input price of enterprise 3 (₦),

Y* = average output (tonnes),

X_6 = depreciation of farm assets (₦), and

The inefficiency model (*Ui*) for the stochastic cost frontier was defined by:

$$Ui = \delta_0 + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \delta_4 z_4 + \delta_5 z_5 + \delta_6 z_6 + \delta_7 z_7 + \delta_8 z_8 + \delta_9 z_9 + \delta_{10} z_{10} + (v_i - u_i) \quad (3.25)$$

Where:

z_1 = age (years),

z_2 = sex (1 = male, 0 = female),

z_3 = formal education (years),

z_4 = household size,

z_5 = farming experience (years),

z_6 = farm income (₦),

z_7 = farm labour (man days),

z_8 = amount of credit obtained (₦),

z_9 = number of times visited by extension agent, and

z_{10} = membership of farm association (1 = member, 0 otherwise).

3.5.10.3 Empirical model for profit efficiency

In line with Effiong and Onyenweaku (2006) and Nganga, Kungu, de Ridder and Herrero (2010), the stochastic profit frontier, using Cobb-Douglas functional form, was specified as follows:

$$\ln\acute{} = \ln\beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + (v_i + u_i) \quad (3.26)$$

Where:

´ = gross margin (₦),

x_1 = farm size (ha),

x_2 = average cost of hired farm labour (₦),

x_3 = average price per kg of fertilizer (₦),

x_4 = average price per kg of seed (₦),

x_5 = price per litre of agrochemical (₦),

x_6 = average price of farm tools/machineries (₦),

x_7 = average marketing cost (₦),

x_8 = average transportation cost (₦), and

x_9 = capital input (₦).

The inefficiency model (*Ui*) for the stochastic profit frontier was defined by:

$$U_i = \breve{u}_0 + \breve{u}_1 z_1 + \breve{u}_2 z_2 + \breve{u}_3 z_3 + \breve{u}_4 z_4 + \breve{u}_5 z_5 + \breve{u}_6 z_6 + \breve{u}_7 z_7 + \breve{u}_8 z_8 + \breve{u}_9 z_9 + (v_i - u_i) \quad (3.27)$$

Where:

z_1 = age (years),

z_2 = sex (1 = male, 0 = female),

z_3 = formal education (years),

z_4 = household size,

z_5 = farming experience (years),

z_6 = farm labour (man days),

z_7 = amount of credit obtained (₦),

z_8 = number of times visited by extension agent, and

z_9 = membership of farm association (1 = member, 0 otherwise).

The hypotheses for the study were tested with the following statistical tools:

3.4.11 Heckman's two-stage selection model

Heckmanôs two-stage selection model was used to test hypothesis i. The model had two dependent variables ï the dichotomous (y_1) and continuous (y_2). The specification was as follows:

$$Y^* = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + b_{15}x_{15} + b_{16}x_{16} + e_i \quad (3.28)$$

$Y^* = Y_1$ and Y_2,

Y_1 = probability of investment decision (1 = invested, 0 = otherwise),

Y_2 = amount of investment of off-farm incomeôs share of household income (₦),

X_1 = age of farmer (years),

X_2 = sex of household head (1 = male; 2 = female),

X_3 = education of farmer (number of years spent in formal educational institutions),

X_4 = household size (number of people in a farm household),

X_5 = farming experience (years),

X_6 = total farm size (ha),

X_7 = total crop revenue (₦),

X_8 = distance to market (km),

X_9 = primary occupation (1 = farming; 0 = otherwise),

X_{10} = land ownership (1 = own farm land; 2 = otherwise),

X_{11} = government payment (₦),

X_{12} = ratio of farm assets to household assets,

X_{13} = operating profit margin,

X_{14} = asset turnover ratio,

X_{15} = capital input (₦),

X_{16} = farm capital (₦).

ɓ = coefficient of explanatory variables.

3.4.12 F-statistic

Hypothesis ii was tested with the F-statistic of different functional forms of multiple regression analysis such as linear, quadratic, and double logarithm functional forms. The explicit forms were specified as follows:

3.4.12.1 Linear function

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + b_{15}x_{15} + b_{16}x_{16} + b_{17}x_{17} + b_{18}x_{18} + b_{19}x_{19} + b_{20}x_{20} + e_i \quad (3.29)$$

3.4.12.2 Quadratic function

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + b_{15}x_{15} + b_{16}x_{16} + b_{17}x_{17} + b_{18}x_{18} + b_{19}x_{19} + b_{20}x_{20} + b_{21}x_1^2 + b_{22}x_2^2 + b_{23}x_3^2 + b_{24}x_4^2 + b_{25}x_5^2 + b_{26}x_6^2 + b_{27}x_7^2 + b_{28}x_8^2 + b_{29}x_9^2 + b_{30}x_{10}^2 + b_{31}x_{11}^2 + b_{32}x_{12}^2 + b_{33}x_{13}^2 + b_{34}x_{14}^2 + b_{35}x_{15}^2 + b_{36}x_{16}^2 + b_{37}x_{17}^2 + b_{38}x_{18}^2 + b_{39}x_{19}^2 + b_{40}x_{20}^2 + e_i \quad (3.30)$$

3.4.12.3 Double-log function

$$\log y = b_0 + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + b_7\log x_7 + b_8\log x_8 + b_9\log x_9 + b_{10}\log x_{10} + b_{11}\log x_{11} + b_{12}\log x_{12} + b_{13}\log x_{13} + b_{14}\log x_{14} + b_{15}\log x_{15} + b_{16}\log x_{16} + b_{17}\log x_{17} + b_{18}\log x_{18} + b_{19}\log x_{19} + b_{20}\log x_{20} + e_i \quad (3.31)$$

Where:

Y = off-farm diversification (D_E),

X_1 = age (years),

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

X_3 = primary occupation (1 = farming, 0 otherwise),

X_4 = farmer association,

X_5 = (number of years of formal education),

X_6 = number of male adults in the household,

X_7 = number of female adults in the household,

X_8 = number of children in the household,

X_9 = farm size (ha),

X_{10} = farming experience (years),

X_{11} = off-farm work experience (years),

X_{12} = distance to market (km),

X_{13} = credit market (amount of credit obtained for farming in ₦),

X_{14} = off-farm work hours,

X_{15} = on-farm work hours,

X_{16} = leisure hours,

X_{17} = farmland ownership (1 = own farmland, 0 otherwise),

X_{18} = number of available infrastructures,

X_{19} = farm asset current value (₦),

X_{20} = Crop income (₦), and

ϐ = coefficient of explanatory variables.

3.4.13 One-way analysis of variance

One-way analysis of variance was used to test hypothesis iii. In the model, the dependent variable was farm capital and the factor was off-farm work typology namely, agricultural wage employment, non-agricultural wage employment, and self-employment.

3.4.14 Pearson product moment correlation

The Pearson Product Moment correlation coefficient, which was used to test hypothesis iv, was specified as follows:

$$r = \frac{\text{covariance of } x \text{ and } y}{\text{standard deviation of } x \times \text{standard deviation of } y} \quad (3.32)$$

Where:

X = off-farm incomeôs share (₦), and

Y = farm capital (₦).

3.4.15 Kruskal-Wallis

Hypothesis v was tested with Kruskal-Wallis (H) analytical tool. It was specified as follows:

$$H = \frac{12}{N(N+1)}\left(\frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \frac{R_3^2}{n_3} + \frac{R_4^2}{n_4}\right) - 3(N+1) \quad (3.33)$$

Where:

H = Kruskal-Wallis statistic,

N = total sample size,

n_1 and R_1 = sample size and mean rank of decision to participate in off-farm work by farmers in the first quartile (less than 25% of total farm capital),

n_2 and R_2 = sample size and mean rank of decision to participate in off-farm work by farmers in the second quartile (25% to 50% of total farm capital),

n_3 and R_3 = sample size and mean rank of decision to participate in off-farm work by farmers in the third quartile (51% to 75% of total farm capital), and

n_4 and R_4 = sample size mean rank of decision to participate in off-farm work by farmers in the fourth quartile (76% to 100% of total farm capital).

3.4.16 Test of means' difference

Hypotheses vi and vii were tested using test of meansô difference. It was specified as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (3.34)$$

Where:

For hypothesis vi,

X_1 = farm capital of male-headed household (₦),

X_2 = farm capital of female-headed household (₦),

S_{x_1} = standard deviation of farm capital of male-headed household,

S_{x_2} = standard deviation of farm capital of female-headed household,

NX_1 = sample size of male-headed household, and

NX_2 = sample size of female-headed household.

For hypothesis vii,

t = t-statistic,

X_1 = farm efficiency estimates of participating farm households (₦),

X_2 = farm efficiency estimates of non-participating farm households (₦),

S_{x_1} = standard deviation of farm efficiency estimates of participating farm households,

S_{x_2} = standard deviation of farm efficiency estimates of non-participating farm households,

NX_1 = sample size of participating farm households, and

NX_2 = sample size of non-participating farm households.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Characteristics of Off-Farm Work in relation to main Typology

The characteristics of off-farm work according to main typology are presented in Table 4.1. The main typology of off-farm work included agricultural wage employment, non-agricultural wage employment, and self-employment. The characteristics examined were household members in off-farm work, off-farm work pattern, and off-farm work specification.

4.1.1 Main typology of off-farm work

In Table 4.1, findings showed that many of the respondents (42.78%) were in self-employment category of off-farm work. Self-employment activities in rural areas were non-farm in nature and generated steadier income; they did not require high technical competence. It is, thus, appropriate that, due to low level of literacy in rural areas (Olusola & Adenegan, 2011), most respondents were in this off-farm work typology. Participation in off-farm work was necessary so as to insure against agricultural production risks. This finding is in line with Babatunde *et al.* (2010) that most small-holder farm households (49.5%) were in self-employment category of off-farm work.

4.1.2 Household members in off-farm work

The result in Table 4.1 showed that households where only the husband (40.0%), combination of husband and wife (71.4%), matured children (71.4%), and the combination of husband, wife and matured children (45.8%) participated in off-farm work were predominantly in self-employment category. Households, where only the wife worked off-farm, were dominant in agricultural wage employment (51.6%). These results showed that men participated less in core agricultural activities than women. This participation pattern was further supported by the fact that while men searched for income to lower variability in

farm household income, women were more concerned about household chores and food production.

Table 4.1: Characteristics of off-farm work according to main typology (n=180)

Characteristics	Agricultural Wage Employment		Non-agricultural Wage Employment		Self-employment		Total Frequency
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Typology	60	33.33	43	23.89	77	42.78	180
Household member in off-farm work							
Husband	25	26.3	32	33.7	38	40.0	95
Wife	16	51.6	3	9.7	12	38.7	31
Husband and wife	2	28.6	0	0.00	5	71.4	7
Mature children	2	28.6	0	0.00	5	71.4	7
All members	9	37.5	4	16.7	11	45.8	24
Off-farm work pattern							
Full-time	9	23.1	15	38.5	15	38.4	39
Part-time	45	31.9	34	24.1	62	44.0	141
Years of off-farm work							
2 ï 7	15	29.4	16	31.4	20	39.2	51
8 ï 13	23	34.3	12	17.9	32	47.8	67
14 ï 19	5	17.2	8	27.6	16	55.2	29
20 ï 25	9	45.0	4	20.0	7	35.0	20
26 ï 33	8	61.5	3	23.1	2	15.4	13
Off-farm work specification							
Private sector	13	20.0	6	9.2	46	70.8	65
Salon work	-	-	-	-	4	100.00	4
Carpentry	7	18.9	19	51.4	11	29.7	37
Civil service	4	13.3	23	76.7	3	10.0	30
Masonry	1	3.6	18	64.3	9	32.1	28
Cosmetic	2	20.0	2	20.0	6	40.0	10
Transport	6	25.0	9	37.5	9	37.5	24
Farm produce sale	48	53.3	9	10.0	33	36.7	90
Health work	2	15.4	-	-	11	84.6	13
Livestock/ crop	15	83.3	1	5.6	2	0.1	18
Electrical work	6	26.1	10	43.5	7	30.4	23
Trading	6	21.4	5	17.9	17	60.7	28
Food processing	13	72.2	-	-	5	27.8	18
Grinding engine	7	53.8	4	30.8	2	15.4	13
Hired labour	1	9.1	8	72.7	2	18.2	11
Lumbering	1	100.00	-	-	-	-	1
Iron work	-	-	1	50.0	1	50.0	2

Source: Computed from field survey, 2013

For instance, Skoufias and Parker (2002) found that negative shocks to household income induced increased market labour supply by adult women. This finding is consistent with Kwon *et al.* (2006) that 71.0% of farm households with a husband and a wife had, at least, one spouse working off-farm and 43.0% had both spouses working off-farm work.

4.1.3 Off-farm work pattern

Findings in Table 4.1 further showed that full-time participants in off-farm work were in agricultural wage employment (38.5%). This is the dominant and traditional employment in rural areas among small-scale farmers due to their peculiar characteristics. On the other hand, part-time participants were dominantly in self-employment (44.0%). Self-employment off-farm work typology is farther away from farm operations than agricultural wage category. Therefore, this finding was indicative of gradual departure from farm employment. According to Harris *et al.* (2010), the transition from full-time to part-time farming is often perceived as a first step out of farming. Glauben *et al.* (2004) noted that this category of farmers had lower expectations of continuing with farm business; they are also less likely to have a successor. This is a pointer to the adverse effect of the emerging dual farm structure on food crop production.

4.1.4 Years of off-farm work

The results in Table 4.1 showed that 39.2%, 47.8% and 55.2% of farmers with off-farm work experience from two to seven, eight to 13, and 14 ï 19 years, respectively were in self-employment. These were relatively young farmers who were eager to raise additional income to boost farm investment. On the other hand, 45.0% and 61.5% of farmers with off-farm work experience of 20 ï 25 and 26 ï 33 years, respectively, were in agricultural wage employment. These latter farmers were relatively older and expected to have settled down in

farm business. This finding supported off-farm work reliance in line with Ahituv and Kimhi (2002) that those who have previously worked off-farm had higher probability of continuity.

4.1.5 Off-farm work specification

Analysis of off-farm work specification in Table 4.1 showed that self-employment typology comprised salon work (100.0%), private sector employers (70.8%), health work (84.6%), trading (60.7%), iron work (50.0%), sale of cosmetics/perfumes (40.0%), transportation (37.5%). Civil service (76.7%), carpenters (51.4%), masons (64.3%), and electricians (43.5%) fell under non-agricultural wage as the major typology of off-farm work. Agricultural wage employment had those in lumbering (100.0%), livestock and crop farmers (83.3%), sellers of farm produce (53.3%), food processors (53.8%), and grinding engine owners (53.8%). These were the arrays of off-farm activities from which small-scale farmers raised additional income. This is an extension of the sources identified by Olusola and Adenegan (2011).

4.2 Off-farm Income's Share of Household Income

In Table 4.2, the average annual household income for participants was ₦648,774.91. This was higher than the ₦242,000.00 found by Ogbanje (2010) most probably because of their multiple enterprises and the presence of off-farm income. The result was less than ₦1,272,846 found by Ibekwe *et al.* (2010). Average annual off-farm income per household was ₦231,394.00, while the percentage of off-farm income's share of household income was 50.28% on the average. This implied that off-farm income accounted for, at least, half of the household income of participants in off-farm work. As a measure of reliance of farm household, the result showed that participants highly relied on income from off-farm sources. The off-farm income's share in this study was less than 61.8% for Canada in 2006 (Nantel, Freshwater, Beaulieu & Katchova, 2010). It was, however, higher than 32% in Bedemo,

Getnet, Kassa and Chaurasia (2013) for Ethiopia. This result validated Ibekwe *et al.* (2010) that non-farm activities have become an important component of livelihood strategies among rural households. Increasing share of non-farm income in total household income has been reported by de Janvry and Sadoulet (2001) and Ruben and Van den Berg (2001). The need to mitigate declining farm income and the desire to insure against agricultural production and market risks had been advanced for income diversification (Ellis, 1998; Babatunde *et al.*, 2010). Mishra and Holthausen (2002) found that average farm operator earned much more off-farm income than farm income.

Table 4.2: Off-farm income's share of household income (n=180)

Variables	Minimum	Maximum	Mean
Household income (₦)	102,195.11	2,601,117.96	648,774.91
Off-farm income (₦)	14,000.00	1,300,000.00	231,394.00
Off-farm income's share of household income (%)	2.52	488.97	50.28

Source: Computed from field survey data, 2013

4.3 Factors affecting Enterprise Diversification among Small-Scale Farmers

Discriminant function analysis was used to estimate the weighted linear combination of categorical variables that influenced or discriminated against enterprise diversification among small-scale farmers in North Central Region. The grouping variable was off-farm work main typology.

4.3.1 Group statistics of factors affecting enterprise diversification

The means and standard deviations of the independent variables in the group statistics presented in Table 4.3 indicated that large differences existed among the variables. In line with Garson (2008), this implied that the variables were good discriminators. Variables with the highest means included higher off-farm income (18.76), inadequate farm income (17.76), absence of government payment and subsidy of farm inputs (17.59), risky farm production (17.22), poor produce price (17.03), unstable farm income (16.84), farmland ownership (15.67), inefficient credit market (14.62), and inefficient input market (14.62). These were the main reasons that accounted for the tendency of farmers to belong to various categories of off-farm work in North Central Nigeria.

