UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

MARKET PARTICIPATION AND ITS EFFECTS ON OUTPUT AND COST EFFICIENCY OF RICE PRODUCTION IN THE UPPER EAST REGION, GHANA

BY

DAMIAN NSOGLINYIN PAAGA

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THIS THESIS IS SUBMITTED TO THE DEPARTMENT OF AGRICULTURE AND RESOURCE ECONOMICS, FACULTY OF AGRIBUSINESS AND COMMUNICATION SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES, NYANKPALA CAMPUS, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS

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DECLARATION

Student

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature: …… Date: ……

Name: Damian Nsoglinyin Paaga

Supervisors

We hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

Principal Supervisor's Signature: …… Date: ……..

Name: Prof. Samuel A. Donkoh

Co-Supervisor's Signature: …….. Date: ……..

Name: Mr. Isaac G.K Ansah

DEDICATION

This work is dedicated to my dear mother, Mrs. Felicitas Tantuo, my beloved wife, Safia Aziz Mumuni and my lovely daughter and son, Eliana Mwinmaale Paaga and Elias Mwinkare Paaga, respectively.

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ABSTRACT

Market participation in agriculture has substantial prospects, essential for providing better incomes and sustainable livelihoods for small-scale rice farmers. This study, therefore, examined factors that influence the level of market participation among rice farmers in the Upper East Region and also estimated how market participation affects the level of production and cost efficiency of rice farmers. A multi stage random sampling procedure was employed to select 400 farmers (200 FBO members and 200 non-members) from four districts in the region (Boils South, Kassena-Nankana Municipal, Bolgatanga municipal and Garu district). A semi-structured questionnaire was used to collect data during the 2018 farming season. The Fractional logit model was used to estimate the factors influencing the level of market participation. The results from this study revealed that the following factors were positively significant in influencing the level of market participation: output levels, prices offered by buyers, the reason for cultivating rice, contract farming, access to transportation and cultivation of rice as a main crop. While the following were negatively significant in determining the level of participation: household consumption, farmers' non-involvement in price setting, years of rice farming experience, distance to market, and farmers' ability to choose between buyers. Furthermore, market participation was also found to be very significant in determining the cost efficiency of farmers, as well as their level of production in the region. The study concludes that rice is mostly produced as a cash crop in the Upper East Region and so recommends that government ensures the existence of adequate markets and better prices that would motivate farmers to increase production so as to boost economic growth.

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LIST OF ABBREVIATIONS

3SLS	Three stage least squares
2SLS	Two Stage Least Squares
ACET	African Centre for Economic Transformation
AEA	Agricultural Extension Agent
AMSEC	Agricultural Mechanization Services Enterprise Centre
CAADP	Comprehensive Africa Agriculture Development Program
CARD	Coalition for Africa Rice Development
CIA	Central Intelligence Agency
CIF	Cost Insurance Freight
DEA	Data Envelopment Analysis
DTM	Distance to Market
FAO	Food and Agriculture Organization
FASDEP	Food and Agricultural Sector Development Policy
FBO	Famer Based Organization
FTC	Farmer Training Centre
FtF	Feed the Future
GDP	Gross Domestic Product
GFSR	Global Food Security Response
GHc	Ghana cedis
GIDA	Ghana Irrigation Development Authority
GIHOC	Ghana Industrial Holding Corporation
GLS	General Least Squares
G-NRDS	Ghana National Rice Development Strategy
GSC	Ghana Seed Company
GSFP	Ghana School Feeding Programme
GSGDA	Ghana Shared Growth and Development Agenda
GSSP	Ghana Strategy Support Programme
Ha	Hectares

IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Centre
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IMR	Inverse Mills Ratio
JICA	Japan International Cooperation Agency
LBC	Licensed Buying Companies
MAFAP	Monitoring African Food and Agricultural Policy
METASIP	Medium Term Agriculture Sector Investment Plan
MoFA	Ministry of Food Agricultural
MT	Metric tones
NAFCO	National Food Buffer Stock Company
NAMSECO	National Association of Agricultural Mechanical Service Centre Operators
NGO	Non-Governmental Organization
NPK	Nitrogen, Phosphorous, Potassium
ODI	Overseas Development Institute
OLS	Ordinary Least squares
RFCR	Reasons for Cultivating Rice
RMC	Rice as Main Crop
ROI	Range of Other Income(s)
RSSP	Rice Sector Support Project
SAP	Structural Adjustment Programmes
SFA	Stochastic Frontier Analysis
SME	Small and Medium scale Enterprise
US$	United States Dollar
USAID	United States Aid
UN	United Nations
UNDP	United Nations Development Programme

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CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture is, largely, a strategic sector in the development of most global south nations. Agriculture was reported by the World Bank (2006) to employ about 40% of the active labor force globally. Further to that which was reported, the agriculture-dependent population in Sub-Saharan Africa, Asia and the Pacific is over 60%, while 18% in Latin America and 4% in high income economies.

In Ghana, the agricultural sector employs a large chunk of the national labor force in both its forward and backward industrial linkages, hence providing food and incomes to individuals and households, according to the CIA-World Fact book (2017), over 50% of the national labour force are employed by the sector.

Similar to what pertains in other African countries that rely on agriculture, the contribution of Ghana's agriculture to the gross domestic product (GDP) has been declining over the years. Its share of the GDP plunged from 39.4% in 2000 to 19.5% in 2016 according to ACET (2015) and CIA world fact book (2017) respectively.

Albeit the reduction of in the agricultural sector's share in the national income is a justified expectation as an economy grows, such change is also expected to be attended by a significant reduction in the population that depends on agriculture, but as it were, the narrative in Ghana does not conform.

Rice has become one of the main food security crop in Ghana due to the changing tastes and preferences of consumers for social and official gatherings(Osei-Asare, 2010). The Ministry of Food and Agriculture (MoFA, 2009) revealed that the per capita consumption of rice increased from 17.5 kg in 1999 to 38kg in 2008 and is expected to further rise to 63kg by 2018 resulting from a tremendous population expansion and urbanization. As such, its production is very important to the economic growth of the country as emphasized by the Food and Agricultural Sector Development Policy (FASDEP) II.

In line with increasing rice production and agriculture as a whole, various governments have implemented diverse interventions to increase rice production to meet the increasing demands and to make Ghana self-sufficient in food production at large. Some of the interventions to increase the production of rice and agriculture in general in the country over the years include:

The "Ghana Shared Growth and Development Agenda**"** (GSGDA) launched in 2010; the "Medium Term Agriculture Sector Investment Plan**"** (METASIP) also launched in 2010;the "Ghana National Rice Development Strategy" (G-NRDS) launched in 2009; the "Block Farm Programme" also launched in 2009; the "National Fertilizer Subsidy Programme" which was re-introduced in 2008; the "Agriculture Mechanization Services Enterprises Centres" (AMSECs) programme launched in 2007; the "Food and Agriculture Sector Development Policy"(FASDEP I & II), launched in 2002 & 2007 respectively and the "Ghana Vision 2020" launched in 1995.

Since the 1970s, the efforts made by various governments to develop the rice industry have proved unsuccessful due to a lot of limiting factors, among them are, lack of research and extension support, inappropriate production system, inadequate basic infrastructure and inappropriate marketing strategy. Between 1989 and 1996, there was a steady increase in rice production at the rate of 13% per annum due to area expansion and yield increase from 0.9 kg/ha to 2.4 kg/ha (MOFA, 2009).

Despite the increases in production, importation of rice continues to increase currently reaching the tune of US$ 600 million per annum as noted by ACET (2015). It has been the objective of successive governments to reduce rice importation by increasing local production. Since the present production levels are low, there exists an immense opportunity for increasing the production of rice to the level of self-sufficiency.

Market participation, according to Gebremedhin *et al.*, (2010), in crop production is measured by the proportion of crop produced that is sold. The gains of interventions such as, the National Food Buffer Stock Company(NAFCO) which was established in 2010, with the objective of ensuring a minimum and guaranteed price for farmers among other objectives and the Ghana School Feeding Programme (GSFP) which was also launched in 2005 with one of its aims being the provision of an output market for farmers (particularly, domestic food producers) were not sustained in subsequent years, largely because farmers could not sell their produce as and when they wanted.

Even those who sold their produce did so at unfavorable prices. This was a disincentive for many farmers and they produced relatively little, or in some cases none at all, in the following years for the fear of not being able to sell again or get favorable prices for their produce. From the annual report of MoFA (2016), the GSFP bought about 0.93% of the total nominal volume of rice produced locally in the year 2015, which is largely insignificant given the fact that the programme offers a very large market opportunity for local farmers.

However, Ghana is reported to spend about US$600 million each year on rice imports (about 70% as deficit), although the country is largely suitable for growing rice, according to ACET (African Centre for Economic Transformation, 2015). Perhaps, if this money or part of it is invested in the local market (that is, buying from the domestic rice producers) annually, Ghana would have been able to make up for the 70% deficit in rice production by now.

From the above narrated happenings in the country, one then can make the inference that the rice sector is possibly under producing because most farmers (especially the resource poor farmers who are unable to delay sales during low price periods to sell at peak prices) are not incentivized to increase their production for fear of the recurrent low prices, especially, at harvest which is the time majority of them sell their produce.

1.2 Problem Statement

Rice is by far a very indispensable staple crop in the Ghanaian society and for that matter, its availability all year round is of great importance to this effect, yet the country is barely self-reliant in its rice production. Increasing rice production could be achieved through extensive cultivation (farmland expansions) or intensive cultivation (increased output per unit area), but, as argued by Anang and Yanwen (2014), due to several factors coupled with the over liberalization (with particular reference to the withdrawal of some restrictive measures) of rice trade in Ghana in the 1980. Locally produced rice has since then lost its competitive edge.

Market participation has been identified as one of the economic growth poles of poor rural households (e.g., Muamba et al., 2011; Olwande & Mathenge, 2012), however, marketing of rice produced in Ghana has not been given the needed consideration by the state over the years (production has always been considered more important than distribution hence, very little has been achieved by government policies in ensuring good markets and prices for the local rice producers). But on the contrary, marketing, according to Sadhu and Singh (1988), is equally instrumental to the better performance of agriculture as is farming itself and should be treated with equal care.

Since the 1970s, attempts have been made by various governments to boost the rice sector by adopting various measures with incentives for increasing food production for the achievement of food security and as well check the rising incidence of poverty. Such efforts have not produced the preferred results. A case in point is the implementation of import

tariffs and taxes on imported rice and the fertilizer subsidy programme which have been found to be non-beneficial to farmers (MAFAP, 2013). It was noted that these interventions did not provide adequate protection for domestic producers against foreign competitions as these policies were intended. To reverse the situation requires government to also seriously consider farmers' access to market (referred to in this study as market participation), particularly, one that recompenses farmers.

The virtual lack of interventions to provide good and sustainable markets for rice farmers (especially in the Upper East Region) has put farmers at the mercy of buyers who mostly take undue advantage of the vulnerability of these poor farmers. Almost on a yearly basis, farmers make countless appeals to government to intervene in providing them with markets for their produce but these appeals seem not to have had a lasting solution implemented.

To understand the current production situation of rice farmers in an attempt to increase production, it is imperative to assess their market participation and how it influences production. Their inability to sell significant proportions of their produce means that production is hampered which threatens the nation's self-sufficiency and food security.

According to current available statistics, such as the one published by the USAID (2012), the total rice imports are estimated at 70%. This means the nation is only able to supply about 30% of its domestic demand for rice.

Through effective marketing, output and consumption of local rice can be increased. It guides farmers towards new production prospects and inspires diversification and as well improving farmer's response to market demands and prices. Its dynamic functions are thus of primary importance in promoting economic activity and creating employment. If the government's aspiration of realizing self-sufficiency in rice production and food security at large is to be realized, then marketing of local rice ought to be strongly considered and the needed policies together with strategies implemented.

Market participation is a fundamental component in the commercial transformation of agriculture in Ghana, which is a well-known fact to be very important in achieving economic growth and development, especially, due to the nation's huge dependence on agriculture. It is in the light of this that a study to investigate the factors that influence farmers' ability to sell their produce and its implications on output is of great prominence. It is, essentially, regarding the issue of low production in the local rice sector that this research seeks to look into the level of market participation among rice farmers. Another motivation for the pursuit of this study is the lack of literature on the current levels of market participation among rice farmers in the region and the extend (magnitude) to which the level of market participation increases farmers rice output levels.

1.3 Research Questions

The research questions to be addressed by the study are as follows:

1. What are the levels of market participation among rice farmers in the Upper East Region?

2. What are the determinants of market participation?
3. What are the effects of market participation on farmers' output?
4. What are the effects of market participation on the cost efficiency of rice farmers?

1.4 Research Objectives

The core objective of this study is to determine the factors influencing rice farmers' market participation and its effects on output and cost efficiency in the Upper East Region.

1.4.1 Specific research objectives

The study specifically seeks to:

1. Assess the level of market participation among rice farmers;
2. Investigate the determinants of market participation;
3. Measure the effects of market participation, on farmers' output; and
4. Examine the effects of market participation on the cost efficiency of rice farmers.

1.5 Hypothesis

In finding answers to the research questions and to further achieve the objectives of this study, the following hypothesis was tested in the course of this study.

1a. H_0: Market participation does not have any significant effect on rice output and farmers' cost efficiency.

1b. H_1: Market participation does have a significant effect on rice output and farmers' cost efficiency

The study also hypothesized that market participation is influenced by the farmer's output levels, farming experience, sex, household size, education level, engagement in contract

farming, access to transport, distance to market, ability to choose between buyers, reason for cultivating rice, and the price offered by buyers, among others.

1.6 Justification for the Research

The Upper East Region is among the prominent rice producing regions in the country and so serves as a good setting for this study to make an assessment of farmers' market participation.

Market participation is very critical to a better performance in the local rice industry. But, unfortunately, very little has been done in this regard. In view of this, studies on the effects of market participation on rice production in the region serves as guide to policy makers (such as MoFA, G-NRDS and NAFCO) in future investment and policy formulation in the rice sector.

Again, this study provides evidence on the levels of market participation and its direct effects on farmers' output and this information will be useful to the relevant authorities. The study further provides evidence to Non-Governmental Organizations in the design and implementation of their interventions on how to ensure greater market participation and a sustainable growth in rice output. Lastly, the study contributes to literature and will serve as a future guide to academics in similar fields of study.

1.7 Organization of the Thesis

The study is organised into five chapters; Chapter one comprises of an introduction to the study, problem statement, research questions, research objectives and justification for the study. Chapter two consists of literature review while Chapter three entails the methodology used in collecting and analysing the data. Chapter four presents the results and discussion while Chapter five summarizes the findings and also entails conclusions made based on the findings as well as makes recommendations based on the conclusions.

CHAPTER TWO

LITERATURE REVIEW

2.1 The liberalization policy and trend of rice production in Ghana

According to Khor and Hormeku, (2006), the liberalization policies under the structural adjustment programme (which was implemented in 1983) generally had consequences for agriculture and, particularly, for smallholders in rice production in particular. Reduction of applied tariffs caused an increase in the imports of agricultural outputs which can be locally produced. Import subsidization by government resulted in cheaper prices of imported agricultural produce as compared to the locally produced ones, and the removal of government subsidies on agricultural inputs by the Ghana government largely contributed to unequal market competition between local agricultural produce and farm produce from advanced countries which are heavily subsidized.

As part of the liberalization process, applied tariffs on agricultural produce were also reduced and in some cases, completely removed while prices of agricultural inputs increased. This, largely, contributed to an increase in the volumes of agricultural commodities imported to make up for the deficits in the domestic supply. This deficit is largely attributable to the fact that smallholders lack the means to access credit facilities whose interest rates have sharply increased since the failure of large-scale commercial farmers to repay their debts.

The few commercial rice farmers who remained faced keen market competition from imported rice which sold cheaply on the market resulting from the heavy subsidies received

from their home governments, plus the cut down on tariffs which applied to imported agricultural commodities. The imported polished rice diverted consumers away from the local rice partly due to its ease of cooking since it is free from stones and chaff as compared to local rice.

As noted by Khor and Hormeku (2006), in the Katanga Valley of the Northern region of Ghana, the massive rural-urban migration by some farmers, who were affected by the liberalization policies, resulted in farms being abandoned and children dropping out of school since their parents could no longer afford to pay school fees. The migration also hugely affected households which made their living from providing farm labour

In Ghana, rice is one of the prominent crops and it is cultivated as a food crop as well as a cash crop. Rice cultivation in the country was characterized by smallholder farmers producing under indigenous production system.

According to Konings (1986) and Amanor (2011), this system was subject to change and transformation resulting from the promotion of large-scale commercial rice farms. They noted that, in spite of the promotion of large-scale commercial farms which received huge financial support from the state, the system collapsed, resulting largely from the commercial farmers' failure to pay off their loans owed the banks. This led to a shift in paradigm, focusing on smallholders' incorporation into the national agricultural modernization programme premised on mono-cultural food crop production system in which high crop yields are synonymous with external input use. Nonetheless, the nation's

rice sector is still generally known to be underperforming, and for that matter, the huge imports to meet domestic consumption.