Table 4.3: Group Statistics of Factors affecting Enterprise Diversification (n=180)

Discriminators of off-farm work typology Group Statistics

	Mean	Standard Deviation
Fund for farm investment	4.32	2.149
Fund for household needs	5.65	2.152
Hospital	5.62	1.969
Pipe borne water	6.62	1.969
Inadequate farm land	7.62	1.969
Drought	9.96	5.267
Crop failure	9.81	4.675
Electricity	5.76	3.939
Tarred road	6.76	3.939
Market	7.76	3.939
Increased household size	8.76	3.939
Inefficient input market	14.62*	6.093
Unstable farm income	16.84*	3.447
Poor produce price	17.03*	2.462
Risky farm production	17.22*	1.477
Farmland ownership	15.67*	4.220
Government payment	17.59*	0.492
Credit market	16.76*	3.939
Inadequate farm income	17.76*	3.939
Higher off-farm income	18.76*	3.939
Main occupation	9.52	10.340
Shares received	12.62	2.025

* best discriminators

Source: Computed from field survey data, 2013

The behaviour of these variables has been observed by various researchers elsewhere. For instance, Harris *et al.* (2010) contended that off-farm income contributed to reducing the riskiness of the income stream facing the farm household. In addition, Reardon (1997) and Ellis and Freeman (2004) have noted that income diversification was induced by declining farm income and the need to insure against agricultural production and market risks. The distress-push diversification (farm becoming less profitable and more risky) and the demand-

pull diversification (higher and less risky returns to off-farm employment) articulated by Babatunde *et al.* (2010) were also confirmed by this finding.

4.3.2 Test of equality of group means

The test of equality of group means is presented in Table 4.4. The result provided strong statistical evidence of significant mean differences among the components of off-farm work. All the variables produced significant F-statistics, with the highest f-statistic coming from fund for farm investment (18.892).

Table 4.4: Tests of Equality of Group Means (n=180)

Variables	Wilks' Lambda	F	Significance
Fund for farm investment	0.824	18.892	0.000
Fund for household needs	0.857	14.729	0.000
Hospital	0.848	15.817	0.000
Pipe borne water	0.848	15.817	0.000
Inadequate farm land	0.848	15.817	0.000
Drought	0.904	9.446	0.000
Crop failure	0.911	8.695	0.000
Electricity	0.848	15.817	0.000
Tarred road	0.848	15.817	0.000
Market	0.848	15.817	0.000
Increased household	0.848	15.817	0.000
Inefficient input market	0.896	10.323	0.000
Unstable farm income	0.848	15.817	0.000
Poor produce price	0.848	15.817	0.000
Risky farm production	0.848	15.817	0.000
Farmland ownership	0.965	3.187	0.044
Government payment	0.848	15.817	0.000
Credit market	0.848	15.817	0.000
Inadequate farm income	0.848	15.817	0.000
Higher off-farm income	0.848	15.817	0.000
Main occupation	0.848	15.817	0.000
Shares received	0.973	2.502	0.085

Source: Computed from field survey data, 2013

4.3.3 Test of equality of covariance matrices

4.3.3.1 Log determinants

Following the assumption of discriminant analysis that the variance-co-variance matrices are equivalent (Hardle & Simar, 2007), the log determinants and Boxôs M test were used to test the null hypothesis that the covariance matrices did not differ among the groups ï typology. As shown in Table 4.5, the log determinants appeared similar to one another.

Table 4.5: Log Determinants of off-farm work (n=180)

Component of off-farm work - major	Rank	Log Determinant
Agricultural wage employment	5	4.115
Non-agricultural wage employment	4	5.995
Self-employment	5	5.999
Pooled within-groups	5	5.787

The ranks and natural logarithms of determinants are those of the group covariance matrices.
Source: computed from field survey, 2013

4.3.3.2 Box's M

In Table 4.6, however, the Boxôs M was 7.071 with F-statistic which was significant at one percent level. The implication was that the covariance matrices were not equivalent. Nevertheless, the significant Boxôs M was disregarded since the sample size was large and the dependent variable was made up of three groups. The significance of Boxôs M further implied that the group with the least log determinant might not be considered so important for further analysis. In this study, the group with the least log determinant was agricultural wage employment (4.115).

Table 4.6: Box's M test results table (n=180)

Box's M		110.549
F	Approx.	7.071*
	df1	15
	Significance	0.000

* significant at 1% probability level, indicating that covariance matrices were not equivalent.
Source: computed from field survey, 2013

4.3.5 Summary of Canonical Discriminant Functions

4.3.5.1 Eigenvalues

In Table 4.7, the canonical correlation was 0.572. As indicated by Green, Salkind and Akey (2008), the square of the canonical correlation (0.3272) suggested that 32.72% of the variation in the grouping variable was explained ï whether a respondent belonged to either of the off-farm work typology. The average canonical correlation was attributed to the obvious overlapping of the groups. The

Table 4.7: Eigenvalues (n=180)

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	0.486*	90.7	90.7	0.572
2	0.050*	9.3	100.0	0.218

*First 2 canonical discriminant functions were used in the analysis
Source: Computed from field survey data, 2013

Chi-square statistic (77.889) of Wilksô Lambda in Table 4.8 was significant at 0.01 level, implying that the discriminant function was significant.

Table 4.8: Wilks' Lambda (n=180)

Test of Function(s)	Wilks' Lambda	Chi-square	df	Significance
1 through 2	0.641	77.889*	10	0.000

* significant chi-square at 1% probability level
Source: Computed from field survey data, 2013

4.3.5.1 Structure matrix

The structure matrix in Table 4.9 indicated the relative importance of the predictors as it displayed the correlations of each variable with each discriminate function, resulting in discriminant loadings. With 0.30 as the cut-off point, predictors which were not loaded on the discriminant function, using function one, were shares received (0.021) and farmland ownership (0.235). These predictors were, therefore, not associated with off-farm work in the study area. On the other hand, the strongest predictor was fund for farm investment (0.654) while the weakest predictors were crop failure (0.359), drought (0.398) and inefficient input

market (0.478). This highest discriminant loading conformed to Harris *et al.* (2010) that the presence of off-farm income relaxed the budget constraints in farm households. Farm households that depended solely on farm income often used a larger proportion of farm profit to satisfy consumption demands, thereby, reducing capital available for farm investment. Reardon (1997) and Ji *et al.* (2011) have noted that off-farm income increased farm capital accumulation if the farm family was subjected to borrowing constraints. Obike *et al.* (2007) observed that borrowing constraint was prevalent among small-scale farmers in Nigeria.

Table 4.9: Structure Matrix (n=180)

S/N	Predictors	Function	
		1	2
i	Fund for farm investment	-0.654*	0.334
ii	Fund for household needs	-0.585*	0.024
iii	Inefficient input market	0.478*	-0.335
iv	Crop failure	-0.359*	0.846
v	Drought	-0.398*	0.772
vi	Risky farm production	-0.554*	0.766
vii	Inadequate farm income	0.554*	-0.766
viii	Tarred road	0.554*	-0.766
ix	Market	0.554*	-0.766
x	Credit market	0.554*	-0.766
xi	Poor produce price	-0.554*	0.766
xii	Electricity	0.554*	-0.766
xiii	Increased household size	0.554*	-0.766
xiv	Government payment	0.554*	-0.766
xv	Unstable farm income	-0.554*	0.766
xvi	Inadequate farm land	-0.554*	0.766
xvii	Pipe borne water	-0.554*	0.766
xviii	Higher off-farm income	0.554*	-0.766
xix	Main occupation	-0.554*	0.766
xx	Hospital	-0.554*	0.766
xxi	Shares received	0.021	-0.750
xxii	Farmland ownership	0.235	-0.430

* predictor of enterprise diversification

Source: Computed from field survey data, 2013

4.3.6 Off-farm work typology classification

As shown in the cross-validated section of Table 4.10, the off-farm work typology classification result showed that self-employment had better accuracy (88.3%). This, in line with Bokeoglu & Buyukozturk (2008), indicated that majority of farmers tended towards self-employment, *ceteris paribus*. The next most likely group that was attractive to farmers was non-agricultural wage employment, with classification of 67.4%. The poor classification of agricultural wage employment (0.0%) indicated further drift from core agricultural wage labour supply as demonstrated by Harris *et al.* (2010). This is also a further proof of the true state dependency of Ahituv and Kimhi (2002) that those who had worked off-farm earlier had higher probability of commuting to more intensive level of off-farm work.

Table 4.10: Off-farm Work Typology Classification (n=180)

			Predicted Group Membership			
		Off-farm work typology	AWE	NAWE	SE	Total
Original	Count	AWE	0	26	34	60
		NAWE	0	34	9	43
		SE	0	9	68	77
	%	AWE	0.0	43.3	56.7	100.0
		NAWE	0.0	79.1	20.9	100.0
		SE	0.0	11.7	88.3	100.0
Cross-validated	Count	AWE	0	26	34	60
		NAWE	0	29	14	43
		SE	0	9	68	77
	%	AWE	0.0	43.3	56.7	100.0
		NAWE	0.0	67.4	32.6	100.0
		SE	0.0	11.7	88.3	100.0

AWE=Agricultural wage employment; NAWE=Non-agricultural wage employment; SE=Self-employment

Source: Computed from field survey data, 2013

4.4 Degree of Off-farm Diversification

The degree of off-farm diversification was determined using entropy measure of diversification (D_E). In Table 4.11, the entropy of diversification ranged from 0.009 to 0.677,

with 0.669 as the overall average entropy measure of diversification. This finding confirmed that all the participants had, at least, an off-farm enterprise. The mean index of diversification of 66.9%, indicated that no farm household was completely specialised, neither was any completely diversified. This is a further proof of off-farm income reliance. Off-farm employment is an important strategy in dealing with income fluctuation and risk associated with agriculture. The average index of diversification in this study was higher than the indexes for Upper Austriaôs part-time farmers (0.374) and full-time farmers (0.526) in McNamara and Weiss (2005). It was also higher than that of U.S. farms (0.17) in Mishra and El-Osta (2002). These differences could be attributed to the axiom that diversification was more crucial to developing economies with inherent imperfect input market, near absence agricultural subsidy and prevalent poverty (McNamara & Weiss, 2005; Ibekwe *et al.*, 2010; Myyra *et al.*, 2011).

Table 4.11: Degree of off-farm diversification (n=180)

Parameters	Index
Mean	0.669
Minimum	0.009
Maximum	0.677
Standard Deviation	0.139
Kurtosis	0.215

Source: Computed from field survey data, 2013

4.5 Effect of Farm Income and Off-farm Income on Market Labour Supply

Of the three functional forms fitted to the model for the effect of farm and off-farm incomes on market labour supply, the double-log was chosen as the lead equation. The choice was based on earlier stated econometric criteria. The result is presented in Table 4.12. The

coefficient of determination was 0.642, implying that the independent variables accounted for 64.20% of the variations in market labour supply among farmers in North Central Nigeria. In addition, the F-statistic (61.984) was significant at one percent level of probability. This meant that the independent variables jointly and significantly affected market labour supply.

Table 4.12: Effect of Farm Income and Off-farm Income on Market Labour Supply (n=180)

Parameters/Functional forms	Linear	Quadratic	Double-log
(Constant)	1864.840	2403.045	5.919
	(15.521)*	(13.488)*	(13.063)*
Farm income	-0.001	0.000	-0.625
	(-7.14)*	(6.305)*	(-10.237)*
Off-farm income	0.000	0.000	0.118
	(0-218)*	(-1.628)	(2.536)**
R-square	0.478	0.620	0.642
F-statistic	26.197*	27.336*	61.984
VIF (farm income)	1.018	7.012	1.031
VIF (off-farm income)	2.018	8.420	1.031

, significant at 1%, 5% levels of probability, respetively
Source: Computed from field survey data, 2013

In the lead equation, the coefficient of farm income was negative (-0.625). Its t-ratio (-10.237) was significant at one percent probability level. This meant that a one percent decrease in farm income led to additional 0. 625man-days of market labour supply by farmers who participated in off-farm work. In other words, whenever farm income became inadequate and unstable, or farming became uncertain, farmers sought off-farm work to address the shortfall and continue in farm business. This empirical result confirmed the theoretical model of the effect of farm income variability on market labour supply. This finding is in line with the distress-push strategy of Babatunde *et al.* (2010) that farmers seek off-farm work whenever farm income became unstable. The result is, also, in line with Mishra and Holthausen (2002) that the coefficient of variation in net farm income increased the probability of off-farm work participation by farm operators in Kansas (0.70%) and North

Carolina (0.60%). The result further confirmed the tradeoff examined by Sonoda (2006) that when farm profitability was high, the household head allocated more labour to farm production, which simultaneously reduced his market labour supply.

The field findings further showed that off-farm income was positively significant (0.642) at one percent probability level in explaining market labour supply, implying that one percent increase in off-farm income would increase market labour supply by 0. 642man-days. Increase in off-farm income indicated that off-farm work was financially favourable and lucrative; hence, a rational farmer would tend to re-allocate more of his endowed time away from farm production to off-farm work. This finding is consistent with Mishra and Holthausen (2002) who reported an upward sloping off-farm labour supply curve of farm operators by 2% and 1.5% in Kansas and North Carolina, respectively, with increase in off-farm wage. The result is also in line with Huffman (1980) who reported an elasticity of 0.34 for counties in Iowa, North Carolina, and Oklahoma.

4.6 Disaggregation of Off-farm Income into main Typology

4.6.1 Descriptive statistics of off-farm income by main categories

The descriptive statistics of off-farm income by categories in Table 4.13 showed that self-employment category of off-farm income had the highest average annual income of ₦266,680.78 while agricultural wage employment had the least (₦185,866.67). In terms of percentage contribution to total off-farm income, self-employment had the highest (49.31%) while non-agricultural wage employment had the least (23.92%). The standard deviation of agricultural wage employment (127,160.68) was the least indicating greater homogeneity than self-employment and non-agricultural wage employment which were relatively more heterogeneous. The result further indicated that farm operations were more uniform with fairly uniform prices and more seasonal than the activities in the other categories whose

demand was even more continuous and varied. It is, therefore, possible to earn more income from self-employment and non-agricultural wage employment than agricultural wage employment. The average distribution pattern in this study is in line with Ibekwe *et al.* (2010) where self-employment, non-agricultural wage employment, and agricultural wage had average annual incomes of ₦88,372.76, ₦22,911.23 and ₦18,328.99, respectively. The percentage distribution in this study is consistent with Babatunde *et al.* (2010) where self-employment, agricultural wage employment, and non-agricultural wage had 23.9%, 13.3% and 6.0% respectively as shares of total household income.

Table 4.13: Descriptive statistics of off-farm income by main categories (n=180)

Main Category	N	Sum	Percentage (%)	Mean	Standard Deviation
AWE	60	11,152,000.00	26.77	185,866.67	127,160.68
NAWE	43	9,964,500.00	23.92	231,732.56	275,041.95
SE	77	20,534,420.00	49.31	266,680.78	222,128.02
Total		41,650,920.00	100.00		

Source: Computed from field survey data, 2013

One-way analysis of variance was used to determine the difference in off-farm income among off-farm work categories as presented in Table 4.14. The F-statistic of the model was neither significant at one percent nor five percent, hence it was de-emphasised.

Table 4.14: Difference in off-farm income among off-farm work categories

	Sum of Squares	df	Mean Square	F	Significance
Between Groups	220,246,286,214.82	2.00	110,123,143,107.41	2.47	0.09
Within Groups	7,881,144,594,505.18	177.00	44,526,240,646.92		
Total	8,101,390,880,720.00	179.00			

Source: Computed from field survey data, 2013

The Duncan multiple range test in Table 4.15 confirmed that self-employment had the highest average income (₦266,680.78), followed by non-agricultural wage employment (₦231,732.56) and then agricultural wage employment (₦185,866.67).

Table 4.15: Duncan's multiple range test of off-farm income

	Major Component of off-farm work	N	Subset for alpha = 0.05
Duncan	Agricultural wage employment	60	185,866.67
	Non-agricultural wage employment	43	231,732.56
	Self-employment	77	266,680.78
	Significance		0.054

Source: Computed from field survey data, 2013

4.7 Level of Farm Capital among Off-farm Work Typology

In Table 4.16, the farmers in agricultural wage employment had the highest percentage (38.83%) of farm capital. For these farmers, agricultural production was the main occupation. As such, they would plough relatively higher proportion of income generated from off-farm sources back into their farms and increase the capital base needed for expansion and sustainable production. In addition to generating annual income, Myyra *et al.* (2011) noted that a farm family had the goal of accumulating wealth through capital gains by investing and increasing the value of its assets either on-farm or off-farm. According to Hill (2000) in Myyra *et al.* (2011), accumulated assets enabled farms to secure credit and smoothen the consumption expenditures in times of income shortfall.

Table 4.16: Descriptive statistics of Farm Capital by Off-farm Work Typology (n=180)

Off-farm work typology	Farm capital				
	N	Sum	Percentage (%)	Mean	Standard Deviation
AWE	60	24,299,451.59	38.83	404,990.86	423,332.00
NAWE	43	15,707,721.27	25.10	365,295.84	325,652.49
SE	77	22,572,191.95	36.07	293,145.35	233,015.13
Total		62,579,364.82	100.00		

Source: Computed from field survey data, 2013

4.8 Inequality of Farm Capital

In Table 4.17, the inequality of farm capital was determined using Gini coefficient. The Gini index (0.56) was slightly above the cut-off point of (0.50). In line with Iheanacho and Mshelia (2004) and Bellù and Liberati (2006), the index indicated inequality in farm capital. In other words, farm capital among small-scale farmers in the region under study was unequally distributed. Given the heterogeneity of the population used for this analysis, farm capital could differ among the farmers. This also implied disparity in income sources, differing transfer of income to farm production, as well as varying productivity.

Table 4.17: Inequality of Farm Capital (n=360)

SN	Class interval	midpoint	F	X (%F)	Total Farm capital (tfc)	%tfc	Y	Xb100	Yb100	XY
1	1-250,999	125500.00	56	15.6	10,879,311.81	5.32	5.32	0.16	0.05	0.01
2	251,000-500,999	375999.50	139	38.6	53,709,559.79	26.27	31.59	0.39	0.32	0.12
3	501,000-750,999	625999.50	91	25.3	54,709,559.79	26.75	58.34	0.25	0.58	0.15
4	751,000-1,000,000	875999.50	31	8.6	26,983,080.86	13.20	71.54	0.09	0.72	0.06
5	1,001,000-1,250,999	1125999.50	18	5	20,333,508.33	9.94	81.48	0.05	0.81	0.04
6	1,251,000-1,500,999	1375999.50	13	3.6	16,964,690.01	8.30	89.78	0.04	0.90	0.03
7	1,501,000-1,750,999	1625999.50	8	2.2	12,750,165.65	6.24	96.02	0.02	0.96	0.02
8	1,751,000-2,600,000	1875999.50	4	1.1	8,154,216.14	3.98	100	0.01	1	0.01
	Total		360	100.00	204,484,092.38	100.00		1		0.44
								GC		0.56

Source: Computed from field survey data, 2013

The disaggregation of farm capital inequality into participants and non-participants in Tables 4.18 and 4.19, respectively placed the farmers below the cut-off point. The result showed that participants in off-farm work had greater equality (GC=0.33) than non-participants (GC=0.36). This implied that there was more equal distribution in farm capital in each group. Furthermore, the results indicated that all the farmers neither had the same farm capital nor

did all the farm capital belonged to only one farmer and every other farmer had zero farm capital.

Table 4.18: Inequality of Farm Capital among Participants (n=180)

SN	Farm capital class interval	Midpoint	F	x (%F)	Total farm capital	%tfc	Y	Xb100	Yb100	XY
1	1-250,999	125,500.00	27	15.00	14,036,850.13	14.16	14.16	0.15	0.14	0.02
2	251,000-500,999	375,999.50	71	39.45	42,135,458.17	42.52	42.52	0.40	0.57	0.23
3	501,000-750,999	625,999.50	49	27.22	30,852,229.98	31.13	31.13	0.27	0.88	0.24
4	751,000-1,000,000	875,999.50	15	8.33	7,119,520.55	7.18	7.18	0.08	0.95	0.08
5	1,001,000-1,250,999	1,125,999.50	7	3.89	2,285,002.96	2.31	2.31	0.04	0.97	0.04
6	1,251,000-1,500,999	1,375,999.50	9	5.00	2,141,370.41	2.16	2.16	0.05	0.99	0.05
7	1,501,000-1,750,999	1,625,999.50	2	1.11	527,475.76	0.53	0.54	0.01	1.00	0.01
8	1,751,000-2,600,000	1,875,999.50	0	-	-	0.00	0	-	-	-
			180	100.00	99,097,907.96	100.00	100	1.00		0.67
									GC	0.33

Source: Computed from field survey data, 2013

Table 4.19: Inequality of farm capital among non-participants (n=180)

SN	Farm capital class interval	Midpoint	F	X (%F)	Total farm capital (tfc)	%tfc	Y	Xb100	Yb100	XY
1	1-250,999	125,500.00	29	16.11	16,901,632.52	16.02	16.02	16.02	0.16	0.03
2	251,000-500,999	375,999.50	68	37.78	41,336,823.80	39.19	39.19	55.21	0.55	0.21
3	501,000-750,999	625,999.50	42	23.34	26,793,597.47	25.40	25.41	80.62	0.81	0.19
4	751,000-1,000,000	875,999.50	16	8.89	12,408,254.26	11.76	11.76	92.38	0.92	0.08
5	1,001,000-1,250,999	1,125,999.50	11	6.11	3,868,786.78	3.67	3.67	96.05	0.96	0.06
6	1,251,000-1,500,999	1,375,999.50	4	2.22	721,371.34	0.68	0.69	96.74	0.97	0.02
7	1,501,000-1,750,999	1,625,999.50	6	3.33	1,912,462.65	1.81	1.81	98.55	0.99	0.03
8	1,751,000-2,600,000	1,875,999.50	4	2.22	1,530,831.50	1.45	1.45	100	1	0.02
			180	100	105,473,760.32	100.00	100			0.64
									GC	0.36

Source: Computed from field survey data, 2013

4.9 Causality between Off-farm Income and Farm Capital

The results of the causality between off-farm income and farm capital are presented in Tables 4.20 and 4.21. In Table 4.20, the farm capital model confirmed the endogeneity of off-farm income. With t-ratio (4.769) which is significant at one percent probability level, an increase in off-farm income by 1% was associated with increase in farm capital by 0.894%. The coefficient of determination, however, indicated that off-farm income accounted for 11.3% of the variations in farm capital. In the absence of off-farm income, farm capital was large (461,235.272) and significant (t=14.632) as indicated by the constant of the model.

Farmers with off-farm income tended to have more farm capital. The implication was that apart from agricultural markets, production decisions, and agricultural policy, the surrounding business climate and employment opportunities equally affected farm capital accumulation. This is in line with Mishra and El-Osta (2005) that off-farm income

contributed to investment in agricultural assets. Reardon (1997) also found that off-farm income increased farm capital accumulation. According to Vercammen (2007), off-farm income, especially direct payments or fund transfer, raised the expected value of marginal investments by reducing the risk of bankruptcy over time and, thus, affected the expected values of farm assets.

Table 4.20: Farm capital model (n=180)

Parameters	Coefficient	T-ratio	Significance
Constant	461,235.272	14.632	0.000
Off-farm income	0.894	4.769*	0.000
R^2	0.113		
Mean Standard residual	-2.10E-17		
Sum of Standard residual	-3.77E-15		

Source: Computed from field survey data, 2013

In the off-farm income model (Table 4.21), farm capital and the residual (an instrumental variable) from the farm capital model were included as explanatory variables. The t-ratio of farm capital was significant at one percent probability level. Farm households that have obtained higher wages from off-farm income in the past have higher probability of continuous participation in off-farm work. The impact of off-farm wage on farm productivity could also spur them to persist in off-farm work. According to Ahituv and Kimhi (2002), one of the implications of underdeveloped capital markets in developing economies was that farm capital accumulation was determined more by life-cycle accumulation and less by intergenerational transfers. This confirmed substitution effect in labour theory that farm capital deepening releases labour from farm production.

The signs and significance of both off-farm income and farm capital indicated simultaneous and complementary relationship between the variables. The positive signs of the coefficients of off-farm income (0.894) and farm capital (1.119) indicated that bi-directional relationship

existed between off-farm income and farm capital accumulation. In Lagerkvist *et al.* (2006), causality did not run from off-farm income to farm capital.

In Table 4.21, the coefficient of the residual generated from the farm capital model was found to be significantly different from zero at one percent probability level. This is a confirmation of bi-directional relationship between off-farm income and farm capital. In line with Jerome (2002) and Twerefou, Osei-Assibey and Agyire-Tettey (2011), there was simultaneity bias in the relationship and that causality ran from farm capital to off-farm income. Thus, farm capital was exogenous to off-farm income.

Table 4.21: Off-farm income model (n=180)

Parameters	Coefficient	T-ratio	Significance
Constant	-516,134.127	-191,370,532.340*	0.000
Farm capital	1.119	233,932,364.980*	0.000
Farm capital Residual	-380,303.470	-22,0281,113.506*	0.000
R^2	1.00		
F-statistic	2.736E16*		

Source: Computed from field survey data, 2013

4.10 Difference in Farm Capital between Participants and Non-Participants

In Table 4.22, the meansô difference in farm capital (₦-32,151.31) indicated the amount by which participants in off-farm work had less farm capital than non-participants. In spite of their access and acquisition of additional finance (from non-farm sources), participants in off-farm work had less farm capital than the non-participants. This is a pointer to non-utilisation of available finance for farm production purposes. This result contravened the condition for optimal investment of off-farm income in farm production as advanced by OôBrien and Hennessy (2005) and Harris *et al.* (2010) which was maintenance or increase in farm output with less labour. Harris *et al.* (2010) have observed that transition from full-time to part-time farming, invariably off-work participation, is the first step out of farming, hence farmers who

worked off-farm might not reinvest in farming. Anderson *et al.* (2005) have shown that an increase in off-farm income increased investment in non-farm assets rather than farm assets. This finding also confirmed the traditional viewpoint of off-farm employment, which was debunked by Mishra and Holthausen (2002), as a mechanism of easing exit from farming especially by marginal producers.

Table 4.22: Difference in Farm Capital between Participants and Non-participants (n=360)

Sample	Mean Farm capital	Mean Difference	t-ratio	Degree of Freedom	Significance
Participants in off-farm work	550,721.30	-32,151.31	-0.862	179	0.390
Non-participants in off-farm work	582,872.61				

Source: Computed from field survey data, 2013

4.11 Farm Financial Characteristics of Respondents

In Table 4.23, a comparative analysis of 21 farm financial characteristics between participants and non-participants in off-farm work was undertaken. The result showed that, at one percent probability level, non-participants had more total farm liabilities (-₦5,107.51) and loan obtained for farm production (-₦4,434.15) than participants. The reason is that financial constraint is severe among non-participants in off-farm work, hence they resorted to obtaining credit, sometimes from money lenders who charged high interest rates. According to Bierlen, Barry, Dixon, and Ahrendsen (1998), credit constraint was common in farm businesses due to the absence of equity markets. Conversely, participants in off-farm work financed their farm production with part of their off-farm income and, hence, had relatively less need for farm credit. This is consistent with Harris *et al.* (2010) that the presence of additional income in a farm household could relax budgetary constraints.

Table 4.23: Farm Financial characteristics of respondents

SN	Financial characteristics	Participants (n=180)	Non-participants (n=180)	Mean Difference	t-ratio
1	Operating Margin	0.038	0.045	-0.007	-1.045
2	Total Farm Liabilities	3,459.02	8,566.53	-5,107.51	-13.062*
3	Debt-Asset-Ratio	0.523	0.969	-0.446	-7.331*
4	Total Depreciation	63,632.42	60,858.57	2,773.85	0.637
5	Farm Capital	550,721.30	582,872.61	-32,151.31	-0.862
6	Average Farm Asset	14,431.61	16,084.93	-1,653.32	-0.882
7	Asset Turnover Ratio	81.313	81.877	-0.563	-0.054
8	Ratio of Farm Asset to Household Asset	1.009	1.084	-0.074	-0.295
9	Value of Household Item	48,796.45	44,089.18	4,707.27	1.292
10	Value of Farm Asset	14,835.97	16,769.39	-1,933.42	-1.017
11	Loan for Farm Production	3,004.60	7,438.75	-4,434.15	-12.902*
12	Revenue - cowpea	94,267.81	93,275.23	992.582	-0.716
13	Production cost - cowpea	19,920.19	19,848.71	71.477	-0.794
14	Revenue - rice	133,114.31	123,143.29	9,971.02	0.262
15	Production cost - rice	53,084.70	43,026.54	10,058.16	1.3
16	Revenue - yam	317,316.56	292,093.39	25,223.17	0.995
17	Production cost - yam	114,257.38	89,448.09	24,809.29	2.72*
18	Total Farm Revenue	479,534.22	453,391.28	26,142.94	0.86
19	Total Variable Cost	166,282.64	136,347.00	29,935.64	2.87*
20	Net worth	549,049.44	575,257.92	-26,208.48	-0.702
21	Total Gross Margin	313,251.59	317,044.28	-3,792.69	-0.128

* t-ratio is significant at 1% probability level

Source: Computed from field survey data, 2013

The result also showed that the debt-to-asset-ratio of non-participants (0.969) was significantly higher than that of the participants (0.523) at one percent probability level. This implied that reliance on debt financing was more prevalent among the non-participants than participants. In line with Arene (2002), this result indicated lower net farm value and more

difficulty of loan repayment among non-participants than participants. This leverage ratio analysis further underscored the relevance of off-farm income. This result is supported by Blank *et al.* (2009) and Briggeman (2011) who asserted that several farms in the United States of America could not boast of favourable leverage ratios without off-farm income.

The result in Table 4.23 further showed that participants significantly incurred more yam production cost (₦24,809.29) and overall total variable cost (₦29,935.64) than non-participants at one percent probability level. Due to their reallocation of own labour away from farming, participants in off-farm work had to spend more on farm production, especially on labour, leading to (capital) substitution effect (Huffman, 1980). In other words, participants were in more capital intensive farm production than the non-participants. The reason was that farmers who worked off-farm needed to bear the opportunity cost of off-farm work. This result is supportive of tradeoff phenomenon in labour supply and optimal time allocation theories articulated by Huffman (1980), Kurosaki (2001), Ahituv and Kimhi (2002), and Tocco *et al.* (2012).

4.12 Farm Efficiency of Small-scale Farmers

4.12.1 Summary statistics of the descriptive variables for efficiency measures

The summary statistics of descriptive variables used for efficiency measures were presented in Tables 4.24 to 4.26. Generally, few disparities were observed between participants and non-participants. Of particular interest in Table 4.24 for yam enterprise was the difference in average fertiliser usage which was 205.81kg for participants and 128.76kg for non-participants. In line with the direct relationship between supply and price, prevalent scarcity of fertiliser meant high price for the commodity. With their off-farm income, participants in off-farm work could afford the fertiliser at the going price. Similarly, participants had more herbicide (6.28kg) than non-participants (3.50kg). This is understandable, again, because of

the capital substitution posture of participants. Without large quantities of herbicide, weeds would have overtaken the yam farms of off-farm work participants.

Participants were found to have more years of formal education (10.25 years) than non-participants (6.92 years), implying that the former attained, at least, secondary level of education while the latter were more within the primary school range. The exposure of participants to formal education at this level could have spurred them towards diversification of their economic base in order to meet household demands. Similarly, participants had more average extension visits (8.66) than non-participants (4.65). This too, would have contributed to their decision to embark on off-farm work as an alternative source of income.

On the other hand, non-participants (11,099.14) incurred more cost on capital input than participants (2,596.58). Non-participants belonged to the category of small-scale farmers who, in dire need of income from their largely monobasic farm economy, sold their farm produce piecemeal. Hence, they could have incurred more cost on taxes. Again, due to their poverty status, invariably inability to comply with loan terms, they could have incurred more interest and penalties for loan default.

Table 4.24: Summary statistics of the descriptive variables for yam

Samples	Participants (n=180)		Nonï Participants (n=180)	
Parameters	Mean	Standard Deviation	Mean	Standard Deviation
Yam output (kg)	24,930.97	15,080.78	24,923.49	20,029.27
Farm size (ha)	1.50	1.12	1.33	1.04
Family labour (man days)	203.99	192.16	206.13	275.40
Hired labour (man days)	215.76	257.94	206.11	217.13
Farm income (₦)	317,316.56	272,119.07	292,093.39	247,721.93
Fertiliser (kg)	205.81	144.38	128.76	140.96
Seed (kg)	255.69	231.08	210.76	218.98
Herbicide (L)	6.28	5.60	3.50	6.81
Pesticide (L)	11.46	11.33	1.93	6.23
Farm capital dep (₦)	16,075.85	17,307.41	15,529.50	20,266.49
Capital input (₦)	2,596.58	3,176.88	11,099.14	7,945.61
Age (years)	43.43	9.75	43.08	9.50
Education (years)	10.25	3.82	6.92	5.61
Household size (number)	6.14	2.21	6.06	2.19
Farming experience (years)	23.49	11.42	22.92	10.64
Loan (₦)	5,990.24	4,103.61	3,971.12	4,569.18
Extension visit (number)	8.66	7.13	4.65	6.02

Source: computed from field survey, 2013

For cowpea enterprise in Table 4.25, both participants and non-participants had similarities in all the descriptive variables.