2.2 Importance of the rice sector

Dietary habits in Ghana show a shifting tendency towards rice, it is increasingly growing into an essential staple food demanded throughout the country. Rice plays a central role in Ghana's agriculture sector and further contributes, considerably, to the country's Gross Domestic Product. Hence the importance of Self-sufficiency in rice production together with market developments, as noted in Bangladesh by Francesco (1994), brings about relative stability in food grain prices and a decline in the incidence of poverty in an economy.

Under the Vision 2020 perspective plan, rice production is expected to be instrumental in achieving national food security, reducing rural poverty and adding to the general economic wellbeing of the country through import substitution and conservation of foreign exchange. This is underpinned by the many studies that have shown the immense role rice plays in the growth of an economy. An example is the study by Brown (1993), which noted that the growth of the rice industry in Malaysia was a major source of foreign exchange, an avenue of creating wealth for the poor and attaining self-sufficiency in rice production.

The value of Ghana's rice imports is currently estimated to stand at US$ 600million per annum. If the government's rice import substitution policy proves successful, the nation

will save a substantial amount of foreign exchange and as well create job opportunities resulting from backward and forward industrial linkages.

2.3 Rice farming systems

Rice production in Ghana is mainly for household consumption and for market. It is cultivated under three different ecologies or systems namely: Rainfed Lowland/Valley-bottom; Rainfed Upland and Irrigated ecology/schemes. These are explained briefly below.

2.3.1 Rain fed upland rice cultivation

This system of rice farming is reliant on free draining soils with its water table always being lower than the root zone. This system is contingent solely on adequate and constant rain water (Kranjac-Berisavljevic *et al.*, 2003). This system, therefore, also provides a suitable condition for upland weeds' competition with the crop. Additionally, pest attacks (mostly birds and rodents, MOFA, JICA and CARD, (2009)), long spells of drought and low level of technological adoption characterize such production systems which are known to account for poor rice yields.

The rice varieties which are appropriate for this ecology are early maturing and drought tolerant types. Cultivation of the traditional local varieties of *rice* dominates this system of farming despite the preponderance of evidence that the yields are, comparatively, very low. Some desirable traits that legitimizes the sustained cultivation of the local varieties includes tallness, less dependence on external inputs (fertilizer) and ability to compete effectively

with weeds. Upland rice is also tolerant of some hostile soil conditions such as drought, poor fertility and acidity, some diseases, insects and pests.

2.3.2 Rain fed lowlands rice cultivation

Rain fed lowlands also referred to as inland valleys areas are estimated to be relatively suitable for rice production than the uplands. It also solely depends on constant rainwater which is collected in the soil due to its hydromorphic nature and the topography. Farmers under this system level the rice fields and make bunds around the fields in order to increase water retention. Rain-fed lowland ecology has water management challenges emanating from perennial flooding from ground water and rainfall even though it has a more suitable crop-water condition than the rain-fed uplands. Weed control, water management, absence of the right varieties and unfavorable soil conditions are some of the major constraints in this ecology, as identified by Oteng (1997).

2.3.3 Irrigated farming system

Irrigated lands or schemes are noted to have the highest rice yields – more so in the Upper East Region - because of the levels of technology utilization (improved land preparation, adequate water supply and management techniques, improved seed varieties, fertilizer application and effective weed control) which are higher than found in cultural practices in the rain fed lowland and upland areas (MOFA, JICA and CARD, 2009).

Water is dispersed to the various farm plots via a system of irrigation canals in the scheme. In some parts of West Africa, two to three rice production cycles can be undertaken in a

year under irrigated conditions. Some areas are even reported to be able to produce five cycles over a period of two years. Presently, the government of Ghana owns 22 irrigation sites that cover 8,700 hectares.

Studies have shown that the maximum potential is in the expansion of irrigated structures along the Volta and its tributaries, where a number of Small and Medium Enterprise (SME) rice producers are operating and a larger facility has been developed by an American company called Prairie Volta Ltd (formerly Quality Grain Rice Company).

In addition, a Millennium Challenge Corporation funded programme is seeking to develop new irrigation sites and rehabilitate others, totaling an additional 5,200 hectares of irrigated area (GFSR, 2009). The problem with irrigation schemes however is the high cost of agricultural technology which the resource poor farmers are not able to afford.

2.4 Modernization and Commercialization of Agriculture in Ghana

Ghana has, since independence, endeavored to modernize agriculture mainly through the establishment of agricultural service centres so as to promote; mechanized agriculture, the use of synthetic inputs, the use of improved seed varieties, and good farm management practices. The regimes of modernization pursued by various governments were influenced by their ideological commitments and the prevailing global developmental agenda.

The agricultural policies during the first republic were mostly import substitution based with so much state activism. The state was largely involved in establishing farms as well as the forward and backward linkages in the sector.

The successors of the first republic pursued agricultural policies that targeted the promotion of large-scale private plantations influenced by the Green Revolution approaches of the UN Food and Agriculture Organization (FAO) and United Nations Development Programme (UNDP). Owners of these large-scale private farms became beneficiaries of subsidized agricultural inputs and low- interest loans.

According to Kranjac- Berisavljevic *et al*., (2003), there was a substantial reduction in the number of state farms in order to make way for private sector participation. By the mid-70s, fertilizer subsidies increased from 50% to 81% (Shepherd and Onumah 1997), resulting in the emergence of large scale capitalist farmers in rice production in northern Ghana.

Peasant-led food crop production in the North as noted by Konings (1986) was relegated while large fertile lands were appropriated by large private commercial farmers most of whom were migrant farmers, who benefited from the region's cheap labour as well as government incentives (farm subsidies) and bank loans while production by smallholders received no government support.

The impact of national focus on large estate and private commercial farms on smallholder production was outlined by Kranjac-Berisavljevic *et al.*, (2003) in the following lines: The first being the establishment of large-scale commercial farms brought about no impact on the local rural populations, as the crops cultivated on these farms were mostly targeting urban markets and not the demands of the local rural economies.

Next was the promotion of modern techniques, with emphasis on cash crops and financial gain, to shove traditional farmers aside. Traditional farm technologies such as animal traction implements, hoes and cutlasses were discouraged; this was done through the institution of subsidies on the purchase of tractors, while the traditional farm implements and draught animals were not subsidized.

Regardless of all the huge national investment in large estate and private commercial farms, the system could not endure. The failure of large commercial farmers (mostly, urban elites) to repay bank loans resulted in credit failure, leading to the collapse of large commercial rice farms in the northern part of the state. This resulted in a policy shift which now focused on the incorporation of smallholders into the national agricultural modernization policy

This, according to Konings (1986), emerged later in the late 1970s after large-scale rice commercial production failed to meet urban needs and commercial farmers diverted supplies to neighbouring countries. Government, through the policy of "*encadrement*" (Konings, 1986) sought to incorporate smallholders into government assisted projects.

Amanor (2011) contended that, peasant farmers were included in government-sponsored projects which allocated to arable lands to them (irrigation sites included), together with farm inputs and seeds, and agricultural services (such as extension services and farm mechanical services) on the condition that these farmers cultivated only particular varieties of crops prescribed and adhered to the cultural practices defined by the projects through the extension agents, and to, in turn, sell their produce to parastatal marketing organizations.

Not only did the policy suggest the rising deficiency of economically viable large estate agriculture; it also explains the growing national financial crisis resulting from defaults in payment of bank loans received by the large commercial farmers intended to improve their farms. In addition, the policy of *encadrement* was an indication of donors' interests to commercialize small-scale agriculture and contract farming (Konings, 1986; Shepherd and Onumah 1997; Amanor, 2011).

Underpinning the commercialization policy was the desire to waver smallholders' sovereignty over production means (land, input and technology), processes and marketing which smallholders still largely retained during the period of growing large-scale commercial farms (Konings, 1986). *Encadrement* came with attractive packages (loans, inputs, mechanized technology, and available irrigation water) which easily captured smallholders' attention and resulted in damaging their autonomy over their labour and knowledge of what they do and how they do it.

By moving smallholders away from their original communities to settler environments where mono-cropping is dominant, cultivation of traditional staples became limited and downgraded. This was more conspicuous in environments where peasant farms were taken over and developed for the national agenda and farmers now became dependent on government authorities to acquire limited parcels of land for cultivating only prescribed crops which fit only into the national programme.

Since high yields of these mono-crops are synonymous with external input use which can only be purchased from the market, smallholders were even more trapped to relying on the state for credits of which lending terms in the banks have become high, drawing from the lessons from large-scale commercial farming. The cases of Vea and Tono irrigation schemes in the Upper East Region of Ghana demonstrated the displacement of smallholders when their homes were pulled down, indigenous food crops destroyed and lands taken over for the national 'development' programme.

Displaced peasants were forced by the situation to sell their livestock and remaining indigenous crops which were their livelihood insurance and to resettle in strange environments. Consequently, these settlers became dependent on the market for their food supply. In addition, while some settlers could not access land on the irrigation projects, those who did were not entitled to the same parcels of land as the indigenous people, a situation which led to growing impoverishment among displaced smallholders.

Specific modernization programmes such as out-growers' schemes undermine smallholders' autonomy. Apart from high costs of production under such schemes, marketing of produce is overseen by the farm management. Resource poor farmers, mostly smallholders, are susceptible to losing their parcels of lands on project sites to those who have the means to produce large scale for commercial purposes. This will result in the recreation of emerging large-scale commercial private cultivators who will then employ the original land owners as labourers on their farms.

Where smallholders do not lose their land, they will resort to combining indigenous strategies with low input use to sustain their cultivation. What is significant is to note that under these 'development' schemes, agricultural strategies are conditioned by political and economic interests and these often weaken interests of smallholder farmers.

Meanwhile, the bankruptcy of the banks due to large-scale commercial farmers' failure to repay their debts compelled the government to seek financial support from the International Monetary Fund (IMF) leading to the execution of the Structural Adjustment Programmes (SAP) during the 1980s and 1990s. Ghana consequently disengaged from interventions in the agricultural sector due to pressure from the IMF and World Bank, and major agricultural facilities were sold to the private sector (Amanor 2011; Konings, 1986).

Agricultural commercialization entails the processes of shifting from subsistence farming to a more market-oriented farming. Haddad and Bouis (1990), postulates that, it measures the percentage of the total volume of output that is sold. Market-oriented production

involves the transformation of systems to ones characterized by intensive production processes and the adoption of new farm technologies. As the volume of farm output marketed increases, input utilization (technology adoption) and output levels are significantly influenced by profit maximization objectives.

Inferring from Omiti *et al*., (2006), market orientation brings about a systematic switch from non-traded inputs to purchased inputs and a steady reduction in integrated farming systems as well as resulting in an emergence of specialized high-value farm enterprises. Stimulating substantial investments in agricultural commercialization could reduce poverty; this is because, as noted by IFAD (2001), the benefits of higher prices of farm outputs and lower prices of inputs are better transferred to farm households when market access is guaranteed. This, on another hand, implies that weak institutional frameworks discourage effective agricultural commercialization and market participation.

According to Shilpi and Umali-Deininger (2007), enhancing markets by providing more and better market structures, as well as ensuring easier access for farmers, is as much a necessity for improving the scale of market participation, especially in developing countries. This is, perhaps, one of the bases for the efforts by various governments to revamp NAFCO.

2.5 The Structural Adjustment Programme and Market Participation

The structural adjustment programme (SAP) is made up of two main components; privatization and deregulation. According to Kranjac-Berisavljevic *et al*., (2003), it

involves the steady liberalization of trade, a partial elimination of controlled prices, privatization of certain state monopolies, and the steady removal of government financial supports.

Within the agricultural sector, reforms took the form of reduced government control, withdrawal of subsidies on agricultural inputs such as chemical inputs and fertilizers, reduction of export taxation and trade restrictions, divestiture of state owned-farms and fertilizer plants.

In 1989, the government ceased procuring, dispensing and funding fertilizer while parastatals in charge of certified seed and fertilizer distribution were privatized that same year (Amanor, 2011). This led to drastic increase in fertilizer prices as well as high interest rates on agricultural credits. Removal of fertilizer subsidies resulted in striking reduction in fertilizer utilization, especially among small farmers who could not afford the high costs, resulting in drastic decline in fertilizer imports from 59,000 tons in 1979 to 20,000 tons in 1986. This figure was fluctuating between 35,000 to 55,000 tons annually during the 1990s (Shephard and Onumah 1997; Amanor, 2011).

Amanor (2011) pointed out that Ghana's seed industry which was developed with the competence to produce certified seeds was hampered by macro-economic reforms through the introduction of the structural adjustments. The high price of fertilizer and its consequential reduced usage on farms significantly affected the quantity of new seeds purchased by farmers since their prospective higher yields were connected to the required

quantities of fertilizer application. SAP had devastating effects on the rice industry in particular.

They include high influx of foreign rice into the Ghanaian market resulting from the liberalization policy which led to the collapse of large rice mills nationwide. In addition to the partial abolition of restricted pricing and SAP led to the privatization of state-owned enterprises and machinery, as well as the withdrawal of government financial support on farm inputs and very high interest rates on agricultural credits (36% to 46%) from the nation's financial institutions.

2.6 Agricultural Sector Policies and rice production in Ghana

As acknowledged by Anang and Yanwen, (2014) small-scale farmers generally constitute the largest group in the agricultural sector in most developing countries such as Ghana, these farmers produce about 80 % of the total agricultural production using rather rudimentary technology on family-operated farms and tend to be among the low income and the poorest of the population with little public expenditure and development programmes designed to improve their lot.

Ghana's agricultural modernization drive has become more of "tractorization" and fertilization policy, making no room for smallholders' participation in contributing to policies that will provide exactly what they need. While tractors are good farm labour saving machinery, it is equally important for policymakers to note that not all farmers need tractors, and not every farmer needs fertilizers. And until there is a reversal of the current

policy framework from top-down to bottom-up, the gap between actual needs of smallholders and what government deems fit for the 'development' projects will continue to widen mostly to the disadvantage of smallholders. A point in case is FASDEP II which focuses on promoting the adoption of external inputs as a universal remedy for higher crop yields. However, the provision or supply of these inputs as well as access to these inputs (seed, fertilizers, herbicides, etc.) remain a challenge in farm environments where smallholders whose farming systems require little external input usage are dominant.

While healthy practices such as the combination of compost (or manure) with chemical fertilizers persist among farmers, modernization policies give no room to explore such opportunities that have the potential to reduce the cost burden unleashed on smallholders by modernization packages. The agricultural sector document identifies the need to promote smallholder agriculture by stating the sector's willingness to support to improve the productivity of smallholders without clearly stating the type of assistance smallholders will receive from the government. This reinforces the view that little attention is given to smallholders' contribution to food crop production.

Leaders of these organizations are mostly large-scale commercial farmers whose goals and production orientations are different from smallholders' and therefore do not advance the course of smallholders. It is important that policymakers understand the diversity embedded in agricultural production so that they can cater for the different needs of the different farm systems through policy designs and resources allocation. This can only be

realized when smallholders are given space to participate in decisions that affect their production systems.

Deliberate government attention to develop the rice sector in the country go as far back as in the 1970's. However, according to MAFAP (2013), the elimination of input subsidies under the SAP in the 1980's resulted in a fall in local rice production. FASDEP-I launched in the year 2002, was intended to serve as a policy framework for agricultural modernization and a support for rural growth. It aimed to reduce rice importation by 30 % by 2004 through an increased domestic production (up to 370,000 tonnes), MOFA, JICA and CARD, (2009).

This ambition was not reached, hence, the inception of FASDEP II in 2007 with a revised aim of achieving food security by means of the promoting the following five primary food crops; cassava, cowpea, maize, rice and yam as well as mobilize all categories of farmers with a keen attention for the poor and risk-prone farmers.

Furthermore, CARD (2009) also revealed that the policy was to promote developments along the rice value chain and, in this vein, it sought to regulate agricultural imports by means of enforcing standards other than quotas and import tariffs. In addition, it was to increase food security, incomes, and as well ensure a sustainable utilization of land resources, while, on the other hand, improving competitiveness, institutional coordination and the application of technology in agriculture.

The strategy emphasizes on the development of two of these crops (cassava, cowpea, maize, rice and yam) that have a relative advantage in each agricultural zone depending on their significance and level of in market penetration. The policy also included providing input support (irrigation systems, land, planting materials, among others) to increase productivity along the value chain.

Furthermore, resolving the deterioration in the level of incomes of poor and peasant farmers, crops like mango, cashew, oil palm, rubber, plantain, citrus and vegetables were to be promoted coupled with the production of small ruminants (sheep and goats) and poultry in accordance with the comparative and competitive advantages of the agro-ecological zones and market accessibility. Through the forward and backward linkages between agriculture and industry the policy sought to increase productivity and contribute to poverty alleviation.