Table 4.25: Summary statistics of the descriptive variables for cowpea

Sample	Participants (n=180)		Non ï Participants (n=180)	
Parameters	Mean	Standard Deviation	Mean	Standard Deviation
Cowpea output (kg)	1122.778	356.8364	1,111.16	380.77
Farm size (ha)	1.0338	0.31849	1.01	0.34
Family labour (man days)	17.1783	7.14629	22.07	10.04
Hired labour (man days)	19.6589	9.52833	15.16	8.66
Farm income (₦)	18,877.18	6094.738	18,632.80	6,531.66
Fertiliser (kg)	64.0847	20.60572	68.28	66.52
Seed (kg)	2,646.919	2827.003	2,320.96	2,649.50
Herbicide (L)	1.4631	0.37088	1.45	0.37
Pesticide (L)	2.2609	1.17021	2.25	1.13
Farm capital dep (₦)	14,674.39	13933.93	14,706.56	15,070.92
Capital input (₦)	47,902.6	46141.96	42,579.23	49,910.50
Age (years)	42.845	9.19022	43.34	9.85
Education (years)	6.5419	5.69151	6.44	5.66
Household size (number)	6.5969	2.32352	5.96	2.41
Farming experience (yrs)	23.8219	11.14604	23.49	11.38
Loan (₦)	3,630.24	4188.829	3,789.06	4,200.88
Extension visit (number)	4.1262	5.49791	5.32	6.12

Source: computed from field survey, 2013

For rice enterprise in Table 26, there was a slight deviation as participants in off-farm work had more average hired labour (61.83 mandays) than non-participants (39.32 mandays). Due to the nature of their diversification, participants in off-farm work had more need for hired labour than non-participants. The standard deviation in hired labour was more for participants (52.62) than for non-participants (39.32), indicating a wider variation among the former and

greater homogeneity among the latter. Non-participants, however, obtained more average income (₦139,122.48) than participants (₦119,605.95). Rice farming required more attention than most arable crop production. As such, capital resources could not completely substitute for own labour. This result further validated the tradeoff theory in labour allocation away from farm sector as farmers searched for additional funds for farm reinvestment.

Table 4.26: Summary statistics of the descriptive variables for rice

Samples	Participants (n=180)		Non-Participants (n=180)	
Parameters	Mean	Standard Deviation	Mean	Standard Deviation
Rice output (kg)	207,048.59	201,346.84	240,944.30	419,553.67
Farm size (ha)	2.12	0.68	2.12	0.77
Family labour (man days)	25.74	17.28	49.92	46.44
Hired labour (man days)	61.83	52.62	39.32	31.66
Farm income (₦)	119,605.95	134,350.82	139,122.48	228,204.10
Fertilizer (kg)	325.85	107.50	321.05	126.97
Seed	80.35	33.55	82.00	44.59
Herbicide (L)	2,027.24	747.29	2,008.64	855.87
Pesticide (L)	4.69	3.16	6.15	4.67
Farm capital dep (₦)	15,088.67	17,315.35	16,851.31	23,106.33
Capital input (₦)	7,491.95	7,721.16	6,324.42	7,327.42
Age (yrs)	43.87	8.51	43.88	9.90
Education (yrs)	9.71	3.72	10.31	3.91
Household size (number)	6.33	1.97	6.32	2.25
Farming experience (yrs)	23.89	9.85	23.38	11.05
Loan (₦)	5,871.26	4,282.57	6,559.30	4,749.37
Extension visit (number)	7.99	6.99	9.60	9.70

Source: computed from field survey, 2013

4.12.2 Summary statistics of the descriptive variables for cost and profit efficiency

The summary statistics of the descriptive variables for cost and profit efficiencies were presented in Tables 4.27 and 4.28, respectively. Generally in Table 4.27, similarities were

observed in the average values of enterprise production cost between participants and non-participants. This suggested high level of homogeneity in the samples. Non-participants in off-farm work took their produce to the market more frequently in order to earn quick returns. This exposed them to more market-based taxes. Due to their monobasic farm economy, the non-participants possibly violated loan terms and incurred more penalties. Consequent upon these reasons, average capital input was higher for non-participants in off-farm work.

Table 4.27: Summary statistics of the descriptive variables for cost efficiency

Item	Participant (n = 180)		Non-participant (n = 180)	
	Mean	Standard Deviation	Mean	Standard Deviation
Production Cost	25,053.63	17,897.59	27,021.41	20,018.57
Total production cost ï cowpea (₦)	19,136.08	18,154.52	21,334.87	19,841.78
Total production cost ï yam (₦)	3,977.21	2,276.13	4,041.23	2,233.69
Total production cost ï rice (₦)	1,940.34	1,407.01	1,645.32	1,180.06
Average total output (tonnes)	20,867.25	16,122.51	19,307.19	15,745.73
Depreciation of farm asset (₦)	606.87	2,934.97	416.67	467.89

Source: computed from field survey, 2013

For profit efficiency in Table 4.28, the same trend of homogeneity was observed except for average cost of fertiliser. Average fertiliser usage was more among the participants (312.77kg) than the non-participants (246.23kg). Fertiliser has been the bane of crop production among small-scale farmers in Nigeria. This is worse among resource-poor farmers. This result showed that fertiliser scarcity and exorbitant were less severe among participants in off-farm work, owing to their relatively relaxed farm budget.

Table 4.28: Summary statistics of the descriptive variables for profit efficiency

Item	Participant (n = 180)		Non-participant (n=180)	
	Mean	Standard Deviation	Mean	Standard Deviation
Total revenue (₦)	479,534.22	329,271.80	453,391.28	264,229.52
Farm size (ha)	3.69	1.49	3.59	1.48
Average cost of hired farm labour (₦)	1,897.33	1,374.90	1,568.44	1,194.65
Average cost per kg of fertilizer (₦)	312.77	971.58	246.23	77.60
Average cost per kg of seed (₦)	1,508.92	1,304.00	1,731.45	1,457.71
Average cost per L of agrochemical (₦)	2,020.92	829.67	2,138.43	847.23
Average price of farm tools (₦)	14,835.97	17,689.90	16,769.39	19,890.07
Average marketing cost per bag (₦)	2,296.37	3,664.55	2,406.04	2,827.32
Average transport cost per bag (₦)	2,181.35	1,175.18	2,161.44	1,116.34

Source: computed from field survey, 2013

4.12.3 Maximum likelihood estimates of the stochastic frontier production function for yam

The maximum likelihood estimates of the stochastic frontier for small-scale yam production were presented in Table 4.29 for participants and non-participants. In the diagnostic statistics, the estimated sigma squared was statistically different from zero for both participants (5.63) and non-participants (7.76) at one percent probability level. This indicated that the estimated production function fitted the data very well. Furthermore, gamma (ɔ) was significantly different at 1% for both participants (0.9908) and non-participants (0.9965). In line with Koutsoyiannis (1977) and Rahman (2002), this result implied that 99.08% and 99.65% variations from the maximum output produceable were due to technical inefficiency among participants and non-participants, respectively rather than random errors.

Family labour was negatively significant while hired labour was positively significant at 1% probability level for both groups. This implied that 1% increase in family labour would reduce yam output by 0.07% and 0.015% for participants and non-participants, respectively. Although, labour is a critical productive input (Shehu, Tashikalma & Gabdo, 2007), its

elasticity is finite. With particular reference to non-participants, the negative sign of the coefficient of family labour could be, especially, caused by the aging trend of farmers which reduced labour productivity and invariably yam output.

Table 4.29: Maximum Likelihood Estimates of the Stochastic Frontier Yam Production Function

Variable	Parameter	Participants (n=180) Coefficient	Non-Participants (n=180) Coefficient
Constant	$ß_0$	7.1700 (22.5700)*	7.0920 (6.4590)*
Farm size (ha)	$ß_1$	0.0098 (2.0140)**	0.0138 (0.1737)
Family farm labour (mandays)	$ß_2$	-0.0728 (-4.8730)*	-0.0148 (-3.9860)*
Hired farm labour (mandays)	$ß_3$	0.1470 (9.3930)*	0.1560 (3.5849)*
Farm income (₦)	$ß_4$	-0.0148 (-2.0150)**	-0.0010 (-0.1077)
Fertilizer (kg)	$ß_5$	0.0010 (1.2790)	-0.0024 (-1.0279)
Seed (kg)	$ß_6$	0.0770 (10.8600)*	-0.0088 (-0.5245)
Herbicide (litres)	$ß_7$	0.0078 (1.7830)**	-0.0262 (-2.9236)**
Pesticide (litres)	$ß_8$	-0.0039 (-2.8760)**	0.0014 (-0.8995)
Depreciation (₦)	$ß_9$	-0.2720 -(12.5560)*	-0.4460 (- 4.0358)*
Capital input (₦)	$ß_{10}$	-0.0220 (0.9510)	-0.1910 (-6.0489)*
Inefficiency function			
Intercept	$ŭ_0$	-4.9750 (-4.8240)*	12.5020 (5.0043)*
Age (yrs)	$ŭ_1$	-2.9110 (-7.6500)*	1.9240 (4.1664)*
Sex (dummy)	$ŭ_2$	-0.0045 (-0.4930)	-0.0037 (-0.2476)
Formal education (yrs)	$ŭ_3$	-0.1390 (-1.8090)	-0.781.00 (-15.6812)*
Household size (number)	$ŭ_4$	-0.3400 (-1.9870)**	-0.0418 (-0.2098)
Farming experience (yrs)	$ŭ_5$	-1.7900 (-8.2430)*	-1.4680 (-4.8268)*
Credit obtained (₦)	$ŭ_6$	-0.0074 (-0.2170)	-0.0469 (-4.9054)*
Extension visit (number)	$ŭ_7$	0.1910 (10.4340)*	0.9470 (14.6918)*
Membership of farmer association (dummy)	$ŭ_8$	-0.0140 (-1.4270)	-0.0259 (-2.5221)**
Diagnostic statistics			
Sigma square	$ů^2$	0.0240 (5.6300)*	0.0228 (7.7631)*
Gamma	ɔ	0.9908 (211.91)*	0.9965 (313.46)*
Log likelihood		277.7380	232.1990
LR test		297.2150	284.0328

*,**significant at 1% and 5%, respectively; values in parentheses represent t-ratios;
Source: Computed from field survey data, 2013

For the participants, farm family labour reduced output because of its negative effect on off-farm work. This is in line with Bojnec and Ferto (2011) where family labour correlated with farm inefficiency in Slovenia.

Farm income significantly reduced yam output for participants at 5% probability level. This meant that increase in farm income by 1% would lead to decrease in yam output by 0.015%. Output here was assumed to be a function of labour, holding other inputs constant. As farm income increased, rational participants in off-farm withdrew labour from off-farm employment and allocated more time to farm work. This conformed to the reverse of distress-push diversification that favourable and less risk farm enterprise would discourage off-farm work participation. On-farm and off-farm activities compete for limited managerial time. According to Ellis (1998) and Chikwama (2004), the expansion of the rural off-farm sector would have adverse effects on the development of household agriculture. Available empirical evidence showed that farm household members increased their participation in off-farm work at the expense of farming, mainly when the marginal returns to off-farm work become larger than the marginal returns to on-farm work (USDA, 2008). This result is in line with Rahji (1999) that farm income significantly reduced off-farm work participation. The result invalidated Amao (2008) where farm income did significantly account for participation in off-farm work.

Seed was positively significant at 1% probability level, while herbicide and farm size were positively significant for participants at 5% probability level. This meant that for a one percent increase in seed, herbicide and cultivated yam farmland, yam output would increase by 0.077%, 0.078% and 0.098%, respectively. This is in line with Lawal, Ogbanje and Nenker (2011) found that farm size was positively significant in yam production in Ukum Local Government Area of Benue State. Arene and Okpukpara (2006) noted that smallness of farm size constrained capital injection. For non-participants, increase in herbicide application

would decrease yam output by 0.026%. This was due to the associated high production cost outlay. Participants in off-farm work had the capacity to contain the financial outlay associated with increased production because they enjoyed relaxed farm budget constraints unlike the non-participants. According to Huffman (1980), off-farm income reduced financial constraints, particularly for resource poor farmers, and thus enabled them to purchase productivity enhancing inputs.

Depreciation of farm assets increased production for both participants and non-participants by 0.27% and 0.45%, respectively at 1% probability level. This meant that current value (depreciated) of farm asset would enhance yam production more for non-participants than for participants in off-farm work. This difference could be attributed to the relative financial endowment of participants. Capital input significantly decreased output for non-participants at 1% probability level. This was largely due to their vulnerability to financial shocks, which has been the lot of most small-scale farmers in Nigeria.

The inefficiency model in Table 4.29 showed that the effect of age on the inefficiency of participants and non-participants was significantly negative for the former and positive for the latter. This meant that increase in age by 1% would increase efficiency in yam production for participants by 2.91% but decrease efficiency for non-participants by 1.92% at 1% probability level. For the participants, production was largely capital intensive, hence accumulated years of production would increase knowledge of efficient capital substitution for own labour. Based on the average age of the population for this study (43 years), family labour efficiency might be low. This would be further worsened by the increasing labour migration from farming as observed by Audu *et al.* (2009). The result is consistent with Lawal *et al.* (2011) for yam production in Ukum Local Government Area of Benue State.

Formal education significantly and negatively affected (-0.781) inefficiency in yam production for non-participants at 1% probability level. This implied that increase in formal

education of these farmers by 1% would increase yam production efficiency by 0.78%. Education enhances farm management techniques and efficient utilisation of resources. It is more important to the non-participants because farming is their major source of livelihood. This finding was in line with Idiong, Agom and Ohen (2006) that education enhanced acquisition and utilisation of information on improved technology by farmers. According to James (2008), education is critical to the attainment of development goals.

The result of inefficiency model in Table 4.29 further showed that household size significantly reduced inefficiency of participants at 5% probability level, implying that 1% increase in household size would increase efficiency in yam production by 0.34%. Increase in the size of a farm household would mean that more labour could be released from farm to off-farm activities where more income would be generated for possible reinvestment in farming. This is in line with the positive coefficient in Shehu, Iyortyer, Mshelia & Jongur (2010).

Farming experience statistically reduced inefficiency in yam production for both participants and non-participants at 1% probability level. This implied that increase in farming experience by 1% would raise efficiency of yam production for participants and non-participants by 1.79% and 1.47%, respectively. Farming experience allows farmers to adapt to changing economic conditions and adopt most efficient cultural practices in a given enterprise. This finding is consistent with Nasiru, Jubril, Sani and Sabo (2006) and Mbah (2009).

Credit obtained for yam production had negative effect on non-participantsô efficiency at 5% probability level, implying that 1% increase in credit availability and utilisation would raise their efficiency by 0.05%. In the presence of budget constraints, credit is required to purchase farm inputs as well as pay for supplementary labour. This study indicated that credit was more imperative among non-participants than participants for yam production. According to Emereole (1995) and Nwaru (2004), credit is necessary for the application of superior

technology to traditional agricultural production system. Nwagbo (1989) also stated that credit facilitated productivity.

Number of extension agentsô visit increased inefficiency of both participants (0.1910) and non-participants (0.9470) at 1% probability level. This meant that 1% increase in the number of extension agentsô visits would reduce efficiency in yam production among the respondents by 0.19% and 0.95%, respectively. Extension agentsô visit would normally increase farmersô knowledge and even expose them to improved technologies. However, where farmers are used to a particular mode of production that is already yielding economic results, the introduction of new methods could lead to confusions which would be counter-productive. Membership of farmer associations reduced yam production inefficiency among non-participants. This implied that 5% increase in participation in farmer associations would increase yam production efficiency by 0.03%. Membership of farmer associations affords farmers the opportunity to interact and share new knowledge on yam production with one another.

4.12.4 Maximum likelihood estimates of the stochastic frontier cowpea production function

The maximum likelihood estimates of the technical efficiency in small-scale cowpea production for participants and non-participants were presented in Table 4.30. In the model, the estimated sigma squared was statistically different from zero for participants (4.6468) and non-participants (9.0991) at 1% level, indicating that the estimated stochastic production function fitted the data very well. Also, at 1% level, the gamma (ɔ) of the model was statistically significant for participants (0.9315) and non-participants (0.9999), respectively. Thus, according to Rahman (2002) and Koutsoyiannis (1977), the inefficiencies observed in cowpea production were stochastic and not due to random errors.

Farm size was significant at 1% probability level for participants (0.076) and non-participants (0.109). This meant that 1% increase in farm size would increase the output of cowpea by 0.076% for participants and 0.109% for non-participants. The non-participants had greater elasticity with respect to farm size, obviously because they had more time for their farms than the participants. This is consistent with Jirgi, Ogundeji, Viljoen and Adiele (2010).

Table 4.30: Maximum Likelihood Estimates of the Stochastic Frontier Cowpea Production Function

Variable	Parameter	Coefficient	
		Participants (n=180)	Non-Participants (n=180)
Constant	β_0	4.0240 (14.3186)*	4.5105 (8.9646) *
Farm size	β_1	0.0763 (3.7097) *	0.1093 (4.1470) *
Family farm labour	β_2	0.1607 (4.9244) *	-0.1324 (-2.2943) **
Hired farm labour	β_3	-0.2444 (-4.6100) *	0.1909 (7.3571) *
Farm income	β_4	0.0268 (1.4821)	-0.0643 (-1.4560)
Fertilizer	β_5	-0.0057 (-2.1373) **	-0.0121 (-5.0806) *
Seed	β_6	-0.0172 (-1.2162)	-0.0061 (-0.9935)
Herbicide	β_7	0.0296 (5.7790) *	0.0109 (1.5243)
Pesticide	β_8	0.0441 (3.2141) *	0.0098 (1.6307)
Depreciation	β_9	0.3463 (11.2941) *	0.3453 (16.4344) *
Capital input	β_{10}	-0.0018 (-0.6909)	-0.0016 (-0.8878)
Inefficiency function			
Intercept	δ_0	9.3056 (2.1581) **	8.3377 (7.4138) *
Age	δ_1	-1.4928 (-2.0358) **	-1.5669 (-7.1333) *
Sex	δ_2	-0.0485 (-2.0457) **	-0.0329 (-1.9024)
Formal education	δ_3	-0.0541 (-2.1461) **	-0.0575 (-4.2968) *
Household size	δ_4	-0.1309 (-1.2754)	0.0426 (0.6103)
Farming experience	δ_5	-1.2197 (-2.1385) **	-0.0974 (-7.1523) *
Credit obtained	δ_6	-0.0008 (-0.0950)	0.0116 (1.3186)
Number of extension visit	δ_7	0.0091 (0.5998)	-0.0131 (-1.2864)
Membership of farmer association	δ_8	0.0329 (2.1438) **	-0.0059 (-0.4186)
Diagnostic statistics			
Sigma square	σ^2	0.0174 (4.6468) *	0.0269 (9.0991) *
Gamma	γ	0.9315	0.9999
Log likelihood		203.1745	219.7735
LR test		160.8231	182.1263

*,** significant at 1% and 5% levels, respectively; values in parentheses represent t-ratios.
Source: Computed from field survey data, 2013

Farm family labour significantly increased cowpea output for participants (0.1607) but decreased same for non-participants (-0.1324) at 1% and 5% probability levels, respectively. Cowpea is susceptible to a wide range of pests and diseases. Therefore, the more labour a farm household allocated to cowpea farm, the greater the output would be, opportunity cost of off-farm enterprise notwithstanding. For non-participants, the sign contradicted Omonona, Egbetokun and Akanbi (2010) that family labour increased elasticity of cowpea production.

Hired labour reduced cowpea output for participants (-0.2444) but increased production for non-participants (0.1909) at 1% probability level. For the participants, total reliance on hired labour would be counterproductive as the labourer would not pay adequate attention to monitoring the development of the crop. On the other hand, hired labour would supplement the efforts of non-participants, thereby increasing elasticity of cowpea production.

Fertiliser application significantly reduced cowpea production for participants (-0.0057) and non-participants (-0.1201) at 5% and 1% probability levels, respectively. Increase in the amount of fertiliser applied to cowpea farm by 1% would reduce output by 0.0057% for participants and 0.1201% for non-participants. Cowpea is a nitrogen fixing plant. Increase in inorganic fertiliser application would make the plants to only increase in vegetative growth. The result in this study differed from Wakili (2011) where fertiliser was positively and significantly related to technical efficiency.

Herbicide and pesticide application significantly increased cowpea output for participants (0.0296 and 0.0441) at 1% probability levels, respectively. Increase in herbicide would mitigate weedsô competition with the plants for essential soil nutrients. Increase in the application of pesticide would relieve the plant of its natural susceptibility to a wide range of pests. Participants in off-farm work relied more on these agrochemicals to compensate for their re-allocation of labour away from the farming sector. This is consistent with Jirgi *et al.* (2010).

Depreciation in farm asset increased the output of cowpea at 1% probability level for participants (0.3463) and non-participants (0.3453). Although, this was contrary to expectation, the statistical relevance of hired labour could have greatly suppressed the effect of depreciation.

In the efficiency model, age of the farmer significantly reduced technical inefficiency at 5% and 1% probability levels for participants (-1.4928) and non-participants (-1.5669), respectively. Increase in age afforded the farmer the ability to optimise resource allocation, resulting in increased technical efficiency. At 5% probability level, sex significantly reduced output of cowpea for participants (-0.0485) and non-participants (-0.0329). Based on the indexing, greater number of females in the farm household would raise technical efficiency in cowpea production. This is because adult females gave more attention to farm work (Adepoju *et al*., 2006). At 5% and 1% probability levels, increase in formal education reduced the technical inefficiency of cowpea production for participants (-0.0541) and non-participants (-0.0575) respectively. Educated farmers could better manage farm resources, thereby, increasing technical efficiency.

Farming experience significantly decreased technical inefficiency of cowpea production for participants and non-participants at 5% and 1% probability levels respectively. Farming experience conferred on farmers the ability to thrive under difficult farming conditions, hence the increase in technical efficiency. Membership of farmer association significantly increased technical inefficiency of participants at 5% probability level. Those who were in off-farm work attached high economic value to time utilisation. Hence, the time demand of farmer association would reduce their opportunities to raise capital for farm investment. Although, farmer association would have afforded them new management techniques, off-farm worker relied more on hired labourers for production purpose.

4.12.5 Maximum likelihood estimates of the stochastic frontier rice production function

The maximum likelihood estimates of the stochastic frontier rice production were presented in Table 4.31. The result showed that in the diagnostic model, the statistical significance of the estimated sigma squared at 1% for participants (t=2.7648) and 5% non-participants

Table 4.31: Maximum Likelihood Estimates of the Stochastic Frontier Rice Production Function

Variable	Participants	t-ratio	Non-Participants	t-ratio
Constant	2.3032	5.4368*	5.6581	8.5574*
Farm size	0.335	4.7191*	-0.0052	-0.087
Family farm labour	-0.1252	-2.5116**	-0.5949	-7.1345*
Hired farm labour	0.2606	5.4387*	0.6954	10.2596*
Farm income	0.7029	15.3076*	0.0626	2.3611**
Fertiliser	0.0074	1.3669	-0.2003	-1.5275
Seed	-0.0043	-0.3596	2.5427	11.9561*
Herbicide	-0.0149	-1.4437	-0.0867	-1.8850
Pesticide	0.0098	3.2394*	0.0015	0.4543
Depreciation	0.0974	1.7341	-0.3282	-4.3972*
Capital input	0.0176	1.3679	-0.0947	-3.8539*
Inefficiency function				
Intercept	18.7717	2.2374	0.1524	0.1835
Age	-4.6528	-2.2600**	-0.1483	-0.3214
Sex	0.0488	0.8988	0.0938	1.6994
Formal education	-0.2386	-2.4847**	0.0492	1.2503
Household size	-0.7952	-2.0102**	0.3986	1.6686
Farming experience	-0.2262	-0.7001	-0.0586	-1655.000*
Credit obtained	-0.0083	-0.6243	-0.0298	-1.7889
Number of extension visit	0.0493	1.9043	0.0153	0.5947
Membership of farmer association	0.0004	-0.0039	-0.0082	-1.2302
Diagnostic statistics				
Sigma square	0.0459	2.7648**	0.0074	4.6597*
Gamma	0.9663	64.2432	0.6734	1.6734
Log likelihood	152.1669		149.3179	
LR test	67.9392		10.5611	

*,** significant at 1% and 5% levels

Source: Computed from field survey data, 2013

(t=4.6597), respectively indicated the appropriateness of the model. The gamma for the model was significant for both participants and non participants. This meant that the observed inefficiencies were stochastic and not due to random error. The result, also, showed that farm size significantly increased rice production for participants (0.3350) at 1% probability level. This meant that 1% increase in farm size raised rice output by 0.3350%. With the presence of off-farm income, participants could meet the increased financial obligation associated with large farms. This is consistent with Khai and Yabe (2011) who found that rice farm land increased output in Vietnam.

At 5% and 1% probability levels, family labour significantly decreased rice production for participants (-0.1252) and non-participants (0.5949), respectively. Rice production was labour intensive. Therefore, sole reliance on family labour would reduce productivity. This finding contradicted Khai and Yabe (2011) for Vietnamese rice farmers. Conversely, hired labour significantly increased rice output at 1% probability level for participants (0.2606) and non-participants (0.6954) alike. Increase in hired labour by 1% raised the level of rice production by 0.2606% for participants and 0.6954% for non-participants. This finding was inconsistent with Tijani (2006) that labour did not significantly increase rice production.

At 1% and 5% probability levels, farm income significantly increased rice production for participants (0.7029) and non-participants (0.0626), respectively. With increased farm income, farm households could purchase inputs that were critical for rice production, and hence, have higher output levels.

The use of improved seeds significantly increased rice production for non-participants (2.5427) at 1% probability level. A 1% increase in improved seeds would raise rice production level by 2.5427%. Improved seeds are high yielding; some are drought-resistant, while others are tolerant to water-logging. Non-participants in off-farm work who relied

solely on farm income would obtain higher output from the use of improved seeds. The result is consistent with Khai and Yabe (2011).

The use of pesticides statistically increased rice output for participants (0.0098) at 1% probability level. Increase in pesticide usage by 1% would increase rice output by 0.15%. Use of pesticide, especially, minimises post harvest loss.

Depreciation significantly decreased output for non-participants (-0.3282) at 1% level. Participants embarked on capital intensive production system and therefore would not be affected by depreciation in farm asset. On the other hand, non-participants attached relatively higher values to farm assets since farming was their sole source of livelihood. Hence, their rice output would decline with increasing depreciation of farm assets.

Capital input negatively affected rice output for non-participants (-0.0947) at 1% probability level. Due to cash constraints, non-participants often obtained loan for farm production from informal financial institutions where the interest rate is often high. Thus, increased interest rate and taxes could adversely affect production by non-participants.

The technical inefficiency model showed that age (-4.6528) significantly decreased technical inefficiency for participants at 5% probability level. This meant that increase in age raised the level of technical efficiency among participants. At greater age, participants could pay more attention to rice production due to its high demand so that they could earn more income. This is inconsistent with Khai and Yabe (2011) and Abdulai and Huffman (2000) that participation in non-agricultural activities did not significantly affect rice production.

Formal education (-0.2386) significantly reduced technical inefficiency among farmers who worked off-farm at 5% probability level. This implied that 1% increase in the number of years of formal education would raise technical efficiency in rice production among participants by 0.24%. Coupled with reduced farm budgetary constraints, education would

further enhance the ability of participants to increase production with the knowledge and understanding of farm management skills.

Household size significantly reduced technical inefficiency at 5% level for participants (-0.7952). In other words, increase in household size increased technical efficiency for participants in off-farm work. More members in a household meant that those who were in off-farm could have labour reserve for farm work and, thus, increase technical efficiency. For non-participants, increased household size could increase consumption and, hence, reduce the amount of capital available for farm investment. This result invalidated Khai and Yabe (2011) where household size had no significant effect on technical inefficiency.

At 1% level of probability, farming experience reduced technical inefficiency for non-participants (-0.0586) in off-farm work. In other words, the more years of farming experience a farmer had, the more technically efficient he was. Farmers with more years of experience are expected to be more knowledgeable and effective in farming operations. This result is contrary to Omonona *et al.* (2010) that farming experience increased technical inefficiency.

4.12.6 Maximum likelihood estimates of the stochastic frontier cost function

The maximum likelihood estimates of the stochastic frontier cost function were presented in Table 4.32. In the variance parameters, the sigma square was statistically different from zero at one percent probability level for non-participants. This meant that the model appropriately fitted the data well, especially for non-participants. The significance of gamma (ɔ) indicated the presence of cost inefficiency effect. Hence, cost inefficiency observed in the study was not random errors but stochastic. This result showed that participants were more cost inelastic than non-participants.

Table 4.32: Maximum likelihood estimates of the stochastic frontier cost function

Variable	Parameter	Coefficient and t-ratio	
		Participants (n=180)	Non-Participants (n=180)
Constant	β_0	1.1032 (11.1068)*	1.0550 (8.6948)*
Farm size	β_1	0.7401 (52.9549)*	0.7684 (81.1987)*
Average input price of enterprise 1	β_2	0.1751 (14.6296)*	0.1632 (15.0138)*
Average input price of enterprise 2	β_3	0.0118 (12.6348)*	0.0101 (13.6534)*
Average input price of enterprise 3	β_4	-0.0040 (-0.7256)	-0.0015 (-0.2990)
Average output (tonnes)	Y*	0.0139 (1.9004)	-0.0015 (-0.3064)
Depreciation of farm assets	β_6	0.0125 (1.6376	0.0077 (0.8596)
Inefficiency model			
Intercept	δ_0	0.6623 (0.6077)	3.6318 (2.6133)**
Age	δ_1	0.3422 (1.0691)	-1.5543 (-1.3468)
Sex	δ_2	-1.1157 (-1.1759)	-0.2071 (-4.0576)*
Formal education	δ_3	-0.0515 (-1.0747)	-0.0286 (-2.1879)**
Household size	δ_4	0.3747 (1.0846)	-0.4395 (-3.2150)*
Farming experience	δ_5	0.0382 (0.5449)	-0.3466 (-2.7215)**
Farm income	δ_6	-0.6487 (-1.1484)	-0.1675 (-2.5462)**
Farm labour	δ_7	-0.2918 (-1.1324)	0.7179 (3.6892)*
Credit obtained	δ_8	0.0054 (0.7666)	-0.0391 (-3.4667)*
Number of extension visit	δ_9	-0.0276 (-0.9873)	0.1116 (3.1562)*
Membership of farmer association	δ_{10}	-1.4621 (-1.1660)	0.0719 (7.1906)*
Diagnostic statistics			
Sigma square	σ^2	0.2379 (1.1303)	0.9408 (3.7204)*
Gamma	γ	0.9983 (570.0094)	0.9954 (423.7108)
Log likelihood		190.8569	233.6087
LR test		92.5253	194.8168

*,** significant at 1% and 5% levels; values in parentheses represent t-ratios.

Source: Computed from field survey data, 2013

Two reasons could be advanced for this position. One, participants had more finance, cheaper and more regular funds than the non-participants whose income was seasonal and more uncertain. Hence, cost effectiveness was not always a priority among them. They could be classified as relatively irrational farmers. Two, farming was not the main source of income for participants. In fact, farmers in off-farm work represented the emerging dual farm structure in rural economy. This implied less attention to farm operations, especially as they were already on the threshold of exiting the core farm production sector.

Farm size significantly increased the cost outlay of participants (0.7401) and non-participants (0.7684) at 1% probability level. Similarly, average input prices of enterprises one for participants and non-participants (0.1751 and 0.1632) and two (0.0118 and 0.0101) were statistically significant at 1% probability level. Larger farms required more production inputs, hence more resources were required.

The cost inefficiency function in Table 4.32 indicated that sex (-0.2071), household size (-0.4395), and credit obtained (-0.0391) significantly reduced cost inefficiency for non-participants at 1% probability level. The implication was that the presence of more male-headed households increased cost efficiency. Naturally, men are stronger than women and could undertake arduous farm tasks and consequently conserve fund. More members in non-participating farm households that depend largely on family rather than hired labour, mean increased availability of labour and increased division of labour, thereby leading to cost efficiency. With available funds, farm operations could be performed timely due to the cost advantage of the farmer. For instance, at the early stage of weed emergence, herbicide application could be mild. Conversely, the application of herbicide at a later stage might require the services of an expert which are associated with higher cost.

Formal education (-0.0286) significantly reduced cost inefficiency for non-participants at 5% probability. Farmers who were educated had the capacity to judiciously apply funds and obtain maximum returns. They had information and, hence, could not be exploited by farm services and input providers. Finally, they had better capacity to bargain, especially for labour, and commanded more respect among rural dwellers.

Farming experience (-0.3446) significantly reduced cost inefficiency for non-participants at 5% probability. Farming experience conferred on farmers the historical cost profile of various farming activities and would consequently spend minimally on the operations. Farming experience, also, enabled farmers to avoid cultural practices that would unnecessarily

increase cost. With increased farm income, farmers could afford efficient technology that reduces the financial cost of farm operations.

Farm income (-0.1675) significantly reduced cost inefficiency for non-participants at 5% level of probability. In other words, cost efficiency increased among farmers who had higher farm income. Similarly, increased farm income increases farmersô interest in farm enterprise, thereby sharpening farm management skills.

4.12.7 Maximum likelihood estimates of the stochastic frontier profit function

The maximum likelihood estimates of the stochastic frontier profit function were presented in Table 4.33. In the diagnostic statistics, sigma square was significant for both participants and non-participants, indicating that the model fitted the data well. Gamma was significant for non-participants at 1% probability level. It was close to one (0.9870), indicating high level of profit inefficiencies among the farmers. Rahman (2002) also found high level of profit inefficiency among small-scale farmers in Bangladesh.

The result, also, showed that farm size (0.5387) significantly increased profit among participants at 1% probability level. Although, farm size is normally associated with large cost outlay, participants had the resources to accommodate the cost difference. It is also a fact that farm size is often associated with greater output which translates to more revenue. This finding is consistent with Nganga, Kungu, de Ridder & Herrero (2010) that farm size increased farm firm profit.