The policy also considers the prospects and benefits from expanding domestic markets (including agro-industry) as incomes grow. The ambition here is to strengthen Ghana's comparative advantage and to become self-sufficient in food production a net exporter of food and cash crops in and beyond the sub-Saharan African region. This could be accomplished by resolving the challenges bedevilling the domestic markets (such as, standardization and infrastructure).

In addressing the constraints pertaining to production (for instance, skills/knowledge requirements, market information access among others); and post-production challenges

(such as, product development, institutional arrangements, and supply-side limitations), FASDEP II indicates government's partnership with the private sector in a drive to increase investments and build the capacity of the actors to compete favourably beyond the domestic market.

In 2011, the Medium-Term Agriculture Sector Investment Plan (METASIP 2011–15) was developed, this was a five-year agricultural development plan with the aspiration of modernizing agriculture, transforming the economy, attaining food security, creating employment opportunities and alleviating poverty in the country. The policy was set to execute the medium-term programmes in FASDEP II and to realize the annual agricultural growth rate target of 6%, with a 10% allocation for agriculture expenditure in the national budget as set by the Comprehensive Africa Agriculture Development Programme (CAADP). According to MoFA (2007), four initiatives were put forward under FASDEP II as follows:

I. Subsidise mechanization services in agriculture by way of promoting the establishment and operation of Agricultural Mechanization Service Centres (AMSEC);
II. Fertilizer subsidization through the National Fertilizer Subsidy Programme;
III. Promote the establishment and management of Block Farms via subsidies for mechanization services and farm inputs (these are fertilizers, improved seed, and pesticides) together with agriculture extension services;
IV. Establish and operate the National Food Buffer Stock Company (NAFCO) so as to stabilize output prices.

I. AMSEC Programme

The Agricultural Mechanization Service Enterprise Centre (AMSEC) programme aims to assist individuals from the private sector to procure agricultural machinery and establish vibrant commercial agricultural services provision centres in strategic locations within each district of the country. The programme is the government's intervention to ease the entry barriers faced by agricultural mechanization service provides mainly due to the high level of capital required to invest in farm machinery this further worsened by the high interest rates charged banks and other financial institutions. This was to ensure mechanization services for farm activities were available to farmers.

II. Fertilizer Subsidy Programme

The implementation of a nationwide fertilizer subsidy programme started in 2008, this covered four types of inorganic fertilizers. Hitherto the fertilizer subsidy programme, the level of fertilizer usage in Ghana had plummeted from 21.9 kg/ha in 1978 to 8 kg/ha in 2006.The motive of the subsidy programme was to prevent more deterioration in the level of fertilizer usage by returning fertilizer prices to 2007 levels and guaranteeing homogeneity in the prices across the country.

In the same year, the government of Ghana subsidized 600,000 bags (50 kg each) of inorganic fertilizer. This cost the country US$14,067,964 (as against US$11,000,000 which was budgeted). Under this programme, farmers acquired the subsidized fertilizers by using a region-specific and a fertilizer-specific coupon issued by the extension officers of MoFA at the various district directorates. A study revealed that, the programme caused

an upsurge in fertilizer application in Ghana and that farmers who applied fertilizer on their fields realised higher yields, as anticipated, and further made a higher net income as compared to the other farmers who did not apply fertilizer on their farms.

The programme is also reported to have resulted in an increase in trade and in the level of private-sector actors' involvement in the input market. This in spite of the fact that the fertilizer distribution chain to the rural parts of the country is still a far cry from the desired narrative. It was additionally established that the overall economic gain of the programme is positive, the estimated benefit-cost ratio of the programme is1.7; this has attendant high risks due to its associated costs which, over time, could definitely deplete a greater portion of the MoFA budget (up to 35% by 2020).

III. Block Farms Programme

The Block Farm Programme implementation started in six regions in the year 2009 as a pilot programme with an aim of acquiring huge parcels of arable lands (in blocks) for the purposes of producing some particular crops of comparative advantage to the selected districts of the six regions. This policy targeted to maximize the benefits of the economies of scale, associated with large scale commercial farming, via credit facilities in the form of subsidized mechanization services, inputs (fertilizers, improved seed, and pesticides) and agricultural extension services provided by MoFA.

The delivery of inputs and services were put together under the responsibility of MoFA so as to reduce cost and ensure timely delivery. Extension agents of MoFA were tasked with

the responsibility of ensuring that farmers adhered to the recommended farm management practices to realise the yield achievable yields expected by the programme. The extension agents were again to undertake the recovery of the credit facility given to the beneficiary farmers, either in cash or kind (farm produce). The targeted land size for the pilot programme was 14,186 hectors but 11, 577 representing 81.6% of the target was realised.

IV. National Food Buffer Stock Company (NAFCO) Programme

NAFCO was setup with the purpose of reduce post-harvest losses due to the lack of storage facilities. The programme targets aggregating farm produce in the peak periods to reduce glut and subsequently supply the stock stored to the market to ensure consistency in supply and by that, stabilize food prices. The programme issued licenses to interested aggregators called the Licensed Buying Companies (LBCs) who are responsible for mopping up farmers' produce at farm-gate prices to serve as a guaranteed income, pre-determined by a post-harvest committee.

According to CARD (2009), the post-harvest committee uses the production cost of the farmer together with a 10% profit margin in arriving at the minimum price. NAFCO has an emergency government stock level of 10,000 MT of white maize, 10,000 MT of milled rice, and 1,000 MT of soya beans.

According to ACET (2015), the 2009 Ghana National Rice Development Strategy (G-NRDS), was instituted to promote national food security, increase income, and reduce

poverty. The programme was designed to achieve the following objectives by the end of 2018:

a. It aimed to increase the annual local rice production by 10%by using gender-sensitive and productivity-enhancing innovations for smallholders, commercial rice producers, and entrepreneurs along the value chain;

b. Improve quality of local rice to increase its consumption both domestically and in the sub-regional markets;

c. Increase the utilization of the by-products of rice through the enhancement the rice value chain actors' capacity;

d. Establish and improve efficient information sharing networks and linkages among the actors in the rice value chain.

Rice Trading

Farmers mostly sell their paddy rice at the farm-gates to aggregators and local par boilers for processing and sale. There is an obvious relationship that exists between farmers and aggregators. In the relationship indicated earlier on, the aggregators usually finance the production activities of farmers via informal contractual agreements and this affords the aggregators the dominant position in the farm-gate market (ACET, 2015); they further require that 80% of rice producers sell to aggregators. This coupled with the fact that cost of production is the key factor in determining the sale prices, might be the overarching reason for which local rice farmers are price takers instead of market forces determining prices.

However, ODI (2003) indicated that aggregators mostly provide capital and credit to farmers to finance their farming activities and input needs (such as the purchase of fertilizer, seed, herbicides and insecticides among others) and this creates an unfair competitive edge for the aggregators further resulting in creation of an oligopolistic system that militates against constrains the market and limits innovation. Due to this power, market women often determine and dictate the price of produce and measurement of rice.

The sale of paddy rice in Ghana is largely characterised by the absence of standards in measurements by farmers. Though it is sold in sacks of 85 kg, market women most often take advantage of the porous and weak nature of this system to exploit farmers by using bigger sacks than the standard 85 kg in mobilizing farmers' produce during harvest (ODI, 2003). This retards farmers' (who are usually less-educated small-scale) effort and fortunes but unduly benefits these buyers to the detriment of farmers.

Imports

Though the volumes have dropped significantly since the year 2003, rice imports are still very substantial. However, Ghana is reported to spend about US$600 million annually on the importation of rice (ACET, 2015). This is widely reported to be driven by the taste and preferences of urban dwellers and the middle class based on their perceived superior quality of imported rice over the locally produced rice. It has been suggested that the derive for imported rice is largely due to poor market acceptance of local rice by urban consumers which is also caused by inadequate market infrastructure and inefficient market information systems that pertains in some developing countries.

Rice importers tend to purchase on the international commodity market, but may also deal directly with mills in the major rice-exporting countries. A large number of smaller importers bring in rice, one shipping container load at a time, as the opportunity arises. An importer, however, needs a permit from the Ghana Food and Drugs Authority to clear the rice from the ports. Imported rice is also subject to duties and levies. This has risen to 40% of the CIF value, ACET (2015).

Processing

It is estimated that 30% of locally produced paddy is milled by five large millers, and the remaining 70% by a large number of small-scale millers (with less than 0.5 MT per hour capacity) scattered around the country, with a high concentration in the three northern regions. The exact number of small rice mills operating in Ghana is not known. These small-scale millers lack standardized techniques and equipment, and processing thus varies from one mill to another. Most are also unable to disstone or grade rice.

Most mills operate as a service and do not buy or sell rice. The service fee makes no distinction for quality of output. However, these services millers provide are additional services beyond just milling. These include selling rice on behalf of farmers and paddy traders, rice storage services, provision of loans, and credit services.

From Processor to Markets

Local rice is usually sold through a fragmented chain that includes aggregators, traders, retailers, and wholesalers. Some farmers also sell directly to consumers. Imported rice,

however, can be sold to wholesalers, retailers, or directly to consumers, even though middlemen are often used to link wholesalers to consumers (Angelucci *et al*., as cited by ACET 2015).

There are essentially two rice markets in Ghana, imported rice and one for local rice. Transportation plays a major role in market accessibility and segmentation. Often, local rice producers find themselves in areas with poor road conditions, and this affects pricing and easy access to the market. In contrast, importers are usually located in the cities with improved road conditions, which reduce the cost of transport.

Further, poor internal infrastructure means that the cost of importation by sea to Accra is lower than the cost of transporting rice from the key northern producing areas in Ghana. In essence, poor infrastructure further segments the markets for local rice and imported rice beyond the quality issues mentioned. According to ACET (2015), this is in conformity with available data on retail prices revealing that prices are consistently high in Accra compared to Tamale.

There is, however, a small percentage of locally produced improved aromatic rice sold in Accra and Kumasi that compete with imported rice. This rice is Grade 2 rice and represents about 4% of Ghanaian rice production (USAID, 2009 as cited by ACET 2015). This is a testimony to the idea that with the right support and marketing, local rice can meet the demand of urban markets.

2.7 Challenges in the Rice Sector

The rice sector is confronted with a lot of setbacks running through the entire production cycle. That is, there is a litany of challenges ranging right from government policy levels through to production, aggregation, processing and marketing. Below is a discussion of a number of the challenges that the sector is faced with.

2.7.1 Access to Land and Security of Ownership

Land tenure is a challenge to the rice production industry regarding access and security. Although large stretches of land abound in the country especially in the lowland rain-fed ecology, holdings and investments towards land improvement are limited by the tenure system (such as family ownership). Often times, the landholdings of farmers are small owing (among others) to the high fragmentation of lands. The high fragmentation of productive lands makes it virtually impossible to derive economies of scale emanating from large scale production.

According to Boakye (2008), under irrigated schemes, per the State Lands Act, 1962 (Act 125), any land—stool, family, private—may be compulsorily acquired where the government considers it in the public interest, an executive instrument being required to specify the site, land dimensions, and time of acquisition. By The Act, all initial interests and impediments concerning the land are halted and the initial holder(s) is paid compensations which presently are determined by the Land Valuation Board.

All lands under Ghana's Irrigation scheme are compulsorily acquired for 'public good' (Boakye, 2008) under the Act. However, land disputes still largely remain as an issue of concern to stakeholders, often times escalating into violence. Sometimes, even though initial land owners are prioritized in land allocation on irrigation schemes, what they receive does not compensate their losses (land, traditional staples, livestock and homes).

The situation is aggravated by the introduction of farmers to the cultivation of new cash crops using new methods dependent on external inputs. In addition to high debts resulting from high costs of inputs and mechanization, farmers' livelihood is affected by purchasing food crop from the market since they now produce cash crops.

The new land tenure arrangements under irrigation schemes intercept smallholders' autonomy over what to produce, how to produce it, and how much to produce. Sometimes, the situation degenerates into conflicts between smallholders and project management. In the northern parts of Ghana for instance, original landholders occasionally seize or take back their rice fields which have been occupied by wealthy farmers who have employed original landowners as labourers. There are attestations suggesting distorted history of land tenure arrangements that escalate into community strives and dislocation of the vulnerable poor farmers, (Konings, 1986).

It also provokes the damage of valuable investments, particularly in agriculture. New land tenure arrangements under irrigation schemes where smallholders depend on the management of the project to receive small parcels of land for cultivation have been apart

with smallholders' interests. Such arrangements tend to affect the extent to which smallholders are able to exercise choice and control over their production.

2.7.2 Access to credit

Accessing credit for agriculture, in Ghana is saddled with constraints. While farmers require capital to cover their investment needs, credit facilities are unavailable and even when they are; the cost and terms of conditions are far out of their reach. Farmers, especially smallholders, have limited access to formal financial services as a result of non-existent collaterals demanded by the banks (Namara *et al*., 2011).

Large commercial farmers have been given preference since they have what it takes to acquire the loans. In cases where farmers are allowed credit, there are reported cases of delay in payment and unwarranted limitation of the amount of money which can be accessed.

A study conducted by the Global Food Security Response (GFSR, 2009) on Ghana also revealed how lending to the agricultural sector by formal financial institutions is comparatively low particularly for the commercial banks. Where lending is available, interest rates are high, preventing farmers from accessing the loans, disallowing them from improving upon their productivity. A large proportion of farmers' profit goes back into paying those loans, a vicious cycle that compels farmers to always go back for loans.

2.7.3 Marketing and Standardization

According to Barker (1981) marketing is a widely debated subject with an extensive range of perspectives concerning its scope and importance. It is the collective term used to describe exchanges between buyers and sellers, who are attempting to maximize profit or subjective utility. It may be simply thought of being the processor making goods and services available to the end user.

Further to the widespread debate on the matter is the proposition by Terpstra (1978), Kempner (1976) and Kotler (1972)) that marketing is the collection of activities a firm undertakes to meet the demands of society through the production of goods and services and distribution of same to consumers in their pursuit of profit maximization.

Marketing of produce is confronted with serious challenges resulting in the exploitation of farmers, particularly, during harvest as a result of the usual gluts. Reasons such as poor market infrastructure and road network as well as high cost of transportation are among the major constraints adduced by buyers as the reasons for them pre-determining and dictating the prices of produce to farmers.

The absence of standardization in measurements makes it convenient for market women to take advantage of the fragmented market structure to determine the price of the produce and dictate the measurement for same (ODI, 2003). The use of weights, measures and descriptions of quality that is understood by market participants tends to reduce disagreements and rather strengthen trade relations. Public provision for the enforcement

of contracts and penalties for non-compliance is a basic requirement for the proper functioning of markets.

The poor harvesting, threshing and milling methods largely result in the poor quality of local rice which attracts lower prices and also disqualifies the local rice producers from competing with 'better quality' rice imported into the country (Namara *et al*., 2011). Markets for local rice can be further developed using the school feeding programme and other government sub-vented institutions as a market source for local producers. This would serve as a ready market for local rice and further help in re-orienting the nation's taste and preference for local rice.

2.8 The Concept of Smallholder Farmers

In support of the lack of a universal definition of a smallholder farmer, the concept lends itself to several definitions. Smallholders differ between countries and between agro-ecological zones. According to MoFA (2011) smallholders are farmers who cultivate less than 2 hectares. However, there are other definitions of smallholders based on wealth, resource possessions, market orientation and vulnerability to risks but are heavily faced with criticisms and disagreements. Nonetheless, this study adopts the definition postulated by MoFA (2011).

2.9 Marketing Chain

The long nature of the marketing chain in Ghana's agriculture which stems from the large number of middlemen or women tends to increase the cost of retail prices as a result of the

duplication of retail services. An elimination of this (the long chain) will lower prices without adversely affecting producer prices (the prices farmers receive). The problem of high price, however, is not only related to the high number of duplication of services but also the high cost of transportation due to poor roads, inadequate transport service providers and lack of credit and knowledge of supplies.

As noted by Kotler (2003) marketing channels are all the interdependent activities undertaken in making a product or service available to end user (consumers).Most farmers do not sell their produce directly to the final users, but rather through a channel of intermediaries (widely known middlemen and middle women) playing varying roles. All these actors involved in the trade channel of any commodity constitute a marketing channel.

Similarly, Mark *et al.*, (2004) also espoused that a market chain describes the linkages between all the actors as well as the activities undertaken in moving farm produce from the farm gate to the final consumer. Thus, the marketing chain is all set of activities involved the process of transforming the raw material into an intermediate product or a finished product and moving the product to the level of the consumer (FAO, 2005).

La-Anyane (1988) found that in areas where access to transportation is difficult, farmers are compelled to sell to any aggregator or buyer who comes to the farmer's community or farm. In some cases, the traders play the role of a supplier of credit to the farmer, and by this act further strengthen their hold on the farmer, hence, their basis for their inclination

to dictate to the farmers the price of the commodity. All these conditions have tended to raise costs to the consumer and lower prices to the farmer, thus discouraging increased production.