Average price of farm tools (0.1205) significantly increased participantsô profit at 5% probability level. Two reasons could be advanced for this strange behaviour of this group of farmers. One, their access to additional fund gave them the capacity to acquire more farm

Table 4.33: Maximum likelihood estimates of the stochastic frontier profit function

Variable	Parameter	Coefficient Participants (n=180)	Non-Participants (n=180)
Constant	β_0	10.7625 (10.2546)*	18.9545 (101.4922)*
Farm size	β_1	0.5387 (5.3932)*	-0.3487 (-7.3121)*
Average cost of hired labour	β_2	0.0392 (0.9178)	0.0244 (6.0640)*
Average price per kg of fertiliser	β_3	-0.0814 (-1.0634)	-0.2879 (-8.1207)*
Average price per kg of seed	β_4	0.0265 (0.7616)	0.0265 (2.5773)**
Average price per litre of agrochemical	β_5	-0.0333 (-1.0957)	0.0292 (8.7689)*
Average price of farm tools/machineries	β_6	0.1205 (2.4244)**	-0.1429 (-11.5394)*
Average marketing cost	β_7	0.0317 (0.9517)	-0.0008 (-0.6513)
Average transportation cost	β_8	0.1110 (1.1998)	-0.4363 (-13.3941)*
Capital input	β_9	-0.0393 (-0.8779)	0.0009 (0.5783)
Inefficiency function			
Intercept	δ_0	-0.3027 (-0.3186)	17.5402 (3.2893)*
Age	δ_1	0.2559 (0.6838)	-3.2897 (-3.0959)*
Sex	δ_2	0.7193 (1.9075)	-0.0066 (-0.4267)
Formal education	δ_3	-0.0267 (-1.2479)	-0.1088 (-2.5144)**
Household size	δ_4	-0.3304 (-1.2600)	0.4056 (2.3508)**
Farming experience	δ_5	0.0843 (0.5327)	-0.6245 (-1.9275)
Farm family labour	δ_6	0.2623 (2.1055)**	-0.5546 (-2.4536)**
Credit obtained	δ_7	-0.0382 (-2.2117)**	-0.3687 (-3.0739)*
Number of extension visit	δ_8	-0.0027 (-0.1009)	-0.0091 (-0.8083)
Membership of farmer association	δ_9	0.4589 (1.3089)	0.3473 (0.3455)
Diagnostic statistics			
Sigma square	σ^2	0.2853 (7.2153)*	0.0106 (2.6832)**
Gamma	γ	0.9974 (0.5379)	0.9870 (146.7041)*
Log likelihood		-133.6595	372.9756
LR test		16.3170	156.2749

*,** significant at 1% and 5% levels.

Source: Computed from field survey data, 2013

tools. Two, due to their off-farm status, reliance on efficient machineries was one major strategy that would enable them succeed as farmers. The behaviour of this variable among participants suggested that participants were inelastic to increasing cost of farm operations. Their goal would just be increased output and, possibly, gross margin.

In the inefficiency function for participants, family labour (0.2623) statistically increased profit inefficiency at 5% probability level. For participants, the allocation of own labour to farm work was inimical to their off-farm business. This finding conformed to Nehring and Fernandez-Cornejo (2005) which emphasised on less own labour by farmers who were in off-farm work. The result also validated the tradeoff theory of labour allocation between farm and off-farm works that off-farm work could be counterproductive with respect to farm enterprises. Unlike women, men are not so skillful in agricultural marketing. Besides, men are more extravagant in spending. These factors could reduce profit efficiency among men. This finding validated the relative importance of women in agriculture in Nigeria (Adepoju, Umar & Agun, 2006; Saror, Ogbanje & Obinne, 2008).

For non-participants, age (-3.2897) and credit obtained (-0.3687) significantly reduced profit inefficiency at 1% percent probability level. As the farmer aged, albeit not infinitely, accumulated experience and increased level of maturity would enhance profitability of farm firms. Availability of credit increased profit because more funds meant increased capacity to acquire critical farm production inputs such as improved seeds, fertiliser and labour as well as facilitated timely operations. This finding, however, invalidated Nganga, Kungu, de Ridder and Herrero (2010) where age in the inefficiency function was positively signed.

Formal education (-0.1088) significantly reduced profit inefficiency for non-participants at 5% probability level. Educated farmers had the advantage of selling their farm produce at the lean period, thereby, attracting higher profit. In addition, they had the knowledge that could enhance optimal utility of resources, thereby, minimising variable cost and maximising gross

margin. This finding is consistent with Nganga, Kungu, de Ridder & Herrero (2010) that higher education reduced profit inefficiency. The result, however, contradicted Wadud and White (2000) and Rahman (2002) who explained that, in Bangladesh, education pulled away households from farming as its opened up opportunities to engage in off-farm work that were often more rewarding than farming on small pieces of land.

Family labour significantly reduced profit inefficiency for participants (0.2623) and non-participants (-0.5546) at 5% probability level. In contrast with participants, non-participants in off-farm work relied heavily on family labour for farm productivity because it was their main occupation. Family labour is a critical productive input among small-scale farmers in developing countries (Okoye *et al.*, 2008).

However, household size (0.4056), which was expected to confer labour availability on farm households, was found to have significantly increased profit inefficiency for non-participants at 5% probability level. This was possible because larger households had higher levels of consumption, thereby reducing the quantity of produce available for sale, and invariably reducing profit efficiency. This finding contradicted Nganga, Kungu, de Ridder and Herrero (2010) where household size was insignificant.

4.12.8 Distribution of crop farmer specific efficiency estimates

The distribution of farmer specific efficiency estimates were presented in Tables 4.34 to 4.36. In Table 4.34, majority of yam farmers who participated (76.7%) and those who did not participate (45.0%) in off-farm work had technical efficiency ranging from 90.0% to 99.99%. Average technical efficiencies of yam production were 88% and 75% for participants and non-participants respectively. These averages suggested that 12% and 25% of yam output were lost to technical inefficiency by participants and non-participants, respectively. The mean technical efficiencies in yam production in this study indicated that participants and

non-participants were both lower than Lawal *et al.* (2011) that the mean technical efficiency in yam production in Benue State was 90%. Loss in technical efficiency could have been due to growing apathy for farm work and increasing scarcity and exorbitance of critical production inputs.

Table 4.34: Frequency distribution of yam farmer specific efficiency estimates

Estimates	Participants (n=180)		Non-participants (n=180)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
0.00 - 20.99	0	0.00	8	4.40
30.00 - 39.99	4	2.20	24	13.30
40.00 - 49.99	7	3.90	15	8.30
50.00 - 59.99	11	6.10	8	4.40
60.00 - 69.99	11	6.10	7	3.90
70.00 - 79.99	0	0.00	10	5.60
80.00 - 89.99	9	5.00	27	15.00
90.00 - 99.99	138	76.70	81	45.00
Total	180	100.0	180	100.0

Mean technical efficiency: Participants (0.88); Non-participants (0.75)
Source: Computed from field survey data, 2013

The technical efficiency estimates in cowpea production in Table 4.35 showed that 61.7% of participants and 51.1% of non-participants had technical efficiency ranging from 90.00% to 99.99%. The result also showed that average technical efficiency for participants and non-participants were 94% and 90%, respectively. These averages meant that 6% and 10% of cowpea output were lost to technical inefficiency among participants and non-participants, respectively. Technical efficiency of cowpea production was high because the crop has the capacity to trap and convert atmospheric nitrogen to nitrates and utilise same for growth and productivity. In addition, cowpea is often grown on a virgin land except where it is intercropped. This result is higher than the 66.49% mean technical efficiency in cowpea production that was found by Wakili (2011).

Table 4.35: Frequency distribution of cowpea farmer specific efficiency estimates

Estimates	Participant (n=180)		Non-participants (n=180)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
0.00 - 20.99	0	0.00	0	0.00
30.00 - 39.99	0	0.00	1	0.60
40.00 - 49.99	1	0.60	1	0.60
50.00 - 59.99	1	0.60	6	3.30
60.00 - 69.99	5	2.80	4	2.20
70.00 - 79.99	6	3.30	5	2.80
80.00 - 89.99	5	2.80	28	15.60
90.00 - 99.99	111	61.70	92	51.10
Total	129	71.7	137	76.1

Mean technical efficiency: Participants (0.94); Non-participants (0.90)
Source: Computed from field survey data, 2013

The technical efficiency estimates for rice production in Table 4.36 indicated that 53.3% of participants and 56.1% of non-participants had technical efficiency ranging from 90.0% to 99.99%. The result, also, showed that average technical efficiencies for participants and non-participants were 92% and 93%, respectively. These averages meant that 8% and 7% of cowpea output were lost to technical inefficiency among participants and non-participants, respectively. These averages were higher than 81.6% in Khai and Yabe (2011) for Vietnamese rice farmers.

Table 4.36: Frequency distribution of rice farmer specific efficiency estimates

Estimates	Participant (n=180)		Non-participants (n=180)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
0.00 - 20.99	0	0.00	0	0.00
30.00 - 39.99	0	0.00	0	0.00
40.00 - 49.99	0	0.00	0	0.00
50.00 - 59.99	1	0.60	0	0.00
60.00 - 69.99	5	2.80	0	0.00
70.00 - 79.99	5	2.80	3	1.70
80.00 - 89.99	16	8.90	26	14.40
90.00 - 99.99	96	53.30	101	56.10
Total	123	68.3	130	72.2

Mean technical efficiency: Participants (0.92); Non-participants (0.93)
Source: Computed from field survey data, 2013

4.12.9 Distribution of farmer specific cost and profit efficiency estimates

The distribution of farmer specific cost and profit efficiency estimates are presented in Tables 4.37 and 4.38 respectively. In Table 4.37, 52.8% of participants and 77.2% of non-participants in off-farm work had cost efficiency ranging from 0.00% to 10.99%. The results, also, showed that average cost efficiencies for participants (11%) and non-participants (11%) were very low. This result implied that 89% misapplication of funds was due to cost inefficiency. The low average cost efficiency observed in this study could be attributed to imperfect input market where prices of inputs varied widely across locations and were influenced by distances. In addition, the scarcity of a critical input like fertiliser could only mean that farmers would pay higher prices for the commodity, especially since there was no adequate substitute yet.

Table 4.37: Frequency distribution farmer specific cost efficiency estimates

Cost	Participants (n=180)		Non-participants (n=180)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
0.00 ï 10.99	95	52.80	139	77.20
11.00 ï 15.99	81	45.00	36	20.00
16.00 ï 20.99	4	2.20	4	2.20
21 ï 25.99	0	0.00	0	0.00
26 ï 30.99	0	0.00	1	0.60
Total	180	100.0	180	100.0

Mean cost efficiency: Participants (0.11); Non-participants (0.11)
Source: Computed from field survey data, 2013

Majority of participants (38.9%) and non-participants (87.2%) in Table 4.38 had profit efficiency ranging from 90.00% to 99.99%, while average profit efficiencies for participants (81%) and non-participants (95%) were high. This implied that 9% and 5% of gross margin were lost to profit inefficiencies by participants and non-participants, respectively. The three arable crops selected for this analysis constituted dominant staple foods in many Nigerian households. With increasing urbanisation resulting in greater proportion of non-farmers who are willing to pay for these food items at any price, farmers could obtain high returns to scale.

This result further showed that non-participants in off-farm work had greater profit efficiency than the participants. This is another indicator of the tradeoff in labour supply between farm and non-farm sectors of the rural economy. Furthermore, the emerging dual farm structure may not be so beneficial to the small-scale farmers.

Table 4.38: Frequency distribution farmer specific profit efficiency estimates

	Participants (n=180)		Non-participants (n=180)	
Profit	Frequency	Percentage (%)	Frequency	Percentage (%)
0.00 - 20.99	1	0.60	0	0.00
30.00 - 39.99	0	0.00	0	0.00
40.00 - 49.99	4	2.20	0	0.00
50.00 - 59.99	4	2.20	0	0.00
60.00 - 69.99	26	14.40	2	1.10
70.00 - 79.99	40	22.20	3	1.70
80.00 - 89.99	35	19.40	18	10.00
90.00 - 99.99	70	38.90	157	87.20
Total	180	100.0	180	100.0

Mean profit efficiency: Participants (0.81); Non-participants (0.95)
Source: Computed from field survey data, 2013

Testing of Hypotheses

4.13 Participation in Off-farm Work and Amount of Off-farm Income's Share invested in Farming

Heckmanôs two-stage selection model was used to test hypothesis one. The dependent variable, examined in two hurdles, was a measure of the extent of reliance of farm household on off-farm income. The result is as presented in Table 4.39. The lambda of the model provided the proportion of total variability not explained which was 1.38%. This meant that the variables in the model accounted for 98.62% of the variability in the amount of off-farm incomeôs share of household income that was invested in farming. The chi-square of the model was statistically different from zero. Hence, the null hypothesis was rejected in favour of the alternative hypothesis that socioeconomic characteristics of farmers have significant effect on their participation in off-farm work and the amount of off-farm incomeôs share of household income that was invested in farming.

Table 4.39: Participation in off-farm work and amount of off-farm income's share invested in farming (n=180)

	Independent variables	Coefficient	z	P>|z|
Decision to participate in off-farm work model	Age (years)	0.088122	0.93	0.35
	Sex (1=male, 0 otherwise)	-0.543429	-0.56	0.578
	Education (years)	11.243100	2.06**	0.039
	Household size	0.997243	2.19**	0.029
	Farming experience (years)	-0.140584	-1.60	0.11
	Total farm size	-0.916751	-1.44	0.151
	Total crop revenue (₦)	0.000270	0.45	0.655
	Distance to market (km)	-0.343226	-0.84	0.401
	Primary occupation (1=farming, 0 otherwise	2.673437	1.48	0.14
	Land ownership (1=own farmland, 0 otherwise)	-284.123	-13.00*	0.000
	Government payment (₦)	0.000090	1.86	0.063
	Ratio of farm asset to household asset	-3.8003	-1.56	0.118
	Operating profit margin	798.1200	2.12**	0.034
	Asset turnover ratio	-0.038540	-0.32	0.748
	Capital input (₦)	-0.0079	-2.12**	0.034
	Farm capital (₦)	0.00095	-1.25	0.212
Amount of off-farm income's share invested in farming (₦)	Constant	0.2919	8.28*	0.000
	Age (years)	-0.00123	-4.08*	0.000
	Sex (1=male, 0 otherwise)	-0.000552	-0.09	0.93
	Education (years)	0.017111	2.53**	0.011
	Household size	0.001225	1.15	0.252
	Farming experience (years)	0.000411	1.68	0.093
	Total farm size	-0.005176	-3.49*	0.000
	Total crop revenue (₦)	0.000004	2.25**	0.024
	Distance to market (km)	-0.000366	-0.37	0.712
	Primary occupation (1=farming, 0 otherwise)	0.010739	2.12**	0.034
	Land ownership (1=own farmland, 0 otherwise)	-	-	-
	Government payment (₦)	-0.000107	-12.94*	0.000
	Ratio of farm asset to household asset	0.024532	2.00**	0.046
	Operating profit margin	0.073683	0.30	0.764
	Asset turnover ratio	0.004805	6.65*	0.000
	Capital input (₦)	0.000343	0.78	0.437
	Farm capital (₦)	-0.000010	-5.67*	0.000

*,** significant at 1% and 5%, respectively; Lambda = 0.01377; rho = 0.48381; Sigma = 0.02846; $Chi^2(15) = 631.33$; Prob > $chi^2 = 0.000$;

Source: computed from field survey, 2013

In the first hurdle, age had no significant effect on the probability of participation. In the second model, however, age (-0.00128) significantly reduced the amount of off-farm share as a percentage of household income invested in farming at 1% probability level. As a farmer advanced in age, the intensity of off-farm work, as well as the associated income, reduced. More so, the tempo of farm activities and the level of total investment dropped. All these contributed to the reduction of overall off-farm income and the share that was reserved for farm investment. The results of the two models contradicted Harris *et al.* (2010) and El-Osta (2011) where age did not significantly affect the decision to invest or the level of capital investment in farming.

In the first model, farm size had no significant effect on the probability of participation but significantly reduced the amount of off-farm incomeôs share (-0.005176) that was invested in farming at 1% probability level. This could be attributed to the fact that increasing farm size imposed restriction on off-farm work participation as well as the income from the sector. Although, Harris *et al.* (2010) showed empirically that larger farmers required larger capital expenditures, as the farm size of a household increased, off-farm work and off-farm income declined, thereby reducing the amount of off-farm incomeôs share invested in farming.

In the second model, government payment (-0.000107) significantly reduced the amount of off-farm incomeôs share invested in farming at 1% probability level. Those who were in government service would pay relatively less attention to farming and, hence, reallocated their off-farm incomeôs share to the non-farm sector. Thus, the more of government payment they received, the farther away they drifted from farming. In Harris *et al.* (2010), government payment did not significantly affect investment in the second hurdle.

In the first model, operating profit margin (798.12) significantly increased the probability of participating in off-farm work. This would have arisen from the prudent management of funds injected into farm enterprises. The benefit obtained in the previous period would have

informed and sustained the resolve to participate in off-farm work in line with life cycle hypothesis in Ahituv and Kimhi (2002). The result was consistent with Lagerkvist *et al.* (2006), suggesting the possibility of larger farm firm growth. However, this variable was not significant in the second model.

Capital input (-0.007926) significantly reduced the probability of participating in off-farm work at 5% probability level. For some farmers to participate in off-farm work, they obtained loan or diverted part of their credit for farm investment to off-farm sector. This loan, in rural areas, attracted high interest rate (Nweze, 1990). Again, off-farm businesses were more vulnerable to taxes from various authorities than farm businesses. Thus, capital input, which comprised interest paid on loan and taxes, could discourage and limit participation in off-farm work.

The ratio of farm asset to household asset (0.02453) significantly increased the share of off-farm income that was invested in farming at 5% probability level. Higher ratios shifted emphasis towards farm assets relative to household assets. More farm assets would require maintenance and, eventually, replacement at the end of the useful period. In either of these scenarios, off-farm share came handy.

Asset turnover ratio (0.004805) significantly increased the amount of off-farm income that was invested in farming. For every naira of asset held, a farm household generated annual off-farm income of ₦0.0048. Hence, the more a farm household converted the utilisation of its farm assets to income, the more it would invest its off-farm incomeôs share in farming. According to Myrra *et al.* (2011), this ratio described the capital rotation speed in agriculture.

Farm capital (-0.00001) significantly decreased the amount of off-farm incomeôs share invested in farming at 1% probability level. This meant that farmers with low farm capital level would invest more of their off-farm incomeôs share in farming so as to shore up their farm capital level. In line with Mundlak (1993) that capital constraints constituted major

determinants of the rate of adoption of new technologies, the investment of off-farm incomeôs share would then raise the level of acquisition and utilisation of relevant technologies.

Education significantly (11.243) reduced the odds of participating in off-farm work at 5% probability level. In Nigeria, the elites either abhorred farming or substituted farm labour with capital. This increased their probability to participate in off-farm work. In the second model, education increased the amount of off-farm incomeôs share (0.01711) that was invested in farming at 5% probability level. This implied that more number of years of formal education increased the amount of off-farm incomeôs share that was allocated to farm investment. Higher level of education conferred on farmers increasing efficiency in farm management skills. This was in line with Harris *et al.* (2010) that highly educated farm operators used off-farm income to finance farm investment.

The first model showed that household size (0.9972) increased the probability of participating in off-farm work at 5% level of significance. Large household implied increased consumption expenditure profile. A rational head of large household would seek for additional sources of income or investment that would smoothen the path of consumption. Therefore, the need to participate in off-farm work heightened. This was in line with the push factor diversification observation of Reardon (1997) which induced households to manage income and consumption uncertainties via diversification. In the second model, however, household size had no significant effect on the amount of off-farm incomeôs share invested in farming.

Land ownership (-284.123) largely increased the odd of participating in off-farm work at 1% probability level. Farmers who operated on own farmland could afford to intensify investment on the land and even exploit expansion effect as against those who held temporary farmland rights. Own farm land operators would normally be inclined to seek investment fund off-farm where credit constraint was prevalent. This finding was inconsistent with Jerome (2002) that more secure rights improved householdôs ability and readiness to increase

investment, provided better access to credit, and reduced transaction cost associated with land transfers. Besley (1995) corroborated that more secure tenure to a plot of land increased the probability that individuals would undertake a wide range of investment on the land. This variable, however, did not have significant effect on the amount of off-farm incomeôs share invested in farming.

At 5% probability level, total crop revenue (0.00004) significantly increased the amount of off-farm incomeôs share that was invested in farming. The more income a farm household generated from the farm sector, the more of its off-farm incomeôs share it invested in farming. This is because the economic well-being of a farm is evaluated in terms of farm income. Myrra *et al.* (2011) noted that commercial farms were profitable if they produced annual income and accumulated expected value over time.

Primary occupation (0.0107) significantly increased the amount of off-farm incomeôs share invested in farming at 5% probability level. This implied that farmers who derived their livelihood largely from farming reinvested more off-farm incomeôs share in farming. This, according to Kwon *et al.* (2006), was in response to large fluctuations in farm income faced by farm households.

4.14 Effect of Socioeconomic Characteristics on Off-farm Diversification

In Table 4.40, three functional forms ï linear, quadratic and double-log ï were fitted to the regression model to test hypothesis two in which the dependent variable was off-farm diversification index. Considering the number of significant independent variables, the linear functional form was adopted as the lead equation. The coefficient of determination of the model implied that the independent variables accounted for 98.8% of the variations in off-farm diversification. The F-statistic (649.278) was statistically different from zero. Consequently, the null hypothesis was rejected in favour of the alternative hypothesis,

implying that socioeconomic characteristics of farmers had significant effect on farm diversification.

The result showed that age (-0.001) significantly reduced off-farm diversification at 1% probability level. A 1% increase in age, bearing in mind the average age of participants in this study, would reduce farm diversification by 0.001%. This implied that as a participant aged, his entropy of diversification waned. With the low prevailing life expectancy in the country, a farmer who is close to 50 years old could no longer effectively share his active time among different enterprises, regardless of the benefits. Such a farmer was likely to spend more time on leisure. This result was consistent with McNamara and Weiss (2001) and Mishra and El-Osta (2002) that age was significant and inversely related to farm diversification.

Primary occupation (0.03) was positively associated with diversification at 1% probability level, implying that a one percent increase in the choice of farming as the main occupation increased diversification by 0.03%. The implication was that due to the capital constraint inherent in small-scale farming in Nigeria, a sole farmer would increase diversification, albeit at the early stage and age, to raise fund necessary for the rapid growth of his farm. This was because farm diversification is a strategy used to curb declining farm and household incomes and insuring farms against agricultural production and marketing risks (Reardon, 1997; Kijima *et al.*, 2006).

The number of adult females (-0.013) in a farm household significantly decreased farm diversification at 1% probability level. This implied that a 1% increase in the number of adult females reduced farm diversification by 0.013%. Off-farm work required the ability to share naturally endowed time between mutually exclusive enterprises. This constrained the number of off-farm enterprises females could engage in, while retaining farm work and household chores.

Table 4.40: Effect of socioeconomic characteristics on farm diversification (n=180)

Parameters	Linear		Quadratic		Double-log	
	ɓ	t-ratio	ɓ	t-ratio	ɓ	t-ratio
Constant	0.573	12.435*	0.562	6.148*	-4.005	-2.143**
Age	-0.001	-7.008*	5.13E-08	-0.004	-0.003	-0.020
Sex	-0.004	-0.333	0.005	-0.524	-	-
Primary occupation	0.03	5.107*	0.014	2.454**	-	-
Farmer association	0.001	-0.12)	-0.004	-0.449	-	-
Education	0.003	2.691**	0.001	3.531*	-0.062	-3.171*
Adult male	0.001	-1.355	0.001	-0.975	0.031	-1.156
Adult female	-0.013	-4.299*	0.001	-1.652	0.395	7.336*
Children	0.001	-0.722	-1.58E-05	-0.636	-0.028	-1.549
Farm size	-0.089	-7.809*	-0.004	-1.434	0.631	1.813
Farming experience	-9.22E-05	-0.073	2.26E-05	-0.391	0.224	-1.502
Off-farm work experience	0.007	5.502*	3.20E-06	-0.043	1.733	6.148*
Distance to market	0.001	-0.447	0.001	-1.272	0.084	2.174**
Credit market	2.51E-06	-1.433	1.81E-09	5.512*	0.055	3.557*
Off-farm hours	7.93E-05	4.138*	9.52E-09	-0.62	0.006	-0.182
On-farm hours	-1.76E-05	-6.753*	-2.92E-10	-0.133	-0.664	-7.673*
Leisure hours	-5.76E-06	-2.400**	1.16E-09	-0.984	-0.031	-1.829**
Farmland ownership	0.009	-1.451	0.002	-0.475	-	
Infrastructures	0.002	1.843	5.25E-05	-0.134	0.009	-0.615
Farm asset current value	-1.48E-06	-8.179*	2.97E-11	4.262*	-0.303	-1.688**
Crop income	-3.39E-08	-2.424**	7.42E-14	4.829*	0.733	2.395**
R^2	0.988		0.994		0.902	
F-statistic	649.278*		686.210*		94.282*	

*, ** significant at 1% and 5% probability levels, respectively.

Source: Computed from field survey, 2013;

The result also showed that farm size (-0.089) significantly imposed restriction on diversification at 1% probability, implying that 1% increase in farm size reduced diversification by 0.089%. With the tradeoff in labour allocation observed in this study, the increased cost outlay associated with larger farm size could completely offset the income from off-farm sources. Hence, the greater the farm size a farm household had, the less the amount of time it had left to participate in several off-farm enterprises. In like manner, participation intensity could decline. This result validated Weiss and Briglauer (2002) that smaller family farms had little capacity for risk reduction through diversification given that a

large proportion of the householdôs wealth and labour capacity was allocated to own farm business.

Off-farm work experience (0.007) significantly increased diversification at 1% probability level, implying that a 1% increase in the number of years of off-farm work increased diversification by 0.007%. The more years a farmer spent in off-farm work, the closer his entropy of diversification got to unity. The reason is that, apart from financial benefits, off-farm work is less rigorous than farm work. This result validated the true state dependency of Ahituv and Kimhi (2006) that those who have worked off-farm before were most likely to continue and that the probability of part-time farmers transiting into full-time farming was high. The dangerous trend, however, is that participation in off-farm work is the first step out of farming as noted by Harris *et al.* (2010). Their continuity in farm enterprise was unlikely (Glauben *et al.*, 2004) because increased diversification implies decreasing time for farm work.

Off-farm hours (0.00079) significantly increased diversification at 1% probability level. Time is an important growth factor in most business ventures. Besides, better time management strategies could be learnt with more hours of off-farm work. Hence, more hours of off-farm work increased diversification. This result contradicted McNamara and Weiss (2001) that the degree of diversification was significantly lower for farms where the operator was working off the farm in the previous period. Conversely, on-farm (0.00076) and leisure hours (0.000058) significantly reduced diversification at 1% and 5% respectively. Obviously, a farmer cannot be on his farm or resting place and in his off-farm business simultaneously. Where he cannot efficiently manage time allocation between farm and off-farm sectors, diversification moved backward towards zero. This finding showed that the emerging dual farm structure in a labour-intensive farm production was counterproductive.

Farm asset current value (-0.000048) significantly reduced diversification at 1% probability level. Growth in farm asset, or gradual depreciation of farm assets, or greater ease of asset replacement, had the tendency to retain farmersô interest in farming. In the presence of efficient machineries, farmers could execute farm operations with ease and even accomplish more work per unit time. Consequently, farm diversification could potentially be on the decline.

Education (0.003) was found to have significantly increased diversification at 5% probability level. With more formal education, preference for white collar jobs would be heightened. In addition, the flexibility to effectively switch between farm and off-farm enterprises was higher. Finally, the capacity to manage two competing enterprises was greater among educated farmers. This result was in line with Huffman (1980) that increasing farmersô education directly increased the odd of diversification. Kurosaki (2001) also found that education positively affected off-farm wage level via diversification. This result was, however, inconsistent with McNamara and Weiss (2001).

Crop income (-0.0000034) significantly decreased diversification at 5% probability level. The more income a farmer realised from his farm enterprise, the less attention he might pay to diversification. Besides, more income from crop enterprises would have taken a toll on the farmerôs time endowment, leaving so little time left for off-farm work. Crop income is largely a measure of wealth for a small-scale farm household. This result indicated that wealthier farms are less risk averse and less diversified, which is consistent with Pope and Prescott (1980) who found a negative and significant relationship between wealth and farm diversification. McNamara and Weiss (2001) also confirmed that larger farmers (measured by farm income) tended to be more specialised and required more operatorôs labour time.

4.15 Difference in Farm Capital among Categories of Off-farm Work

The F-statistic of one-way analysis of variance was used to test hypothesis three. The result is presented in Tables 4.41 to 4.43. The F-statistic (4.61) in Table 4.41 was significant at 5% probability level. As such, the null hypothesis was rejected in favour of the alternative hypothesis implying that there was significant difference in farm capital among categories of off-farm work.

Table 4.41: Difference in farm capital among categories of off-farm work (n=180)

Farm capital	Sum of Squares	df	F	Significance
Between Groups	1,147,397,141,018.69	2.00	4.61**	0.01
Within Groups	22,038,641,150,159.40	177.00		
Total	23,186,038,291,178.10	179.00		

** significant at 5% probability level

Source: computed from field survey, 2013

The least square difference in Table 4.42 showed that the mean difference in farm capital (₦176,173.13) between farmers in agricultural wage employment and self-employment was statistically significant at 1% probability level. Also, at 5% probability, farmers in non-agricultural wage employment had significantly more farm capital (₦132,639.36) than those in self-employment category.

Table 4.42: Least square difference in farm capital among off-farm work categories

Major Component of off-farm work LSD	(I)	(J)	Mean Difference (I-J)	Significance
	AWE	AWE	43,533.77	0.538
		SE	176,173.13*	0.004
	NAWE	AWE	(43,533.77)	0.538
		SE	132,639.36**	0.05
	SE	AWE	-176,173.13*	0.004
		NAWE	-132,639.36**	0.05

*,** significant at 1% and 5% levels, respectively

Source: Computed from field survey data, 2013

Finally, the Duncan multiple range test in Table 4.43 confirmed that farm capital was highest in the agricultural wage employment category (₦636,483.99) and least in the self-employment category (₦460,310.85).

Table 4.43: Duncan multiple range test of mean farm capital among off-farm work categories

	Farm capital among Component of off-farm work		
		N	*Subset for alpha = 0.05
Duncan[a]	Self-employment	77	460,310.85
	Non-agricultural wage employment	43	592,950.22
	Agricultural wage employment	60	636,483.99

* Means for groups in homogeneous subsets are displayed.

Source: Computed from field survey data, 2013

4.16 Relationship between Off-farm Income's Share of Household Income and Farm Capital

Pearson product moment correlation was used to test hypothesis four. The result is presented in Table 4.44. The result showed negative coefficient (-0.387) which was significant at 1% probability level. The implication was that 1% increase in off-farm income's share was associated with decrease in farm capital by 0.387%. Consequently, the null hypothesis was rejected in favour of the alternative hypothesis, implying that there was significant (negative) relationship between off-farm income's share of household income and farm capital. Off-farm income's share represented the level of reliance of farm households on off-farm income. Increase in off-farm income's share connoted more labour reallocation away from the farm sector. As the farm household spent more time off the farm sector, the tendency to acquire assets that would enhance productivity in the off-farm sector was high. The opportunity cost became the farm sector investment.

Table 4.44: Relationship between off-farm income's share of household income and farm capital (n=180)

		Off-farm incomeôs share of household income
Farm capital	Pearson Correlation	-0.387*
	Significance	0.000
	N	180

* Correlation is significant at the 0.01 level (2-tailed)

Source: Computed from field survey data, 2013

4.17 Difference in the Decision to Participate in Off-farm work

Kruskal-Wallis (H) was used to test hypothesis five in which farm capital was categorised into quartiles. The result, as presented in Table 4.45, showed that farmers whose farm capital fell within 50% and below had the least mean ranks of 174.50 and 176.50. As a rule of thumb, this result implied that lower farm capital was associated with greater resolve to participate in off-farm work. In the absence of input subsidy and efficient input market, coupled with poor compensation policy, farmers engaged in off-farm work to ensure that their farms were well established. However, the chi-square statistic (1.33) of the model was not statistically significant. Hence, the alternative hypothesis was rejected in favour of the null hypothesis that there was no significant difference between farm capital and the decision to participate in off-farm work. In spite of the financial benefits associated with off-farm work, farmers were probably cautious of the opportunity cost of this paradigm shift to ameliorate farm budget constraint.

Table 4.45: Difference in the decision to participate in off-farm work

Test variable	Sample	N	Mean Rank	Chi-Square	P-value
Decision to participate in off-farm work	at least 25 percent	90	174.50	1.330	0.722
	at least 50 percent	90	176.50		
	at least 75 percent	90	182.50		
	above 75 percent	90	188.50		
	Total	360			

Grouping Variable: quartile of farm capital

Source: Computed from field survey data, 2013

4.18 Difference in Farm Capital between Male and Female-headed Farm Households

Test of meansô difference was used to test hypothesis six. In the result presented in Table 4.46, the mean difference of ₦85,158.80 indicated the amount by which the farm capital of male-headed households exceeded that of the female-headed households. The t-ratio (1.908) was not statistically significant at either 1% or 5% probability level. Consequently, the alternative hypothesis was rejected in favour of the null hypothesis that the difference in farm capital between male and female-headed households was not statistically different from zero.

Table 4.46: Difference in farm capital between male and female-headed households (n=180)

Samples	Mean	Standard Deviation	Mean difference	t-ratio	Significance
Farm capital of male headed household	642,032.49	371,146.06	85,158.80	1.908	0.058
Farm capital of female headed household	556,873.69	335,890.35			

Source: Computed from field survey data, 2013

4.19 Difference in Farm Efficiency Estimates between Participants and Non-participants

The result of the test of meansô difference, which was used to test hypothesis seven is presented in Table 4.47. The result showed that the t-ratios of the mean differences in yam (10.966) and cowpea production (3.153) were statistically significant at 1% probability level between participants and non-participants in off-farm work. This meant that the mean differences observed between the two groups for these enterprises were not due to random errors. The implication was that the capital substitution strategy of participants produced the intended results in yam and cowpea production as against the tradeoff observed for other variables.

The result was different for profit efficiency as the mean profit of the non-participants (0.9499) was significantly greater than that of the participants (0.8129) at 1% probability

level. Profit is the ultimate goal of any farm enterprise. For the non-participants, the farm firm was largely the sole source of household income as well as livelihood. This underscored the time and management skills they devoted to farming, meaning that they were expected to have relatively less variable cost of production. Again, the probability of the exit of this group of farmers from farming was not as high as for the participants.