2.10 Government's functions in marketing

In regulating the market mechanisms, Governments plays an important role to ensure efficiency, equity and macro-economic stability (Scarborough and Kydd, 1992). Governments can create the enabling environment to ensure there is; freedom to start up and run a marketing enterprise, access to transportation, access to financial and other commercial services, maintenance of peace and stability (law and order), and confidence in the economy.

Governments' regulatory actions and support services bring about the development of an effective working marketing structure. Direct government investments are also essential in attaining this objective. The provisioning and maintenance of roads, bridges and other transport facilities, together with communication services by governments further enhances effective markets systems.

Governments, additionally, have the role of ensuring access to information, strict enforcement of the requisite quality standards, an effective legal system which guarantees the implementation and execution of contractual agreements. They also need to provide adequate infrastructure which enhances sellers' and buyers' access to a central place as

well as institute low cost credit facilities and promote researches on improved technologies for storage and processing.

2.11 Market Infrastructure

Market infrastructure is said to the entail the following facilities; transportation, communication, credit, and storage which culminates into a smooth functioning and a reliable functioning market (Singh and Sadhu, 1988). These largely aid in the reduction of cost of services. Products of agriculture (in this case rice) are mostly aggregated from many scattered producers (most often small-scale in nature) located over fragmented small farmlands and distributed to a larger population vastly dispersed across an even greater geographical area.

2.11.1 Roads and Transport Services

Among the marketing infrastructural problems in Ghana are poor roads and transport services. Many roads have been inadequately maintained resulting in persistent hikes in transport cost. Over the years, feeder roads have deteriorated and truckers are refusing to go into rural areas because of the high cost and risk of breakdowns involved. Most roads in the production areas are bad and inaccessible especially in the rainy season. Besides inadequate transport facilities, transportation costs are high and are beyond the reach of many small and marginal farmers and traders.

Inadequate transport facilities also largely contribute to the slow increase in marketing efficiency and the persistence of subsistence farming in many areas. This problem has

many dimensions. It is sometimes the case that there are inadequate vehicles to transport goods from and to the rural markets. On the other hand, transportation cost accounts for a chunk of the total marketing costs.

In some instances, there are no roads or where they exist, they are fewer and might be seasonal. As revealed by Abbott and Makeham (1990), many farmers are limited to village or rural markets and will remain so until the appropriate transportation facilities are provided to make other outlets reachable.

Many places are cut off from markets for their produce, especially during rainy seasons. This results in high cost of transport and time consuming which inhibits the smooth marketing of more perishable farm produce. The further producers are from the consumer market, the greater the transport costs and the lower the producer's profit margin (all costs of transportation are passed from the trader to the producer). This has led to some arguments that marketing costs would be reduced if transport service and cost are improved. This reduction in marketing cost could translate into a fall or stabilization in retail prices.

According to Jaffee and Morton (1995), private processors and traders suffer considerable risks, incur considerable costs, and face more general constraints in market development owing to the inadequate, underdeveloped (and sometimes dilapidated) state of transport and communication infrastructure in Africa. These problems are a major drawback on commodity movements and on trader communications within their own country.

2.12 Market Structure, Conduct and Performance

The SCP approach has been widely criticized as being an oversimplification of the functioning of a market. As most agricultural markets are imperfect in nature, there is the need to develop more dynamic models showing how structure, conduct and performance interact. It means that market structure and market conduct determine market performance and market performance, in turn, will influence market structure and market conduct in the long run (Duc Hai, 2003; Admasu, 1998).

According to Bain (1968) in the SCP analysis, the market structure (the environment) determines the market conduct (the behaviour of firms within the environment) and thereby determines the level of market performance. Kizito (2008) noted that the SCP is an analytical framework used to assess how the market structure and the activities of sellers of different commodities and services affect the performance of marketing.

2.12.1 Market structure

Market structure as postulated by Duc Hai (2003), entails the characteristics associated with how a market is organized and how it tends to influence, strategically, the nature of competition and pricing in the market. Additionally, Abbott and Makeham (1981) argued that market structure is the behaviour of firms in the market, that is, how they compete, acquire and use new techniques and tap into new investment opportunities. Others (Scott, 1995; Duc Hai, 2003) further theorized that market structure refers to the degree of seller and buyer concentrations, the degree of product differentiation, the existence of entry and exit barriers.

Berg (2003) also described market structure as the state of the market, which is fixed in the short to medium turns. These conditions do not change within this period and are described as "exogenous". This means they are beyond the control of the market agents. The conditions range from the least efficient size of operations (economies of scale) through to legal restrictions (patents or regulations) as well as entry and/or exit barriers (in the form of cost to market), all of which influence competitive behaviour in the market.

Additionally, as posited by Bain (1968), market structure refers to the characteristics of a market which influence its nature of competition and price setting behaviours. These are the characteristics of the organisation of a market, which seem to influence, strategically, the nature of competition and pricing behaviour within the market. These characteristics comprise of the number of buyers and sellers, this will ensure:

a) Adequate moderation of price and quality competition;

b) Freedom of entry and exit.

2.12.2 Market conduct

Kizito (2008) further theorizes that market conduct is the pattern of behaviour put up by the actors in a market so as to influence the market. These behaviour include price setting behaviour, and buying and selling practices. Market conduct is the condition which makes possible exploitative relationships between sellers and buyers through unfair price setting practice.

2.12.3 Market performance

Kizito (2008), also defines market performance as a measure of how good or preferred the outcomes of a market are to society. Market performance refers to how well the market satisfies societal needs. Market performance is hitched on price levels and price stability in the short and long terms, profit levels, efficiency levels, quality and quantity of commodities.

2.12.4 Marketing cost and margin

Cost in this regard, can be viewed as all of the accrued expenses entailed in undertaking marketing activities. It is all the expenses incurred in executing marketing activities. These include aggregation, haulage, storage, processing, grading, wholesaling and retailing (all of which are the stages in the marketing chain).

As noted by Tomek and Robinson (1990), marketing margin refers to the difference between the price paid by consumers and the price received by producers (farmers). Menduoza (1995) also added that marketing margin measures the price deferential for each agent in the marketing chain.

2.13 Market Participation

Market participation has been subjected to varying interpretations, some studies have asserted that an economic unit (farmer) can be engaged in a market either as a seller or buyer. The decision to participate in the market as a seller or a buyer is pinned on the theory

of optimization, that is, whether the farmer seeks to maximize utility relative to his or her cash budget and available non-tradable resources.

Improved market participation, according to Salami *et al.*, (2010), is an essential precondition for the transformation of the agricultural sector from subsistence to a predominant commercial production. Furthermore, Kirimi *et al*., (2013) theorized that commercialization serves as an impetus to improve food security due to its relative comparative advantages over subsistence production. This transition from subsistence to commercial production can help alleviate poverty as well as the associated challenges related to low income which confronts many smallholder farmers (Alene *et al*., 2008).

2.13.1 The Concept of Market Participation

Barret (2008) observed that smallholder farmers' market participation is very low in developing countries. The consequence of this situation is the slow growth in agriculture, economic expansion and the exacerbation poverty levels. Farmers, for that matter, are unable to reap the benefit from the economic gains as well as the income growth associated with market participation.

Ana *et al.*, (2008), also propounded that, a higher market participation could increase productivity by virtue of offering incentives such as information and cash flow for working capital. They further argued that higher productivity could, in turn, also increase market participation following from the logic that farmers with higher productivity are more likely to have marketable surpluses.

In order for agriculture to profoundly contribute to economic growth, especially for an economy like Ghana which is dominated by smallholder farmers, (in the wisdom of Jagwe *et al.*, (2010)), smallholder farmers have to commercialize their farming activities to produce marketable surpluses.

According to Reardon *et al.*, (2005), market participation brings about economic development while economic development, in turn, increases market participation. They further propose that markets offer specialization opportunities to households on the basis of comparative advantage and that, trade improves households' welfare.

The potential of markets to stimulate economic development and structural transformation is argued to be the motivation for the pursuance of a market-led paradigm for agricultural development during the 1980s.

Reardon *et al.*,(2005) further explained that as households' disposable income increases, their demand for a wide variety of goods and services also increases and this subsequently increases demand-side market participation which will further increase households' demand for cash and thus supply-side market participation.

Similarly Bellemare *et al.*, (2006), explained the answer for why smallholders' market participation is so important to economic growth and poverty alleviation. They explained further that for a household that desires a diverse range of commodities, it can either produce all of such goods and services for auto consumption or that, it can also specialize

in the production goods for which it has comparative advantage. In this case they would use their surplus monies to buy the goods and services in which they do not have comparative advantage in producing.

Ana *et al.,* (2008) on the other hand explained market participation as the proportion of total out output that is sold. The total output, which is the sum of all agricultural production, they say includes annual and perennial productions, locally-processed and industrial crops. They further add that market participation a "sales index" and would be zero if the household sells nothing and could be greater than unity if the households adds value to their farm produce via processing and/or storage.

This is expressed as:

$$\boldsymbol{Sale\ index_i} = \frac{\sum_{j=1}^{J} \boldsymbol{crop\ sales_{i,j}}}{\sum_{j=1}^{J} \boldsymbol{crop\ production_{i,j}}} = \begin{cases} = \boldsymbol{0\ non-seller} \\ > 0\ seller \end{cases} \qquad \textbf{(2.1)}$$

Stanton *et al.,* (2000) cautioned the increase in efforts to promote free markets by indicating that one must assess the potential impacts on agriculture and some agricultural producers. They argue the position that smallholder local farmers as well as some competitive local buyers may be unable to participate in the new market opportunities. They therefore suggest that the institution of policies should be holistic to encompass agribusiness enterprises. However, they say this may require a state intervention in providing basic infrastructure, transportation facilities and easy access to credit as well as technology.

The concern of why most smallholder farmers, though they constitute a larger section of the poor in global south countries, fail to derive the potential benefits associated with

markets still remains unanswered. It is, for that matter, essential to ascertain the key factors that influence paddy rice market participation. Identifying these determinants could assist smallholder farmers to identify the market entry points along with other existing interventions that could help increase their output, and consequently their income.

As noted by Siziba *et al*., (2011) and Barrett (2008), the trade theory hypothesizes that households that participate in the output markets as a result of producing marketable surpluses, based on their comparative advantage, are well positioned to derive direct welfare and trade gains coupled with the benefits of economies of scale.

Undeniably, smallholder farmers could further benefit from the technological transfers as a result of the exchange of ideas emanating from the new markets or trade relations (Barrett, 2008). Barrett (2008) further stated that although there is a stream of benefits that is inherent in market participation, some studies from southern Africa indicate that smallholder farmers' market participation is low due to high marketing costs, information asymmetries and institutional constraints among others.

Additionally, Phiri and Otieno (2008) postulated that the narrative in most southern African countries is that a chunk of farm produce are lost soon after production (as is the situation in Ghana) largely for the reasons of poor post-harvest practices and the inability of farmers to access formal markets. This development is ascribed to several other debilitating factors as well as the bottlenecks that pertain in agricultural output marketing.

The factors, according to some studies, (Siziba *et al*., 2011, Jagwe *et al*., 2010; Pingali *et al*., 2005) range from low levels of literacy, labour shortages, inadequate government support services, high marketing cost and lack of physical infrastructure. It can, therefore, be argued that most governments in Ghana implemented market liberalization policies in response to these challenges so as to open up the economy to new market-led economic growth. These policies entailed the abolition of commodity boards, introduction of free markets and private sector participation.

Despite the fact that the overall objective of liberalizing markets was to improve their performance (effectiveness). The liberalization of markets resulted in a mixed outcomes; there was a revert back to subsistence agriculture in some cases, while in others there was an increase in market participation in markets that pay well, and finally, there was an improvement in technology, institutional performance and infrastructure (Jayne and Jones, 1997).

IFAD (2003), made the revelation that market participation can be an effective avenue for alleviation of abject poverty among rural smallholder farmers. As theorized by Timmer, (1997) and Pingali (1997), a fundamental principle of commercialization as a development strategy is that it provides increased incomes to farmers who maximize the returns to land and labour via marketing. The increased incomes could be used for an efficient production as against subsistence. Also, von Braun*et al*., (1994) emphasised the need for institutional engagements in market development and support for cash crop production.

Consistent with this position, Goetz (1992), Key *et al*., (2000), and Holloway *et al*., (2005) defined market participation as a two dimensional phenomenon: in the first dimension, a household elects to be a net buyer, a net seller, or autarchic while in the second dimension, deciding to be a net buyer or a net seller determines the extent of market participation.

This is in line with Barrett's assertion that market participation has a demand side where households participate as buyers and a supply side where households participate as sellers. The supply side of market participation is mostly emphasized because many studies lean towards that side of the equation. A case in point is the definition of market participation by Ana *et al*., (2008) as a supply side. They say it is the sales made by a farmer as a fraction of the total of his or her output, which is the entirety of all the farmer's farm produce.

Other literature, for instance, Cazuffi and Mckay, (2012) and Makhura *et al*., (2001) referred to market participation as the commercialization of agriculture. That is, market participation and commercialization are basically used interchangeably. Furthermore, Cazzuffi and McKay (2012) explain that commercialization can be understood and measured in diverse ways but it is often perceived in terms of market participation.

According to Govereh *et al*., (1999), commercialization in agriculture refers to the proportion of the farm produce that is sold. Similarly, Haddad and Bouis (1990) postulate that market participation is generally estimated as the ratio of the marketed output to the total farm output. Furthermore, IFAD-IFPRI (2011) stated that a standard measure of commercialization is the percentage of marketed output relative to total output. They

termed this as "marketed surplus ratio" which they defined as the quantity of produce sold as a percentage of the total quantity of farm produce. The concept of market participation as referred to in this study does not measure farmers' engagement in the inputs market, for that matter, the proxy for this concept in this study is farmers' willingness and ability to sell a proportion of their produce (paddy rice).

2.13.2 Determinants of Market Participation

Research into smallholder farmers' market participation has been conducted in many parts of the world for a variety of agricultural products, especially, in agrarian economies. Evidence shows that the factors that affect market participation are in respect to broad categorization of these factors into household or farmer's characteristics, ownership and access to assets (private and/or public), social capital and transaction cost variables.

Cazzuffi and McKay (2012) have however noted that available literature has generally focused on establishing the role of transaction costs and market failure in smallholder farmers' decision making. They are also inferred from studies by Key *et al*., (2000) and Barrett (2008) that differential in asset access and ownership, coupled with the disparity in access to public goods and services that facilitate market participation, are important factors that influence the differences in market participation among smallholders.

Randela *et al*., (2008) established a direct relationship between distance to market and market participation. Market participation was also found to be positively related to access to market information. On the contrary, however, Omiti *et al*., (2009), Olwande and

Mathenge (2012) and Martey *et al*., (2012), found an inverse relationship between distance to market and market participation of cassava; maize, milk and kales; and milk and fruit respectively.

The argument backing this observation was that the distance to a market centre represents how much travel time and transportation cost the farmer has to endure in marketing his or her produce, hence a longer distance serves as a disincentive to participate more in the market. In contradiction with Siziba *et al*., (2011) and Randela *et al*., (2008), the studies by Martey *et al*., (2012) and Omiti *et al*., (2009) found a negative relationship between market participation and access to market information among producers of cassava, milk and kales.

The findings of Nyoro *et al*., (1999), Cadot *et al*., (2006), Boughton *et al*., (2007), Levinsohn and McMillan, (2007), Stephens and Barrett, (2009), Siziba *et al*., (2011) as well as Martey *et al*., (2012)provide empirical proof of the positive relationship between socioeconomic characteristics, ownership of assets and market participation.

The specific examples of the above mentioned empirical evidence are; the findings of Siziba *et al*. (2011) that off-farm income, ownership of assets (radio and livestock) were positively related to the quantity of cereal grains sold. Socioeconomic characteristics such as age (found by Martey *et al*., 2012 and Randela *et al*., 2008), education (found by Martey *et al*., 2012, Olwande and Mathenge, 2012, and Omiti *et al*., 2009), farm size (found by Martey *et al*., 2012) and gender (male headed households participating more in the market

than female counterparts, found by Omiti *et al*., 2009) positively influence market participation of agricultural commodities.

Other dynamics: ownership of some assets (communication instruments, bicycle and productive asset), group membership (according to Olwande and Mathenge, 2012, and Reyes *et al*., 2012) and farm output (according to Omiti *et al*., 2009) positively affect market participation. However, dependency ratio or household size was also found to negatively affect market participation (according to Olwande and Mathenge, 2012, Omiti *et al*., 2009 and Randela *et al*., 2008).

On the contrary, Randela *et al*. (2008) observed a negative effect of farm size and ownership of livestock on market participation. Farmers' participation in maize market was negatively affect by access to more land (Martey *et al*., 2012).