Table 4.47: Difference in Farm Efficiency Estimates between Participants (n=180) and Non-participants (n=180)

Samples	Mean	Standard Deviation	Mean difference	T-ratio	P-value
Yam participants	0.8753	0.17299	0.1260	10.966*	0.000
Yam non-participants	0.7493	0.25470			
Cowpea participants	0.9356	0.10264	0.01853	3.153*	0.002
Cowpea non-participants	0.9171	0.08783			
Rice participants	0.9211	0.08541	-0.00268	-0.365	0.716
Rice non-participants	0.9238	0.05114			
Participantsô cost	0.1093	0.01486	-0.00058	-0.359	0.720
Non-participantsô cost	0.1099	0.01792			
Participantsô profit	0.8129	0.13956	-0.13700	-12.821*	0.000
Non-participantsô profit	0.9499	0.05713			

* significant at 1% probability level

Source: Computed from field survey data, 2013

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The broad objective of this study was to conduct farm-level analysis of off-farm income and farm capital accumulation among small-scale farmers in North Central Nigeria. The specific objectives were to: examine the characteristics of off-farm enterprises in relation to off-farm work typology; evaluate off-farm incomeôs share of household income; identify the factors that influenced enterprise diversification among small-scale farmers; ascertain the degree of off-farm diversification among the respondents; determine the joint effect of farm and off-farm incomes on market labour supply; analyse the difference in farm capital among off-farm work typology; assess the inequality of farm capital among small-scale farmers; determine the causality between off-farm income and farm capital; determine the difference in farm capital between participants and non-participants in off-farm work; describe the financial characteristics of the respondents; and determine the level of farm efficiency (technical, cost, and profit) among small-scale farmers in the study area.

Multistage sampling technique was used to select respondents for the study. In the first stage, Benue, Kogi and Niger States were selected randomly from the region. In the second stage, two agricultural zones were randomly selected from each state, making a total of six agricultural zones. In the third stage, two Local Government Areas were randomly selected from each agricultural zone, amounting to 12 Local Government Areas. In the fourth stage, three farming communities were randomly selected from each Local Government Area, amounting to 36 farming communities. Finally, 10 small-scale farmers (five participants and non-participants in off-farm work each) were randomly selected from each farming community, bringing the sample size to 360. Data for the study were obtained from primary source with the aid of standard questionnaire. The questionnaire was pretested, validated

using content validity, subjected to reliability test which produced correlation coefficient of 0.87, before the final copies were administered to the respondents with the aid of trained enumerators who made sure that the questions were properly answered. Statistical tools used for data analysis were descriptive statistics, discriminant function analysis, entropy index of diversification, multiple regression, gini coefficient, causality test, test of meansô difference, financial ratios, stochastic frontier analysis, Kruskal-Wallis, one-way analysis of variance, Pearson product moment correlation, and Heckman two-stage selection model.

Results of the study showed that most off-farm participants (42.78%) were in self-employment typology. While most husbands (40.0%) were in self-employment typology, majority of wives were in agricultural wage typology of off-farm work. Years of off-farm work predominantly ranged from 26 ï 33 (61.5%). The dominant off-farm work in the study area were health work (84.6%), livestock business (83.3), civil service (76.7%), food processing and hired labour (72.7%), private sector (70.8%), and trading (60.7%). On the average, off-farm incomeôs share of household income was 50.28%. While age (-4.08), farm size (-3.49), government payment (-12.94) and farm capital (-5.67) negatively affected the amount of off-farm incomeôs share invested in farming, education (2.53), farming experience (1.68), ratio of farm assets to household assets (2.00) and asset turnover ratio (6.65) positively affected off-farm incomeôs share invested in farming. The strongest predictor of diversification was fund for farm investment (0.654), while the weakest predictor was crop failure (0.359). The mean index of diversification was 0.669 or 66.9%. While increasing farm income implied decreasing market labour supply, off-farm income directly correlated with market labour supply. Farmers in self-employment category of off-farm work had significantly more off-farm income than those in non-agricultural and agricultural wage employments. Farm capital was unequally distributed among farmers in the study area. There was simultaneity bias in the relationship between off-farm income and farm capital and

causality ran from farm capital to off-farm income. Farmers in off-farm work had less farm capital than those who were not. Non-participants in off-farm work had statistically more farm liabilities (₦5,107.51), debt-to-asset ratio (0.446), and loan obtained for farm production (₦4,434.15) than participants. On the other hand, participants incurred more yam production cost (₦24,809.29) and had more total variable cost (₦29,935.64) than the non-participants. Participants in off-farm work were more technically efficient in yam and cowpea production than non-participants. Non-participants, however, had more profit efficiency than participants in off-farm work.

5.2 Conclusion

Based on the summary of the findings of this study, the following conclusions have been made:

i. most small-scale farm households in the study area relied on off-farm income;
ii. off-farm work was embarked upon with the intentions of generating funds for farm investment and increasing farm capital, leading to a gradual drift from core farm production;
iii. farmers in agricultural wage typology had more farm capital than those in other categories of off-farm work;
iv. male-headed farm households had more farm capital than female-headed households;
v. no farm household was completely specialised, neither was any completely diversified;
vi. factors that increased farm diversification included primary occupation, formal education, off-farm work experience, off-farm work hours, and available infrastructures. Conversely, age, number of adult females in a farm household, farm size, on-farm hours, farm asset current value, and crop income decreased farm diversification;

vii. increase in farm income decreased the amount of market labour supply, while more off-farm income induced more market labour supply;

viii. more off-farm income came from self-employment typology; and

ix. in spite of participation in off-farm work, technical efficiency in production was not relatively worsened; however, participation was counterproductive in terms of farm profit efficiency.

5.3 Recommendations

Based on the findings of the study, the following recommendations have been advanced:

i. small-scale farm households should increase the share of off-farm income invested in farming so as to raise the level of production;

ii. deliberate policies should be put in place by stakeholders in rural development to encourage small-scale farmers in non-agricultural wage and self-employment categories to reinvest off-farm income in farming. This is because the re-investment would lead to expansion in farm size and output so that they could operate in larger markets and go into full agribusiness;

iii. similarly, the Federal Government, in conjunction with IFAD, should organize training for farmers on the management of additional income from off-farm work activities. This would enable the farmers to commercialise their farms and take advantage of enabling agribusiness environment in the country;

iv. increase in formal education of small-scale farmers should target managerial skills that would enhance diversification through factor mobility and efficient allocation of labour between farm and off-farm sub-sectors of rural economy;

v. extension programmes should target the provision of basic infrastructures in rural areas so as to facilitate diversification through the development of small and medium enterprises;

vi. the blacksmith section of the Federal Ministry of Agriculture and Rural Development should be strengthened by the government and foreign direct investors to increase the production and supply of farm tools. This will facilitate farm asset replacement by small-scale farmers as a check on depreciation, with the ultimate result of enhancing diversification;

vii. similarly, farmers should increase the ratio of farm assets to household assets as well as asset turnover ratio so as to increase the amount of off-farm incomeôs share invested in farming;

viii. crop revenue should also be increased through efficient marketing strategies so as to increase off-farm share invested in farming;

ix. interest on loan and taxes in rural areas (capital input) should be reduced by local financial institutions and rural authorities so that the probability of small-scale farmersô participation in off-farm would be heightened;

x. extension programmes should also focus attention on efficient labour allocation so that off-farm work does not adversely affect profit efficiency among farmers who participate in off-farm; and

xi. IFADôs rural finance institution capacity building programme should assist the aged to increase funding of farming operations. They should encourage increased land tenure security so as the increase the probability of participating in off-farm.

5.4 Contributions to Knowledge

i. The study successfully disaggregated household status into off-farm work typology. This information will guide IFAD in its rural finance institution capacity building programmes.

ii. The socioeconomic and farm financial characteristics that affected income diversification were also found. The nature of relationship of these factors with the index of diversification was identified. Both IFAD and the government could use this information as a guide on the selection criteria for participation in rural finance programmes.

iii. The reliance of farm households on off-farm income was empirically determined to be above average. This implied that off-farm income contributed significantly to minimising the variability in farm household income. On this basis, government could direct extension agents to shift emphasis towards off-farm work.

iv. Other reasons for reallocating labour away from the farm sector were determined. Subsequently, government could address these issues in order for farmers to refocus their attention on food production for the populace.

v. Farmers who worked off-farm incurred more variable costs of production and made relatively less profit than those who worked only on-farm. This indicates tradeoff in labour allocation between farm and off-farm sectors. In other words, there is rigidity in labour mobility. Thus, investment in rural education should focus on efficient labour allocation.

5.5 Suggestions for Further Research

i. Off-farm income and farm capital accumulation among large-scale farmers should be considered;

ii. Off-farm work and on-farm diversification among small and large-scale farmers is recommended;

iii. Factors affecting labour allocation among large-scale farmers is another important gap to be filled;

iv. Locational factors affecting off-farm work should be investigated; and

v. Farming systems and off-farm work typology should be studied.

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APPENDIX I: STANDARD QUESTIONNAIRE

Department of Agricultural Economics,
University of Nigeria, Nsukka.
14/06/2013.

Dear Respondent,

I am a Ph.D student in the above-named institution undertaking a research on **Farm-Level Analysis of Off-Farm Income and Farm Capital Accumulation among Small-Scale Farmers in North Central, Nigeria.** The aim of the study is to obtain information on the personal efforts farmers make in financing their farm production. Kindly respond to the following issues as best as you can. Emphasis is on 2012 farming season. Your anonymity is guaranteed as the information you provide will be used purely for academic purposes.

Thank you,

Ogbanje, E. Christopher [08036350197; 08185281097]

Researcher

SECTION A: CHARACTERISTICS OF OFF-FARM WORK

1. Do you participate in off-farm work? i. Yes [ ] ii. No [ ]
2. Who in your household participates in off-farm work? i. Husband [ ] ii. Wife [ ] iii. Husband and wife [ ] iv. Matured children [ ] v. Husband, wife, matured children [ ]
3. Off-farm work pattern: i. Full-time [ ] ii. Part-time [ ] iii. Work only on-farm [ ]
4. Number of years of off-farm work:é é é é é é é é .
5. Please specify the off-farm work type(s) you were engaged in during the 2012 season:

S/N	Off-farm work specification	Option box
i	Food processing	
ii	Food vendoring/selling	
iii	Marketing (buying and selling) of farm produce	

iv	Brick laying/masonry work	
v	Carpentry/wood work	
vi	Iron work	
vii	Private sector work	
viii	Civil service	
ix	Tailoring	
x	Lumbering	
xi	Transportation	
xii	Storage of farm produce	
xiii	Salon work	
xiv	Electrical work	
xv	Commissions from sale of land, cars, etc	
	Others (please specify)	

SECTION B: SOCIOECONOMIC CHARACTERISTICS OF FARMERS

6. Age (years):é é é é é é é é é ..
7. Sex of household head: i. Male [ ] ii. Female [ ]
8. Number of years of formal education:é é é é é é é é é é ..
9. Number of adult males in the household:é é é é é é é é é .
10. Number of adult females in the household:é é é é é é é é
11. Number of children in the household:é é é é é é é é é é é
12. For how many years have you been farming?.....
13. In which of these farming systems were you involved in 2012? i. Crop farming [ ] ii. Livestock farming [ ] iii. Crop and livestock farming [ ]
14. Number of times visited by extension agents:é é é é é é é é é
15. Total farmland owned (ha or local unit):é é é é é é é é é é é
16. Total farmland cultivated in 2012 (ha or local unit):é é é é é é ..
17. Distance to the nearest market (km):é é é é é é é é é é é é ..
18. Primary occupation:é é é é é é é é é é é .
19. Household status: i. Head [ ] ii. Member [ ]
20. Land ownership type: i. Own farmland [ ] ii. Rented [ ]

21. Government payment (e.g. pension, etc.) received in 2012 ₦:é é é é é é é é

22. Transfer of funds received from relations, friends, etc. in 2012 ₦:é é é é é é é

23. Share received in 2012 of annual profit of a company in which you invested ₦:é é .

SECTION C: FARM INVESTMENT

24. How much of your farm income did you invest in your farm in 2012? ₦:é é é é é ..

25. How much of your off-farm income did you invest in your farm in 2012? ₦:é é é .

26. How much of your farm investment came from sources other than farm and off-farm in 2012?....................................

27. Kindly list the sources in 26 in order of importance:é é é é é é é é é é é é
é é

28. In what areas of your farm enterprise did you invest your off-farm income in 2012

S/N	Areas of farm enterprise	Amount (₦)
i	Labour	
ii	Seed/seedlings	
iii	Fertiliser	
iv	Herbicide	
v	Pesticide	
vi	Post production processes	
vii	Others (please specify)	

SECTION D: FACTORS THAT INFLUENCE ENTERPRISE DIVERSIFICATION

29. Which of these reasons account for your decision to work off-farm (Please rank in order of importance):

S/N	Reasons	Option Box
i	Fund for farm investment	
ii	Fund for household needs	
iii	Hospital	
iv	Pipe borne water	
v	Inadequate farm land	
vi	Drought	
vii	Crop failure	
viii	Electricity	
ix	Tarred road	
x	Market	
xi	Increased household size	
xii	Inefficient input market	
xiii	Unstable farm income	
xiv	Poor produce price	
xv	Risky farm production	
xvi	Farmland ownership	
xvii	Government payment	
xviii	Credit market	
xix	Inadequate farm income	
xx	Higher off-farm income	
xxi	Main occupation	
xxii	Shares received	
xxiii	Others	
xxiv	Others	

30. Which of these infrastructures do you have in your community?

i. Electricity [ ]
ii. Pipe-borne water [ ]
iii. Tarred road [ ]
iv. Market [ ]
v. Hospital [ ]
vi. Others (please specify)é é é é é é é é é é é é é é é é .

SECTION E: DEGREE OF OFF-FARM DIVERSIFICATION

31. Please fill this table as appropriate:

S/N	Off-farm Work in 2012	Income (₦)
i		
ii		
iii		
iv		
v		

SECTION F: FARM AND OFF-FARM INCOME AND MARKET LABOUR SUPPLY

32. Please fill as appropriate

S/N	Component of off-farm work	Income in 2012 (₦)
i	Agricultural wage employment	
ii	Non-agricultural wage employment	
iii	Self employment	

33. Livestock expenditure and income in 2012:

S/N	Name of livestock	Number of animals	Cost of raising the animals (₦)	Revenue from animals sold (₦)	Value of unsold animals (₦)	Value of animals consumed (₦)
1						
2						
3						
4						
5						
6						

34. Labour allocation to farm work in 2012:

S/N	Worker	Average number of days worked **on farm** per week in 2012
i	Adult male	
ii	Adult female	
iii	Children	

35. Labour allocation to off-farm work in 2012:

S/N	Worker	Average number of days worked **off-farm** per week in 2012
i	Adult male	
ii	Adult female	
iii	Children	

36. Average number of days devoted to leisure per week in 2012:é é é é é é é é é .

SECTION G: FARM CAPITAL ACCUMULATION, CONCENTRATION AND CAUSALITY

37. How much did you pay as land rent (₦)?.....

38. Amount of loan obtained for farm production (₦):é é é é é é é é é ..

39. Interest on loan (%):é é é é é é é é é é é é é é é é é

40. Total amount paid as interest (₦):é é é é é é é é é é é é

41. Total tax paid (₦):é é é é é é é é é é é é é é é é é ..

42. Total savings (₦):é é é é é é é é é é é é é é é é é é

43. Quantity of produce stored:é é é é é é é é é é é é é é é é .é é é ..

44. Total market value of produce stored (₦):é é é é é é é é é é é é é é é

45. Quantity of produce consumed:é é é é é é é é ..

46. Market value of produce consumed (₦):é é é é é é é é é é é é é é é é

47. Please fill this table as appropriate

S/N	Farm equipment	No. of units	Year of purchase	Purchase price (₦)	Length of usage (years)	Useful period
1	Hoe					

2	Cutlass					
3	Rake					
4	Basin					
5	Wheelbarrow					
6	Plough set					
7	Ox plough					
8	Knapsack sprayer					
9	Water pump					
10	Water tank					
11	Tractor					
12	Spade					
13	Axe					
	Others (specify)					
14						
15						

SECTION H: FINANCIAL CHARACTERISTICS

48. Please fill this table appropriately

S/N	Household items	Year of purchase	Value (₦)
1			
2			
3			
4			
5			
6			
7			
8			
9			

SECTION I: FARM EFFICIENCY

49. CROPPING ACTIVITIES FOR FIVE (5) MAJOR CROPS: *Please fill this table as it applies to you.*

S/N	Enterprise/Farm size			Input quantity and Price (₦)								
	Name of Crop cultivated	Local unit of farm size measurement	Hectare (ha)	Hired labour		Fertilizer		Herbicide		Pesticide		Seed
				No. of days	Price per day (₦)	No. of bags	Price per bag (₦)	Indicate quantity in Kg or litre	Unit price (₦)	Indicate quantity in Kg or litre	Unit price (₦)	Quantity (kg)
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												