Access to assets and public support services such as extension services and input usage (according to Alene, *et al*., 2008), credit and insurance (according to Cadot *et al*., 2006, and Stephens and Barrett, 2009) and access to training and extension, and participation in research (according to Siziba *et al*., 2011) were found to positively affect market participation. On the contrary, however, Martey *et al*., (2012) observed that access to extension services to negatively influence participation in maize and cassava markets. Also, some studies such as Olwande and Mathenge (2012); Martey *et al*., (2012) and Omiti *et al*., (2009) revealed that commodity prices positively affect market participation among farmers.

2.13.3 Levels of market participation

Farm household's level of market participation largely varies based on the land holding size of the farm household and the ecological zone in which the farmer is located. In the view of GSSP (2007), the levels of participation varies geographically, to some extent. With the exception of rice, the savannah zone is widely reported to have the lowest levels of market participation in general, most likely due to its remoteness from the larger markets down south.

From table 2.2 below, farmers with smaller land holdings tend to have less market participation than those with larger land holdings at the national level. This is particularly similar for farmers in the savanna ecological zone.

Table 2.1: The share of producing households who participate in market

Land holding size	Rice			
	National level	Coastal ecological zone	Forest ecological zone	Savanna ecological zone
< 0.5 ha	26%	0%	0%	29%
0.5-1 ha	39%	0%	100%	36%
1-2 ha	43%	100%	100%	40%
2-3 ha	52%	100%	78%	50%
3-4 ha	65%	0%	100%	62%
4-5 ha	62%	0%	45%	63%
> 5 ha	76%	0%	100%	73%

Source: GSSP 2007

2.13.4 Challenges of Market Participation

Agriculture in Ghana is largely characterized by smallholder subsistence farmers who are, for the most part, rural dwellers with about 90% of farm holdings being less than 2 hectares in size (MoFA, 2011).

These smallholder farmers are constrained with factors that hamper their production capacity and potential as well as their access to the market. In line with this assertion is the findings of Al-Hassan *et al*., (2006), that that major constraint smallholder farmers are confronted with is in accessing guaranteed output markets and the acquisition of inputs.

Al-Hassan *et al*., (2006) further bemoaned the high volatility that characterizes the local commodity markets as a situation that militates against smallholders' effective market participation. These challenges incapacitate these smallholders in their efforts to increase outputs and then subsequently sell these outputs.

Baumann (2000) also contends that international markets, just as the market opportunities provided by agro-industrial firms, though somewhat stable, are also fraught with challenges in the form of some predetermined producer-buyer relationships which tend to limit access. What is apparent in this narrative is that smallholder farmers are not able to keep pace with and exploit the stability of markets offered by international markets and agro-industrial firms, probably due to low production and unsustainable supply as well as inability to meet the requirements of these markets.

These problems are reinforced by the fact that smallholder farmers and local small-scale enterprises lack both reliable and cost efficient inputs such as extension services, mechanization services, improved seeds, fertilizers and credit facilities together with guaranteed and profitable markets for their output (Al-Hassan *et al*., 2006).

Jari and Fraser (2009) observed in South Africa that it is difficult for less developed rural economies and smallholder farmers to participate in commercial markets due to an array of technical and institutional limitations. These limitations include poor infrastructure, poor transport systems and facilities, lack of market information, insufficient expertise on grades and standards, inability to enter into contracts and poor institutional support services have all culminated into the inefficiencies of markets, hence, commercialization bottlenecks. This observation suggests that technical and structural problems are the cause of the low levels of market participation among smallholder farmers.

2.14 Production theories

Production theory, according to Vijay (2015), pertains to the commercial activities involved in transforming inputs into outputs, whereas production is the procedure of combining different material and immaterial inputs (plans and know-how) to create an output of value (good or service) for consumption or utilization.

Further to this, Vijay (2015) added that a production frontier or function is a mathematical function that relates the maximum output level that can be obtained with a give set of inputs and level of technology.It is a technical relationship between output and inputs which

assumes the maximum level of output attainable with the minimal inputs.Mishra (2007) also stated that a production function measures the relationship between a given set of inputs and the maximal technically feasible output.

Besanko (2004), on the production function is a mathematical representation of the types of technological and input mix a firm can choose from for production. In words, it is a mathematical demonstration of the maximum output a firm can obtain from a given set of inputs that it might choose.

Production functions are mainly three types, the single variable, two variables and the multiple variables functions. These are specified by Nicholson and Snyder (2008) and Besanko (2004) as follows:

Single variable function

$$\boldsymbol{Q = f(L)} \qquad \textbf{(2.2)}$$

Where $\boldsymbol{Q}$ is quantity of output and $\boldsymbol{L}$ is the labour employed

Two-variable function

$$\boldsymbol{Q = f(L, K)} \qquad \textbf{(2.3)}$$

Where $\boldsymbol{K}$ is the capital employed, $\boldsymbol{Q}$ and $\boldsymbol{L}$ are as defined above.

Three-variable function

$$\boldsymbol{Q = f(L, K, W, \dots, n)} \qquad \textbf{(2.4)}$$

Where $\boldsymbol{W}$ is the quantity of inputs (raw materials) employed, and the rest of the variables remain as defined above.

This means that the maximum quantity of output a farmer can produce depends on the combination of the various variable inputs he or she employs. The production function is also largely dependent on the technological changes that occur over time, these changes may cause the production function to shift.

2.15 Key findings and Conclusions from the Literature Review

From the review, it is obvious that several studies have undertaken on market participation of smallholder farmers. The attention, content wise, is focused on understanding the market participation behaviour of smallholder farmers and the challenges they encounter. Methodologically, recent empirical studies on market participation usually adopt the two-step analytical methods, namely the Heckman and the Double Hurdle Models.

Rice production in Ghana is potentially a viable commercial enterprise which, in addition to solving food security issues has the prospect of employing a large workforce, the majority of whom are smallholders, while contributing enormously to national income. The feasibility of this can be seen in the vast rice production ecologies which abound in the regions of the nation.

Nevertheless, agricultural policies over the years have not paid particular attention to the majority of smallholder cultivators and their specific production system needs, resulting from policymakers' failure to allow smallholders space to participate in decisions affecting their diverse production systems.

Agricultural policies over the years focused on increasing production through an increase in technology usage and adoption of good agronomic practices, with very little attention given to market access. It has been found that some government policies are the major cause of the market failures in the country coupled with the influx of rice from countries who heavily subsidize their rice production.

While there may be justifications for those policies, advocates often overlook the significance of developing and sustaining a viable domestic rice sector; employment creation, food security and economic growth at large.

CHAPTER THREE

METHODOLOGY

3.1 The Study Setting

The study was carried out in three districts of the Upper East Region of Ghana namely; Bolgatanga Municipality, Kassena-Nankana Municipality and Builsa South District. The study areas (districts) were beneficiaries of the Rice Sector Support Project (RSSP) implemented in the Upper East, Upper West, Northern and Volta Regions by MoFA in collaboration with the Farmer Training Centre (FTC) as the local implementer in the Upper East Region, which ended in 2016. The districts being the beneficiaries of this project was the motivation for their selection as the study location.

The region is one of the largest rice producing zones in Ghana and also among the poorest and least developed regions. The region is situated in the north-eastern part of Ghana and lies between longitude 00 and 10 West and latitudes 10030 North and 110 North, Savannah Accelerated Development Authority (SADA, 2016).

SADA further added that the study region shares borders, to the north, with Burkina Faso, to the east, with the Republic of Togo, to the west, with Sissala District in the Upper West Region and to the south, with West Mamprusi District in the Northern Region. The land is fairly flat with a total land area of about 8,842 sqkm, representing 2.7 per cent of the total land area of Ghana, (SADA, 2016).

The predominant occupation in the region in order of intensity are, agriculture and its associated forward and backwards linkages (65.9%), production and transport equipment work (14.5%), sales work (9.5%) service work (3.9%), and professional, technical and related work 3.8 per cent. The five together make up 97.6 per cent of all occupations, SADA (2016). The major crops grown are maize, rice, millet, sorghum, groundnut, cowpea and soybeans. The region currently has fifteen administrative districts from which the above mentioned were selected.

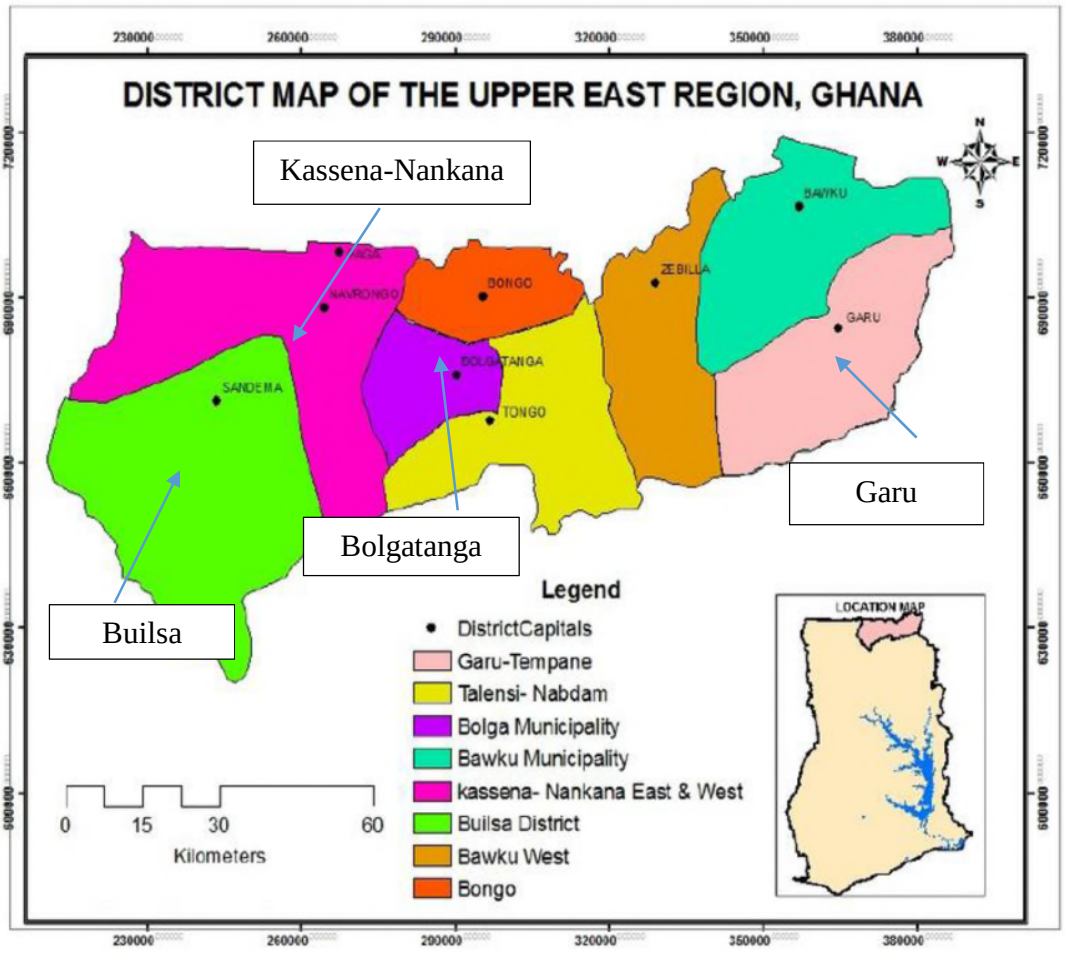

Figure 3.1: A map of the study districts (Bolgatanga, Kassena-Nankana West, Builsa and Garu) in the Upper East Region

Source: https://www.researchgate.net/figure/281340874fig2

The Bolgatanga Municipality is the capital of the Upper East Region and is bordered to the north by the Bongo District, to the south by the Talensi District, to the east by the Nabdam District, and to the west by the Kassena-Nankana Municipality. It has two different seasons, a rainy season that spans from May to October and a dry season that spans from October to April every year, with hardly any rains. According to SADA (2016), the mean annual rainfall is 950mm while maximum temperature is 45°C in March and April with a minimum of 12°C in December. The vegetation of the region is that of Guinea savannah woodland characterised by widely spaced short deciduous trees and a ground flora.

SADA (2016) further revealed that the total population of the Bolgatanga Municipality stands at 131,550 (62,783 males and 68,767 females) constituting about 12.6 percent of the region's population, and the majority of the households (60 percent) are engaged in agriculture. They indicated that the majority (92.2 percent) of these agriculture dependent households are into crop production, whiles less than 1 percent (0.8%) of the households are engaged tree planting.

The Kassena-Nankana Municipal's vegetation is guinea savannah woodland made up of short widely spread deciduous trees and a ground flora of grass. It has a total population of 70,667 making up 6.8 percent of the region's total population. Males make up 50.8percent and females make up 49.2 percent, SADA (2016). Agriculture is the mainstay of the district; it is both rain fed and irrigation. The sector employs over 83.7% of households. Crop production represents 96.7% and livestock 82.8%.

The major crops cultivated are millet, sorghum, rice, groundnuts, leafy vegetables, cowpea, Bambara beans, Okra, Cotton, tomatoes and Onions, while the livestock reared include cattle, sheep, goat, pigs, guinea fowls, fowls and donkeys. The municipality is also noted for fish production.

The Builsa South District has a tropical climate and is bordered to its north by the Builsa North District, to its south by Mamprugu-Moaduri, to its west by the Sissala East District and to its east by the West Mamprusi District. The population of the district is 36,514 with males being 18,111 and female being 18,403, SADA (2016). The District is blessed with Dams and Dug-outs which serve as sources of drinking water for the livestock in addition to being used to irrigate dry season crop production.

The Garu District is situated in the south-eastern part of the Upper East Region of Ghana and stretches over an area of 1060.91 squared km. The District boarders Bawku Municipal to the North, Binduri to the North West, Pusiga District to the North East, East Mamprusi District to the South-West, Bunkpurugu-Yunyoo District to the South East, Bawku West District to the West and the Republic of Togo to the East. It is about 110km from the Regional Capital. It has a population of 130,003 (62,025 males and 67,978 females). Agriculture is the dominant occupation in the district, the long dry season together with the few dry season irrigation facilities forces the youth of the to migrate to southern Ghana during the dry season in search of jobs.

3.2 Sampling Procedure and Sample Size

The farmer population for Upper East Region was 1,958 (FTC-RSSP data, 2016). A sample of 400 farmers was selected representing 20.43% of the population. In the view of Agyedu *et al*., (2013), a choice of 20% (and above) of the population is enough to generate confidence in the data collected and for subsequent generalizations.

The sample was stratified into two (that is, farmers in a farmer association or group and those not in any farmer group) and 200 farmers were then randomly selected from each stratum with an equal distribution among the selected districts. This is because when comparison between strata is critical, according to Moser and Kalton (1989) and Sproul (1988),as cited by Agyedu *et al*., (2013), equal sized samples from each stratum ensures a more precise, meaningful and credible comparison.

The sampled farmers were stratified based on their association to a farmer group or not so as to examine if a farmer's belongingness to such association makes any difference in his or her level of market participation. The random sampling will also allow for an equal chance of selection of each element from the two segments.

3.3 Data types, sources and instruments used in collection

Primary data was collected from rice farmers, while secondary information that assisted in the selection of samples and other primary data collection activities was also collected from institutions and internet journals relevant to the study. The study used semi-structured (open and closed ended) questionnaires for the data collection.

The closed ended questions enabled respondents to select from a suggested list of options in the questionnaire, while the open ended questions allowed farmers to respond to certain specific questions without restrictions. The questionnaires were administered face-to-face to farmers in the 4 selected districts. The data collection and entry were done from March to April, 2018.

3.4 Analytical Framework

The survey data was analyzed using Stata 14. The study employed descriptive statistics, inferential statistics and econometric models (the fractional regression, three stage least squares (3SLS) and the stochastic frontier) in the analysis and in presenting the results.

3.4.1 Econometric Models Employed in Studies of Market Participation

In empirical studies of market participation, several econometric models have been applied. In general, some studies adopt a two-step analytical approach (Omiti *et al*., 2009, and Olwande and Mathenge, 2012) while some other studies also adopt a one-step approach. The rationale for using the two-step analytical approach is that market participation is underpinned by two decision processes (Goetz, 1992, and Bellemare and Barrett, 2006).

The first decision process has to do with the question of whether a farm household would participate in the market or not. The second decision process deals with the level of output with which to participate if the farm household affirms participation in the first stage. The econometric models in view of these two separate decisions are formulated to take them

into consideration. However, some empirical studies (e.g. Omiti *et al*., 2009, and Martey *et al*., 2012) have considered only a one step approach. Such studies concentrate on the second decision process.

According to Alene *et al*., (2008), and Olwande and Mathenge (2012), econometric models in these two-step approaches include Heckman's sample selection model (for instance, Goetz, 1992; Makhura, *et al*., 2001; Boughton *et al*., 2007; Alene *et al*., 2008; and Siziba *et al*., 2011), the two-tier/double hurdle models (e.g. Olwande and Mathenge, 2012, and Reyes *et al*., 2012) and switching regression model (e.g. Vance and Geoghegan, 2004). The one step approaches include Tobit regression (e.g. Holloway *et al*., 2005, and Martey *et al*., 2012).

The Heckman sample selection model was introduced by Heckman (1979) based on wage offer functions in which some wage data was omitted due to the effect of labour force participation. It is comparatively a simple approach for correcting sample selectivity bias. Wooldridge (2002) argues that the selection bias is as an omission of a variable in the selected sample. This is corrected by the Heckman model. The Heckman model consists of two equations to be estimated in two steps.

The first equation is referred to as the selection equation. It is expressed as a probit model which predicts the probability that an individual farmer will participate or will not participate in the market. It also estimates what is known as the Inverse Mills Ratio (IMR).

The purpose of the IMR is to account for sample selection in the study so that the estimates would be unbiased. The second equation is referred to as the outcome equation. It is estimated using the Ordinary Least squares (OLS). The OLS estimation is done with the inclusion of the IMR as a regressor.

The first and the second models incorporate the same variables except that the second model includes some other variables suggested by Wooldridge (2006) as exclusion restriction variables. The weaknesses of the Heckman selection model have been identified as that, the exclusion restriction of the model which is identified solely on distributional assumptions (Sartori, 2003) and also observed to be very sensitive to the assumption of bivariate normality (Winship and Mare, 1992). It is also observed that the rho parameter is also very sensitive in some common applications (Sartori, 2003).

3.4.1.1 The Two-tier/Double Hurdle Models

The two-tier/Double Hurdle Model was introduced by Cragg (1971). According to Lijia *et al*., (2011), Cragg first developed the double hurdle model as a generalization of the Tobit model by incorporating the possibility that a factor might have different effects on the probability of acquisition (in this case, market participation) and its magnitude. Olwande and Mathenge (2012) hold the view that the two-tier /hurdle models are a kind of corner solution outcomes, in some instances referred to as censored regression model.

The application of the model to any empirical study divides the study into two steps/stages: an initial discrete probability of participation model and conditioned on the decision to participate, a second decision is made on the magnitude of participation (Olwande and

Mathenge, 2012). The first stage in the two-tier model uses a probit estimation whereas the second step can take different functional distributions. While the simplest two step models assume lognormal distribution in the second stage, Cragg's double hurdle assumes a truncated normal distribution.

The key advantage the censored normal distribution has over the lognormal distribution is that it nests the typical Tobit Model therefore, allowing the testing of the restrictions implied by the Tobit hypothesis against the two step model (Olwande and Mathenge, 2012). This makes the double hurdle model theoretically more applicable than other two-tier models. The distinction between the Heckman model and the double hurdle model is in the second stage where the Heckman estimates an OLS equation while the double hurdle model estimates a censored regression usually a truncated regression.

The two-tier models also possess a fundamental weakness: they require all observations to be producers of a particular crop (Burke and Jayne, 2011). However, in empirical studies, a random sample might include households who are not producing that crop. They further argue that the models may under-estimate the effects of a given policy on marketing behaviour if policy affects the decision to produce.

3.4.1.2 The Tobit Model

Studies that apply the Tobit model (introduced by Tobin, 1958) in a one-step approach only differ from the double hurdle model in the sense that they do not consider the first stage binary choice that deals with the participation decision. The limitation therefore of considering only the Tobit model in a one-step approach is that of the assumption that the

same set of considerations and variables influence both the probability to participate in the market and the magnitude of participation (Alene *et al*., 2008, and Wan and Hu, 2012).

3.4.1.3 The Switching Regression Model

This model is also a two-stage model designed to overcome the restriction of the Tobit model by an estimation procedure that allows variables to influence the two decisions in different directions (Alene *et al*., 2008). It can also be used to account for the potential simultaneity bias arising from the existence of some variables (Vance and Geoghehan, 2004).

3.4.2 The theoretical concept of the fractional response model (FRM)

According to Papke and Wooldridge (1996) the FRM was propounded for fractional regression models. They theorized that the FRM has no problems in recovering the regression function for the bounded dependent variable, and there is also no need for *ad hoc* transformation measures in handling the observed data at the extreme bounds (0 and 1).

According to Oberhofer and Pfaffermayr (2009), the conditional expectation of the fractional response variable is expressed as:

$$E(y_i|x_i) = G(x_i\beta), i = 1, 2, \dots, N \qquad \textbf{(2.5)}$$

Where $0 \leq y_i \leq 1$ is the fractional variable (market participation, with 0 and 1 boundaries) to be explained by (a $1 \times K$vector of independent variables) x_i

Oberhofer and Pfaffermayr (2009) postulate that, $G(.)$ is, typically, a distribution function like the logistic function$G(z) = \exp(z)/(1 + \exp(z))$ which maps z to the (0, 1) interval. They further specified the conditional mean of the FRM ($y_i \, \epsilon[0,1]$) as follows:

$$E[y_i|x_i] = P(y_i^* = 0|x_i)E[y_i|x_i, y_i^* = 0] + P(y_i^* = 1|x_i)$$

$$= \big(1 - G(x_i\gamma)\big)G(x_i\beta) + G(x_i\gamma) \quad \textbf{(2.6)}$$

The marginal effects of $x_i s$ are derived as:

$$\frac{\partial E[y_i|x_i]}{\partial x_{ij}} = \frac{\partial P\left(y_i^* = 1|x_i\right)}{\partial x_{ij}}(1 - E[y_i|x_i, y_i^* = 0]) + (1 - P(y_i^* = 1|x_i))\frac{\partial E[y_i|x_i, y_i^* = 0]}{\partial x_{ij}}$$

(2.7)

3.4.3 The theoretical concept of endogenous covariates model (the three stage least squares – 3SLS)

The three stage least squares (3SLS) is a straightforward enhancement of the Theil's two stage least squares (2SLS) and it comprises of the application of least squares in three stages, Koutsoyiannis (1977: p475). Koutsoyiannis notes that the first two stages are the same as 2SLS, that is, after the endogenous variables are expressed as direct functions of the predetermined variables, the first stage of the model involves applying least squares to the reduced-form equations so as to obtain estimates of the exogenous variables and their corresponding reduced-form coefficients as well as the random variables.

The structural models are expressed as:

$$y_1 = b_{11}y_2 + \alpha_{11}x_i + \varepsilon_1 \quad \textbf{(2.8)}$$

$$y_2 = b_{21}y_1 + \gamma_{21}x_i + \varepsilon_2 \quad \textbf{(2.9)}$$

Where:

y_1 (Rice output level) and y_2 (level of market participation) are the endogenous variables

x_i's denotes the predetermined variables

b's denote the coefficients of the endogenous variables

γ's denote the coefficients of the predetermined variables

Below is the expression of the reduced form of the structural equations:

$$y_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1k}x_k + \omega_1 \quad \textbf{(2.10)}$$

$$y_2 = \gamma_{21}x_1 + \gamma_{22}x_2 + \cdots + \gamma_{2k}x_k + \omega_2 \quad \textbf{(2.11)}$$

K is the number of independent exogenous variables

Therefore, the estimated values obtained of the endogenous variables are: $\hat{y}_1,\ \hat{y}_2,\ \hat{y}_3$

In the second stage, the endogenous variables in the right side of the structural equation are the replaced with their estimated values and ordinary least squares are applied to the transformed original equation to obtain estimates of the structural parameters. These parameters are used in estimating the error terms of the two equations. This will result in $\omega_1 and\ \omega_2$ set of error terms corresponding to $\varepsilon_1 and\ \varepsilon_2$ of the structural equations above.

The covariance of the error terms are, thus, computed as follows: $\hat{\sigma}_{\omega_1\omega_2} = \frac{\sum \omega_{1i}\omega_{2i}}{k}$

(2.12)

In the last stage, the variances and covariances of the error terms are used in transforming the original variables for the application of the general least squares (GLS) (Koutsoyiannis, 1977).

3.4.4 Cost Function and Efficiency theories

Cost is viewed by many scholars in two folds, that is, accounting and economic. According to Nicholson and Snyder (2008) the accountant's cost is concerned with "out-of-pocket" costs, historical expenditures, depreciation, and other bookkeeping entries while the economist's perspective of cost is the size of the expenses necessary to keep the resource in its present employment as well as what that resource would be paid in its next best use. In line with this position, accounting cost of inputs entails the expenses incurred and/or paid but economic cost goes further to include the alternative foregone for using that input or what would have been gained from the next best use of the input.

The cost measured in this study is the accounting cost due to the difficulty associated with measuring the economic cost that the farmers incurred. Hence, it is the observed cost incurred by the farmers in producing rice.

From the standpoint of Nicholson and Snyder (2008), total cost function is expressed as:

$$\boldsymbol{C = wk + vl} \qquad \textbf{(2.13)}$$

Where $\boldsymbol{w}$ and $\boldsymbol{v}$ are the factor prices of capital ($\boldsymbol{k}$) and labour ($\boldsymbol{l}$) respectively.

Maudos *et al.*, (2002) also specified the cost function as: $\boldsymbol{C = C(y, w, u, v)}$ **(2.14)**

And the logarithmic form as: $\boldsymbol{\ln C = f(y, w) + \ln u + \ln v}$ **(2.15)**

Where $\boldsymbol{y}$ is the output vector, $\boldsymbol{w}$ the price of inputs, $\boldsymbol{u}$ and the level of cost inefficiency and $\boldsymbol{v}$is a set of random factors which captures the effects of measurement errors.

They further express the cost efficiency function as:

$$\boldsymbol{E_c = \frac{C^{min}}{C} = \frac{\exp[f(y,w)]\exp(\ln v)}{\exp[f(y,w)\exp(\ln u)\exp(\ln v)} = \exp(-\ln u)} \quad \textbf{(2.16)}$$

According to Tim (2007), the cost function is specified as:

$$C_i = X_i\beta + (V_i + U_i) \quad \textbf{(2.17)}$$

$$i = 1, \ldots, N \ \ (N \ is \ the \ number \ of \ farmers)$$

Where C_i is the (logarithm of the) production cost of the i^{th} farmer;

X_i Is a vector of cost variables of the i^{th} farmer;

β Is a vector of unknown parameters;

V_i is the random variable which is independently and identically distributed and has a zero mean with a constant variance $N(0, \sigma v^2)$, and independent of the U_i which is a non-negative random variable and is presumed to account for the cost inefficiency in production and are also often $|N(0, \sigma u^2)|$. The U_i now show far the farmer (firm) operates above the cost frontier.

There are several methods for estimating the efficiency of a decision making unit. According to Mehdi and Massimo (2003), these approaches can be categorised into two main types: non-parametric or deterministic approaches for instance, data envelopment analysis (DEA), and parametric or stochastic approaches such as least squares method and stochastic frontier analysis (SFA). They added that, the main advantage of the parametric methods is their ability to control for unobserved heterogeneity among companies (farmers, in this study).

Furthermore, Barros (2004) noted some superior and desirable properties of the SFA over the DEA. That is, SFA has a well-developed statistical test to detect the effectiveness of the model description and it also decomposes the deviations from efficiency levels into noise and pure inefficiency.

The farmers in this study differ in various regards; age, sex, educational status and income status among others. These characteristics as well as other potentially unobserved features do affect their production costs but are not necessarily indicative of different efficiencies. The inefficiency measure may therefore be affected by these confounding factors. This makes the SFA more suitable for this study.

Cost efficiency measures the ratio of minimum cost at which it is possible to attain a given volume of output and the actual cost realised. Cost efficiency, accordingly, is measured as the proportion of the minimum cost($\boldsymbol{C^{min}}$), which is necessary to produce the output vector, to the realised costs($\boldsymbol{C}$), Maudos *et al.,* (2002). They further added that an efficiency value of $\boldsymbol{E_c}$indicates that it would be possible to obtain the same vector of output and yet save $(1 - \boldsymbol{E_c}) \times 100\%$ of the costs. The coefficients of $\boldsymbol{E_c}$ ranges from zero to one (0, 1).

The cost efficiency ($\boldsymbol{E_c}$) measured in the study is the extent to which the farmers produced a given level of output (paddy) at the minimum cost possibleIn and in measuring of the effects of market participation on farmers' efficiency ($\boldsymbol{E_c}$) the predicted value of market participation (***yhet***) from the fractional regression model was used as a proxy for the observed market participation in the frontier model.

3.4.5 Level of market participation among rice farmers

Market participation was measured in this study by the farmer's willingness to sell and actual sales of a proportion of his or her rice output, in line with Gebremedhin *et al*., (2010). The level of market participation was measured by the percentage of the farmer's total output sold. The farmers were categorized under the following characteristics for a comparison of their levels of market participation: willingness to sell, sex, age categories, ability to sell their desired quantities, their description of the prices offered by buyers, the range of other incomes they earn and their landholdings (Ha).

3.4.6 Determinants of market participation

The fractional logit model was used to address this objective. Market participation was measured as a percentage of total rice output sold by the farmer.

3.4.6.1 Empirical model for ascertaining the determinants of market participation

In determining the factors that influence market participation of farmers, the study regressed market participation on the socio-democratic features of farmers, production factors and the income characteristics of the farmers.

The Fractional Response Model for Market Participation

$$E(markPart_i|x) = LnOutput_i - Rice\ Exp.Cat._i + Sex_i - LnQtyConsumed_i + EduLevel_i + SellingPrice_i + Contract\ farming_i - FBO\ Membership_i + Transport\ Acc._i - Choosing\ Buyers_i - Price\ setting_i + RMC_i + RFCR_i - Rice\ system_i - Ln(DTM)_i - ROI_i + \nu_i \quad \textbf{(3.1)}$$

3.4.7 Effects of market participation on output

To assess the effects of market participation on output, the endogenous covariates model (the three stage least squares) was chosen. This model was opted for due to its superiority in dealing with endogeneity, particularly, the reverse causality relationship between level of output and market participation.

3.4.7.1 Empirical model for assessing the effects of market participation on output levels of farmers

The first part of 3SLS model is the output equation. The output level of farmers is regressed on the inputs used (seed and fertilizer among others) as well as market participation and other the socio-democratic features of farmers.

The second part of the model also consisted of market participation as the dependent variable regressed on the output levels of farmers, socio-democratic characteristics and the factors that influence market participation.

Specification of the model

The output equation is as follows:

$$LnOutput_i = \beta_0 + \beta_1 MarkPart_i - \beta_2 Sex_i + \beta_3 LnHHsize_i + \beta_4 LnPrev.price_i - \beta_5 FormalEdu_i + \beta_6 RMC_i - \beta_7 RFCR_i + \beta_8 WaterSuplly_i + \beta_9 Rice\ system_i + \beta_{10} FBOpurpose_i + \beta_{11} ROI_i + \beta_{12} LnTotalFert_i + \beta_{13} HiredlabourAcc_i + \beta_{14} LnFarmsize_i - \beta_{15} LnFSOC_i + \beta_{16} RiceExpCat_i + \omega_i \quad \textbf{(3.2)}$$

The market participation function is also as follows:

$$MarkPart_i = \beta_0 + \beta_1 LnOutput_i + \beta_2 Sex_i - \beta_3 RFCR_i + \beta_4 LnPrice_i - \beta_5 Price\ setting_i + \beta_6 Contract\ farming_i - \beta_7 RiceExpCat_i - \beta_8 FBOPurpose_i + \beta_9 TransAcc_i - \beta_{10} ROI_i - \beta_{11} Choosing\ buyers_i - \beta_{12} Rice\ system_i + \beta_{13} RMC_i + \varepsilon_i \quad \textbf{(3.3)}$$

3.4.8 Cost efficiency of rice farmers

In determining the factors influencing cost efficiency, the stochastic cost frontier model was estimated. The model is in two parts; the first part consists of the variables for the cost frontier of the rice farmers. The unit cost of the various production inputs were captured as the factors influencing production cost, while the second part consisted of the socio-demographic and farm management characteristics of the farmers which tend to influence the farmers' cost inefficiency.

3.4.8.1 Effects of market participation on cost efficiency

To achieve this objective, the predicted market participation (***y-het***) after the fractional regression was substituted into the frontier model as a variable in determining the level of farmers' inefficiency.

The frontier model is as follows:

$$LnProdCost_i = \beta_1 \mathrm{Ln(Seed\_Unitcost)}_i - \beta_2 \mathrm{Ln(Organic\ Fertilizer\_Unitcost)}_i + \beta_3 \mathrm{Ln(Fertilizer\_Unitcost)}_i + \beta_4 \mathrm{Ln(Insecticide\_Unitcost)}_i + \beta_5 \mathrm{Ln(Herbicide\_Unitcost)}_i + \beta_6 \mathrm{Ln(Hired\ labour\_Unitcost)}_i + \beta_7 \mathrm{Ln(Ploughing\_Unitcost)}_i - \beta_8 \mathrm{Ln(Farm\ size)}_i + \varepsilon_i \quad \textbf{(3.4)}$$

$$Cost\ inefficiency_i = \beta_1 Sex_i - \beta_2 Market\ Participation_i - \beta_3 \text{FamilyLabour}_i + \beta_4 \text{FBO purpose}_i + \beta_5 \text{ROI}_i + \beta_6 \text{FormalEdu}_i + \beta_7 \text{Ln(FSOC)}_i + \beta_8 \text{RiceExpCat}_i + \omega_i \quad \textbf{(3.5)}$$

Table 3.1: Description of variables used in the models

Variable	Variable definition	Units of measurement
Age	Age of respondent	Years
Household size	Members of the household	Units
Farm size	Size of rice farm	Acres
Total fertilizer used	Quantity of fertilizer used	Kilograms
Total seed used	Quantity of seed used	Kilograms
Total improved seed variety used	Quantity of high yielding seed variety used	Kilograms
Marital status	Marital status of farmer	1 = married, 2 = single, 3 = widowed and 4 = divorced
Production training	Rice production training received	Dummy: 0 = no 1 = yes
Improved seed variety access	Access to high yielding variety	Dummy: 0 = no 1= yes
Fertilizer access	Access to chemical fertilizer	Dummy: 0 = no 1= yes
Output	Total rice (paddy) harvested	Kilograms
Sex	Sex of farmer	Dummy: 0 = female 1 = male
RFCR	Reason for cultivating rice	0 = sales 1 = household consumption
Price	Unit price per kilogram of paddy	Ghana cedis (GHc)
Price setting	How the price of paddy is determined	1= Market demand, 2 = Production cost, 3 = negotiated with buyer and 4 = imposed by buyer
Contract farming	Engagement in contract farming	Dummy: 0 = no 1= yes
Rice Exp. Cat.	Years of rice farming	1 = 1-5, 2 = 6-10, 3 = 11-15, 4 = 16-20 and 5 = above 20
FBO Purpose	Purpose for which the FBO was formed	1 = production 2 = marketing
Transport Acc.	Access to transportation to market centre	Dummy: 0 = no 1= yes
Distance to market	Walking distance to market centre	Minutes

ROI	Range of incomes other than from rice (in GHc)	1 = 1,000.00 and below, 2 = above 1,000.00 - 3,000.00, 3 = above 3,000.00 - 5,000.00, 4 = above 5,000.00 - 7,000.00, 5 = above 7,000.00 - 9,000.00 and 6 = above 9,000.00
Choosing Buyers	Farmer's ability to choose between buyers	1 = Always, 2 = Sometimes and 3 = Never
Rice system	System of rice farming	1 = rain fed 2 = irrigated
RMC	Cultivation of rice as main crop	Dummy: 0 = no 1= yes
Market Participation	Proportion of harvested produce sold	Continuous (0% to 100%)
Previous prices	Price per kilogram during the immediate past season	Ghana cedis (GHc)
Formal Edu.	Formal educational status of farmer	Dummy: 0 = no 1= yes
Water supply	Adequate water supply on rice farm	Dummy: 0 = no 1= yes
Hired Labour Acc.	Access to hired labour	Dummy: 0 = no 1= yes
FSOC	Farm size of other crops cultivated	Acres
Insecticide	Volume of insecticides used	Litres
Herbicide	Volume of herbicides used (pre and post-emergent herbicides)	Litres
Ploughing	Cost of Ploughing per acre	Ghana cedis (GHc)
Family labour	Access to Family labour and group members' labour	Man-days
FBO member	FBO membership	Dummy: 0 = no 1= yes
Seed Unit	Unit cost of seed used	Ghana cedis (GHc)
Org FertUnit	Unit cost of organic fertilizer used	Ghana cedis (GHc)
Fertilizer Unit	Unit cost of chemical fertilizer used	Ghana cedis (GHc)
Insecticide Unit	Unit cost of insecticides used	Ghana cedis (GHc)
Herbicide Unit	Unit cost of herbicides used	Ghana cedis (GHc)
Hired labourUnit	Unit cost of hired labour	Ghana cedis (GHc)
PloughingUnit	Unit cost of ploughing	Ghana cedis (GHc)
Farm size Unit	Unit cost of the farm land	Ghana cedis (GHc)

Source: Author's construction, 2018

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Demographic and Socio-economic Characteristics of Farmers

This section provides an overview of the farmers' demographic and socio-economic characteristics such as sex, age, educational background, marital status and household size analyzed and discussed in relation to their influence on output (production) and market participation.

A quarter (25%) of the sampled farmers came from each of the four districts selected (Garu, Bolgatanga, Kassena-Nankana and Builsa). Analyses of the data gathered from the field revealed that majority (83.75%) of the respondents were married. This has influence on the farmer's resource management and economic/or income generating activities, as advanced by Nyunza and Mwakaje, (2012).

Table 4.1: Summary statistics of categorical variables

Variable		Frequency	Percentage
Socio-Demographic characteristics			
Districts			
	Bolgatanga	100	25.00
	Kassena-Nankana	100	25.00
	Builsa South	100	25.00
	Garu	100	25.00
Marital status			
	Married	335	83.75
	Single	37	9.25
	Widowed	25	6.25
	Divorced	3	0.75
Sex			

Male	214	53.50
Age Cat		
Early working age	26	6.50
Prime working age	360	90.00
Mature working age	13	3.25
Elderly	1	0.25
Rice farming experience		
1-5 years	120	30.00
6-10 years	154	38.50
11-15 years	64	16.00
16-20	33	8.25
20+	29	7.25
Formal Education		
Yes	238	59.50
FBO member		
Yes	200	50.00
Other Income sources		
Yes	379	94.75
Range of other incomes		
GHs 1,000.00 and below	126	31.50
Above GHs 1,000.00 to 3,000.00	180	45.00
Above GHs 3,000.00 to 5,000.00	68	17.00
Above GHs 5,000.00 to 7,000.00	12	3.00
Above GHs 7,000.00 to 9,000.00	9	2.25
Above GHs 9,000.00	5	1.25
Production characteristics		
RMC		
Yes	317	79.25
IRV		
Yes	249	62.25
Water supply		
Yes	216	54.00
Rice system		

	Rain fed	313	78.25
	Irrigated	87	21.75
Other crops			
	Yes	390	97.50
Credit access			
	Yes	114	28.50
Hired Labour			
	Yes	317	79.25
RFCR			
	Sale	283	70.75
	Consumption	117	29.25
Institutional assistance			
Extension Service			
	Yes	298	74.50
Production training			
	Yes	197	49.25
Contract farming			
	Yes	39	9.75
Institutional assistance			
	Yes	61	15.25
Marketing			
Choosing Buyers			
	Always	43	10.75
	Sometimes	273	68.25
	Never	84	21.00
Description of Price			
	Dissatisfactory	281	70.25
	Satisfactory	119	29.75
Price setting			
	Based on market demand	146	36.50
	Based on production cost	50	12.50
	Negotiated with buyer	46	11.50
	Imposed by buyer	158	39.50
Trans. Access			
	Yes	378	94.50

Source: survey data, 2018

The sex of a farmer, as found by some studies (such as Sigei *et al*, 2013 and Omiti *et al*., 2009), is an important factor that determines their capabilities in production and marketing, especially, as resource ownership is skewed to male farmers in Ghana. The results presented in Table 4.1 show that there are more males involved in the cultivation of rice than females in the Region. That is, 53.5% of the farmers are males while the remaining 46.5 %are females.

Furthermore, the results on table 4.1 shows that 90% of the farmers are between the ages of 25 and54 years (that is, the prime working age), 6.5% were between the ages of 15 and 24 years (the early working age), 3.25% were between the ages of 55 and 64 (the mature working age) and, lastly, 0.25% were 65 years old or more (the elderly working age).

The age distributions of the farmers indicate that majority of them are in their active productive age (as per the categories specified by Indexmundi, 2018), this could, certainly, positively affect productivity and consequently market participation *ceteris paribus*. The age of a farmer largely determines his or her farming experience as well as ownership of factors of production such as land and farm implements.

The results again shows that majority of the farmers (54.5%) have many years of experience in rice farming, that is, from 6 years to 15 years. This has an implication for technology adoption, trade relations (in both input and output markets) and institutional linkages. Farmers of such long time of active rice farming has the opportunity to establish

some level of rapport and personal connections with the various actors in the rice value chain, especially farm service providers, input dealers, extension agents and buyers.

These factors are well known to be major influencers of production and productivity in the agricultural sector. Because ownership of larger lands may lead to larger farms cultivated while ownership of farm implements such as farm machines or draught animals enhance labor productivity which could lead to more crop harvest and household surplus.

Additionally, the results from table 4.1 show that the majority of the farmers had formal education. That is, 59.5% of them received some level of formal education and the remaining 40.5% had no formal education. Majority of the farmers being formally educated will mean that they are able to read and (or) appreciate new agricultural interventions or programmes.

An enhancement of farmers' understanding and adoption of agricultural technologies as well as proper use of other farm inputs will result in higher surplus of crop produced and, consequently, market participation. Again, the results in Table 4.1 shows that 16% of the farmers are not married (they were either single, widowed or divorced).

Table 4.1 again shows that 94.75% (the majority) of farmers earn income from other sources other than rice farming. This should result in more investments into their rice farm and subsequently lead to higher productivity and output, but might not be the case given the fact that majority (76.5%) of these farmers earn GHc 3000.00 or less per annum. This

(all things being equal) is not enough to stimulate significant investment from the farmers in their farms.

The results further revealed a higher level of access to extension services (74.5%) coupled with a higher level of adoption of improved rice varieties (62.25%)among farmers, this should normally translate into higher levels of output (if all the other prerequisites for higher outputs are satisfied). In the view of the World Bank (2008), the adoption of improved and high yielding seed varieties, could lead to a major boost in agriculture in Africa and further inspire the paradigm shift from low and subsistent production to a very productivity and agro-industrial economy.

The issue of specialization has wide been argued to be a central basis for higher productivity, but this concept is yet to be appreciated by smallholder farmers. Majority (97.5%) of the farmers reported they were into the cultivation of other crops, they make a germane argument that crop diversification is their way of hedging against poor crop performance or crop failure. They make the point that their livelihood for the entire year is largely dependent on the performance of their farm (most of whom are only able to farm once a year), and for that matter, relying on one crop may not be prudent since failure of most crops is a common occurrence in the region.

Moreover, the study found that 49% of the farmers have received training on rice production, while 50.75% (the majority) said they never received any of such training. These are trainings aimed at increasing farmers productivity (including best farm

management practices), and so a narrative such as the one found by this study has negative consequences on the rice sector; perhaps, it is part of the main reasons why the sector is still underperforming in the country.

Table 4.2: summary statistics of continuous variables

Variable	Mean	Standard deviation	Minimum	Maximum
Socio-Demographic characteristics				
Age	36.03	8.73	20	68
Household size	10.2575	6.91	1	45
Years of Education	5.215	5.03	0	25
Production characteristics				
Farm size	3.8975	7.44	0.5	82
FSOC	4.64125	5.57	0	82
Total Fertilizer Used	339.535	584.46	0	6000
Herbicide	7.1675	11.90	0	120
Farm Labour	60.2175	40.44	8	413
Farming Experience	15.005	8.74	2	50
Output	2178.943	4414.23	84	67368
Organic Fertilizer	274.51	816.00	0	5000
Local Seed	81.28271	151.07	0	1260
Improved Seed Variety	36.78225	159.39	0	1680

Total Seed used	117.8618	206.02	8	1680
Insecticide	.465	0.90	0	8
Production Cost	1354.356	1733.69	32	16190
Marketing				
Market Participation	.6135021	0.22	4.96e-08	1
DTM	48.3275	33.48	3	180
Price	1.7254	0.46	1.14	2.5
Proceeds	2345.929	4989.19	0	78000

Source: survey data, 2018

The results on table 4.2 revealed the mean age of the sample 36 years and the youngest and oldest participants being 20 and 68 years respectively, with a standard deviation of 8.73. Similarly, the results in Table 4.2 shows an average of about 11 household members with a standard deviation of about 6.91 members as well as minimum and maximum household members of 1 and 45 respectively. A larger household with more dependents (members of the household unable work due to their age or other factors) is likely to have a lower market participation as long-established by Awotide at el. (2013).This is because, the food requirement of such large households (to a larger extend) leaves very little farm surplus for sale.

4.2 Level of market participation among rice farmers

It was found from the survey (as shown on table 4.3), that 55.14% of the male farmers and 47.31% of the female farmers participated between 60% and 100%. From table 4.3, 98.75% as against 1.25% of the farmers were willing to sell their produce but 3.5% failed to sell due to either the lack of marketable surplus or the poor prices offered by buyers. This further buttresses the point that majority of the farmers cultivate rice as a cash crop rather than for their household consumption (as per the findings of this study 70.75% of the farmers indicated that their primary purpose for cultivating rice is for sales).

Table 4.3: Level of market participation

Groupings	**Level of Market Participation (%)**							
Willingness to sell	**0**	**≤ 20**	**> 20 ≤ 40**	**> 40 ≤60**	**>60≤80**	**>80**	**Total**	**Percentage (%)**
Yes	9	6	30	144	117	89	395	**98.75**
Sex								
Male	6	4	18	68	61	57	214	**53.5**
Age Categories								
I. Early working age	1	0	2	3	8	12	26	**6.5**
II. Prime working age	13	6	27	132	106	76	360	**90**
III. Mature working age	0	0	1	8	3	1	13	**3.25**
IV. Elderly	0	0	0	1	0	0	1	**0.25**
Landholdings (Ha)								
≤ 0.5	4	0	12	62	49	14	141	**35.25**
> 0.5 ≤ 1	8	2	9	55	31	11	116	**29**
> 1 ≤ 1.5	0	2	4	14	10	2	32	**8**
> 1.5 ≤ 2.5	1	0	5	10	19	16	51	**12.75**
> 2.5 ≤ 3.5	1	0	0	2	4	19	26	**6.5**
> 3.5 ≤ 4.5	0	2	0	0	2	17	21	**5.25**
> 4.5 ≤ 5	0	0	0	0	0	3	3	**0.75**
>5	0	0	0	1	2	7	10	**2.5**
Description of price								
I. Satisfactory	4	1	8	52	28	26	119	**29.75**

II. Dissatisfactory	10	5	22	92	89	63	281	**70.25**
Range of Other Incomes								
I. ≤ GHs 1,000.00	11	3	12	22	38	20	106	27.97
II. > GHs 1,000.00 ≤ GHs 3,000.00	2	2	10	81	55	29	179	47.23
III. > GHs 3,000.00 ≤ GHs 5,000.00	0	1	5	27	10	25	68	17.94
IV. > GHs 5,000.00 ≤ GHs 7,000.00	1	0	1	5	1	4	12	3.16
V. > GHs 7,000.00 ≤ GHs 9,000.00	0	0	1	2	4	2	9	2.37
VI. > GHs 9,000.00	0	0	0	1	0	4	5	**1.31**
Percentages (%)	**3.5**	**1.5**	**7.5**	**36**	**29.25**	**22.25**	**100**	

Source: Field survey, 2018

Table 4.3 indicates that a majority of the farmers were willing and actually participated in the rice output market. However, this could largely be due to the fact that the majority (75.2%) of them fall in the lowest income brackets, that is, GHc 3,000.00 or less (per annum) from other income sources apart from rice.

Arguably, these farmers could be said to have been pushed into selling their produce as a result of their daily household expenditure needs. This assertion is based on the number of farmers who described the prices offered as dissatisfactory. Additionally, 70.25% of the farmers, as shown on table 4.3, described the prices offered them as dissatisfactory but still went ahead to sell their produce, majority of them still sold more than 40% of their produce.

According to Omiti *et al.*, (2009), poor farm households habitually sell shortly after harvest when the prices are mostly at their lowest (probably due to glut), and then buy in the lean

season from the markets when the commodity prices are usually higher due to scarcity. The rice farmers in the study region also experience similar price fluctuations.

The findings also reveal an increasing horizon in market participation from the early working age category to the prime working age category, but beyond this point the trend plummets sharply from the mature working age category through to the elderly working age category. This development discovered by the study is an absolute confirmation of the findings by several studies (Randela *et al*., 2008 and Chalwe, 2011) that suggest that younger farmers are more inclined to selling than their older counterparts. It is also, however, not an intimation that younger farmers are indifferent to market prices.

By landholdings, farmers with 0.5 hectares or less were found to have sold between 40% and 60% of their produce. This scenario could be due to the fact that farmers of a relatively smaller landholding realize lesser farm output compared to farmers with larger landholdings (under the same conditions). Hence farmers of smaller landholdings may sell fewer bags (or quantity) of their paddy relative to the quantity sold by farmers of larger landholdings in absolute terms, but in proportional terms, relative to their total output, they tend to have higher market participation as found in this study.

What is more worrying is that this group of farmers, smaller landholding farmers, constitutes the majority (35.25%) as found in this survey. It was also realized that 51.5% of the farmers, in general, sold more than 60% of their produce, this means that 48.5% of the farmers are still selling less than 60% of their produce (table 4.3).

From table 4.4, 38.5% of the farmers did not have formal education, 41.5% had basic education, 14.5% had secondary education and 5.5% had post-secondary education. In all, 20% of the farmers have had formal education enough to enable them read and write, at minimum. The farmers under the prime working age, who constitute the majority of the respondents, have the highest representation in all the categories or levels of formal education received by farmers. It is, therefore, satisfying to note that this situation has a positive telling on the prospects of the local rice industry.

Table 4.4: Socio-demographic distribution of farmers

Age categories	Sex	Educational level				
	Males	**None**	**Basic**	**Secondary**	**Post-secondary**	**Total**
Early working age (15-24)	17 (7.94%)	2 (7.69%)	18 (69.23%)	4 (15.39%)	2 (7.69%)	26 (6.50%)
Prime working age (25-54)	189 (88.32%)	141 (39.17%)	145 (40.28%)	54 (15.00%)	20 (5.55%)	360 (90.00%)
Mature working age (55-64)	7 (3.27%)	11 (84.62%)	2 (15.38%)	0 (0.00%)	0 (0.00%)	13 (3.25%)
Elderly (65+)	1 (0.47%)	0 (0.00%)	1 (100%)	0 (0.00%)	0 (0.00%)	1 (0.25%)
Total	214 (53.50%)	154 (38.50%)	166 (41.50%)	58 (14.50%)	22 (5.50%)	**400**

Source: survey data, 2018 ***Note: the age categories are according to IndexMundi, 2018***

4.3 Determinants of market participation

This objective sought to establish the factors that determine farmers' market participation. In doing so, the fractional logit model was employed in assessing the influence of output

level, experience, sex, formal education, contract farming, FBO membership access to transport, household consumption (used as a proxy for household size), buyer's competition (represented by farmers' ability to choose between buyers) other income sources, mode of price setting, market orientation, (represented by farmers' reason for cultivating rice), distance traveled to market and output price on market participation.

The apriori expectation of age and experience of a farmer is a positive effect on the intensity of market participation (Omiti *et al.*, 2009). Furthermore, several studies have shown that farmers' level of participation in the produce market is largely dependent on the volume of output from the farm. That is, the higher the farm output the higher the farmer's marketable surplus especially in the case of a dual purpose crop like rice. For that matter, the coefficient is expected to be positively signed.

The gender variable denotes the differences in market orientation of male and female farmers. Cunningham *et al*., (2008) established that men habitually sell more of their grain, whereas their female counterparts mostly choose to store their produce for their household self-sufficiency in food. If this phenomenon is observed in this study, then the coefficient for sex would be expected to be positive. Furthermore, formal education (post basic level) is hypothesized to increase farmers' appreciation of the dynamics of marketing and therefore informs their decisions on their level or intensity of participation in the output market among others (Makhura *et al*., 2001).

Household size is mostly indicative the labour strength or consumption level of the farm household (Alene *et al*., 2008). A positive sign is an indication that a larger household size offers more farm labour which produces more marketable surplus than their household consumption requirement. Conversely, a negative sign means that a larger household is labor-inefficient and thus, produces less marketable surplus. This means they consume more output leaving a smaller proportion for sale. A negative sing could also be observed in households where not all members work on the farm.

Alene *et al*., (2008) also revealed that farm households with non-farm income tend to have more marketable surplus on the condition that the income is invested in farm technologies if not, their marketable surplus will decline if the non-farm income triggers an off-farm diversification.

Additionally, Key *et al*., (2000) and Mathura *et al*., (2001) established that a negative relationship exists between the distance traveled to the market and the level of market participation. The increasing cost of transportation per unit of distance serves as a disincentive for very remote farmers to participate in urban markets which are usually far-off. This is probably the reason why rural farmers resort to producing lots of cereals (which mostly are of low market value)instead of fruits and vegetables which, comparatively, have a higher market value as noted by Stifel and Minten, (2008).

Finally, the influence of output price on the level of market participation is hypothesized to be positive by Alene *et al*., (2008) among other economists. This is tested in this study

by comparing the levels of market participation in the subsequent years given the previous year's output price. The model shows that fourteen (14) variables are significant and these are illustrated in table 4.5 below. The marginal effects (***dy/dx***) of the determining factors were also predicted and presented on table 4.5.

The results in table 4.5 indicate that the output level of a farmer influences his or her level of market participation positively. It is significant at 1%, indicating that an increase in output increases the farmer's level of participation in the rice market, holding the other factors in the model constant. Since the p-value is 0.000, there is, therefore, a statistically significant difference in the levels of market participation between farmers of a higher output level and those of lower output level. The marginal effect of output level is also positively significant at 1% and a coefficient of 0.18, this show that when output increases by 1Kg the farmer's participation in the rice market will increase by 18%.

Contrarily, farmers' experience in rice farming is negatively significant (at 1%) in determining market participation. The results show that farmers of a higher category of rice farming experience participate less in the rice market, holding the other factors constant. This is consistent with the findings of Randela *et al*., (2008) and Chalwe (2011) that older farmers undertake farming as a way of life and not farm as a business whereas younger farmers are more inclined to adopt new ideas and take more risk than the older farmers. Hence, younger farmers undertake farming as a business and so, participated more in the output market.

It further has a negatively significant marginal effect (at 1%) with a coefficient of 0.019, implying that farmers with many years of rice farming experience sell 1.9% less than farmers of fewer years of experience. The sex of a farmer was also found to be positively significant (at 5%) in determining market participation, the results revealed that male farmers participated in the rice market more than their female counterparts. Its marginal effect is also positively significant at 5% and has a coefficient of 0.288, indicating that male farmers' participation in the rice market is 2.9% more than females. This is probably due to the differences in assets and farmland ownership between male and female farmers. Female farmers in these settings hold smaller farms and as such, may only be able to produce for their household consumption or food security.

On the other hand, the coefficient for household consumption is negatively significant at 1%, indicating that larger household consumptions decrease farmers' rice market participation, holding the other factors constant. The negative sign, according to the position advanced by Omiti (2009), means that larger farm household are labour-inefficient and, so, produce less output but consume a chunk of their produce, leaving smaller marketable surpluses for sale. Additionally, its marginal effect is statistically significant at 1% with a coefficient of -0.17; this indicates that a kilogram increase in household consumption will decrease market participation by 17%.

Moreover, the selling price is positively significant at 1% in influencing market participation. The results indicate that a higher selling price offered by buyers will increase farmers' participation in the rice market, holding all other factors constant. It also has a

significant marginal effect (at 1%) and a coefficient of 0.059 meaning that a cedi (GHc 1.00) increase in price will increase farmers' participation in the rice market by 5.9%.Additionally, price setting is negatively significant at 1% in influencing farmers' market participation.

The results indicate that buyers imposing prices on farmers (to the neglect of farmers' interest), decreases farmers' market participation in the rice market, holding other factors constant. Its marginal effect is positively significant at 1% with a coefficient of -0.028, meaning that imposing prices on farmers will reduces their participation by 2.8%.

Similarly, farmers' ability to choose between buyers is negatively significant at 1%, meaning that farmers who access a wide range of buyers to choose from, participate more than farmers who have a limited choice of buyers, holding other all other factors constant. This is because farmers with a wide range of buyers to choose from are most likely offered higher prices from the competing buyers unlike farmers of other locations where the buyer or buyers may be enjoying a monopoly. Its marginal effect is negatively significant at 1% and with a coefficient of -0.43, reveals that a limited access to competing buyers decreases farmers' participation by 4.3%.

Then again, farmers' engagement in contract farming is positively significant (at 1%), that means, contract farming increases farmers' market participation, holding the other factors constant. The probable reason is that they are provided with a guaranteed market by their contract partners. It also has a positively significant marginal effect (at 1%) with a

coefficient of 0.063, indicating that contract farming increases farmers' market participation by 6.3%.

FBO membership was also not significant, this is contrary to the *a priori* expectation of this study but consistent with the findings of the GSSP (2012) which shows that about 13% of FBOs undertake collective marketing. Several studies suggest that when farmers undertake collective marketing of their produce, they increase their chance of securing good prices and increasing market participation. This implies that group participation tends to increase smallholder farmers' market penetration. It can therefore, be concluded that the FBOs are not functioning effectively in the study area.

Then again, from table 4.4 accessing transportation to market significantly influences farmers' market participation. This is positively significant at 1% and denotes that an increase in transportation access to market centers increases farmers' market participation, holding the other factors constant. Its marginal effect is positively significant at 1% with a coefficient of 0.141, indicating that when farmers have access to transportation, their market participation will increase by 14.1%.

Conversely, distance to a market centre is negatively significant (at 10%) in influencing market participation, the results indicate that a longer walking distance will decrease farmers' market participation, holding the other factors constant. This could be due to a possible high cost associated with accessing transportation or the level of drudgery involved in how they cart their produce to the market. As shown on table 4.5, its marginal

effect is negatively significant at 10% and with a coefficient of -0.021, indicating that a minute more increase in the walking distance to market will decrease farmers' participation by 2.1%.

Farmers' reason for cultivating rice is positively significant at 1% in influencing their level of participation in the market. The findings indicate that farmers who cultivate rice for sale participate more than those who cultivate rice for consumption, holding the other factors constant. Its marginal effect (positively significant at 1%) and with a coefficient of 0.087 shows that farmers who cultivate rice for sale participate8.7% more in the rice market than those who cultivate rice mainly for consumption.

Still among the influencing factors is the range of other incomes a farmer earns from other alternative sources. Statistically significant at 1% and negative, it means that farmers with a higher level of income from other sources sold lesser than other farmers who earned lower incomes from other sources, holding the other factors constant.
This is obviously because farmers with higher incomes from other sources can mostly sustain their daily household needs on the off-rice income. They may only be producing for their household consumption. Its marginal effect (negatively significant at 1%) with a value of -0.030. This indicates that farmers of a higher income category sold3% less than those with a lower income from other sources.

Then again, the system of rice farming is also found to be negatively significant (at 1%) in determining farmers' market participation. The results show that farmers on irrigation

schemes participate lesser than those engaged in rain fed rice production, holding the other factors constant. This is likely because of the fact that farmers at irrigated sites get relatively higher yields (in the Upper East Region) and so may just sell a smaller proportion of their produce (which, in nominal terms, may far exceed what their counterparts sell) and keep the rest in anticipation of higher future prices.

This factor also has a negatively significant marginal effect (at 1%) with a coefficient of -0.062, implying that farmers at irrigation schemes sold 6.2% less than farmers under rain fed production (relative to their proportions of sales).

Lastly, cultivating rice as the main crop also influence farmers' market participation. Similarly, it is positively significant at 5%. This signifies that farmers who cultivate rice as their main crop participates in the rice market more than those farmers who do not, holding the other factors constant. It also has a positively significant marginal effect (at 1%) and a coefficient value of 0.476, denoting that farmers who cultivated rice as their main crop sold about 4.8% of their produce more than the other farmers.

Table 4.5: Coefficient estimates for factors that influence market participation

Variables	Coefficients	z-Statistic	dy/dx
LnOutput	.87***	12.28	.18***
RiceExp_Cat	-.09***	-3.84	-.02***
Sex	.14**	2.05	.03**
LnQty_Consumed	-.82***	-10.00	-.17***

Edu_Level	.04	1.02	.01
Selling Price	.29***	3.61	.06***
Contract farming	.30***	2.76	.06***
FBO Membership	-.06	-0.87	-.01
TransAccess	.68***	2.64	.14***
Choosing Buyers	-.21***	-2.67	-.04***
Price setting	-.14***	-5.12	-.03***
Rice as Main Crop	.23**	2.48	.05**
Reason for rice prod.	.42***	5.63	.09***
Rice system	-.30***	-6.83	-.06***
Ln(Distance to market)	-.10*	-1.86	-.02*
ROI	-.15***	-3.94	-.03***
_cons	-1.12***	-2.58	-

Number of obs = 396 Wald chi2(16) = 608.03 Prob > chi2 = 0.0000
Pseudo R2 = 0.0975

Note: p-values are denoted as follows: * p < 0.1; ** p < 0.05; *** p < 0.01
RFCR (reason for cultivating rice) FBO (farmer based organization) DTM (distance to market) ROI (range of other incomes) RMC (rice as main crop of the farmer)

Source: field survey, 2018

4.4 Effects of market participation on output

To achieve this objective, the endogenous covariates (the three stage least squares) model was used. The results revealed that market participation, among other factors, significantly influence rice farmers' level of production. Market participation was found to be significant (at 10%) in determining farmers' level of production (output). With a positive coefficient

of 0.536, it implies that an increase in market participation will increase rice output levels by about 0.54kg, holding all other factors constant.

Additionally, prices of the immediate past season is also significant (at 1%) in determining farmers' present output levels. It was also found to have a positive coefficient (though infinitesimal) it indicates that a higher price in the previous season will increase farmers' level of output in the preceding season, holding all other factors constant.

Then again, producing rice as the main crop also significantly determines farmers' output levels. It was found to be significant at 1% and with a positive coefficient of 0.26, implying that farmers who cultivated rice as their main crop produced about 0.26kg more than the other farmers, holding all other factors constant. Furthermore, the reason for cultivating rice was also found to be significant at 1% in determining the level of farmers' output.

The results show a positive coefficient of 0.237, indicating that farmers who cultivated rice for sale (farmers with a market orientation) produced about 0.24kg more than those who produce for consumption, holding all other factors constant.

Moreover, rice is a water loving crop and so, adequate water supply on the farm was found to be significant (at 1%) in determining farmers' output. It showed a positive coefficient of 0.211, meaning that access to adequate water supply will increase output by about 0.21kg, holding all other factors constant. Similarly, the system of rice cultivation was found to be significant (at 1%) in determining output levels. Irrigation farming was found to have a

positive coefficient of 0.129, implying that producing on an irrigation scheme will increase output by about 0.13kg, holding all other factors constant. This is, most likely, because of their access to adequate water supply at the irrigation sites.

Also the level of farmers' income from other alternative sources is significant (at 1%) in determining their production levels. This variable revealed a positive coefficient of 0.116, denoting that a higher income from other sources will increase rice output by about 0.12kg, holding all other factors constant. The probable explanation is that farmers invest a significant proportion of their extra income earned from other sources on productive resources to boost their rice production.

Furthermore, fertilizer usage was also found to be significant (at 1%) in determining output levels. This shows a positively significant value of 0.447, implying that an increase in fertilizer usage will increase output by about 0.45kg, holding all other factors constant. In addition, farmers' access to farm labour was significant (at 5%). This also shows a positive value of 0.157; meaning that an increase in farmers' access to farm labour (both hired and family labour) will increase output by about 0.16kg, holding all other factors constant.

Likewise, larger farms resulted in more output. Farm size was also found to be positively significant at 5% and with a coefficient of 0.098, denoting that an increase in farm size will increase output by about 0.1kg, holding all other factors constant.

Lastly, the total farm size of other crops cultivated by the farmers had a negatively significant (at 1%) influence on their rice production. The results indicate a value of -0.035 meaning that an increase in the farm size of other crops will decrease rice output by about 0.04kg, holding all other factors constant. The possible reason is that the farmers share their time, labour and other resources among all the crops cultivated in the period, and so, the best investment in their rice farm is not made. The results on farmers' years of rice farming was found not to be significant in determining the level of production contrary to the a priori expectation of the study.

Table 4.6: Coefficient estimates for determinants of output of farmers

Variables	Coefficients	z-Statistic
LnFarm size	.10**	2.04
LnTotal Fertilizer	.45***	9.48
Hired Labour Acc.	.16**	2.41
Rice system	.13***	3.67
Water supply	.21***	3.87
LnFSOC	-.05***	-2.65
Rice Exp. Cat.	-.00	-0.02
Sex	-.06	-1.11
LnHousehold size	.05	1.18
Edu. Level	-.03	-0.96
RMC	.27***	3.43
RFCR	.24***	3.00
Market Participation	.54*	1.74

Prev. prices	.00***	3.65
FBO Purpose	-.00	-0.19
ROI	.12***	4.20
_cons	3.31***	13.33

Obs	*RMSE*	*"R-sq"*	*chi2*	*P*
355	.4204336	0.7567	1061.14	0.0000

Note: p-values are denoted as follows: * p < 0.1; ** p < 0.05; *** p < 0.01

Source: field survey, 2018

4.5 Effects of market participation on cost efficiency

This objective tested for the effect of market participation, among other factors, on the cost efficiency of farmers. The first part estimates the cost frontier of farmers. The results in table 4.7 shows that seed, organic fertilizer, fertilizer, herbicides, hired labour, ploughing (traction) and farm size are positively significant at 1%, 10%, 1%, 5%, 10% 1% and 5% respectively.

This means that increasing these variables (cost of fertilizer, insecticide, herbicides, hired labour, ploughing (traction) and farm size) will increase farmers' cost of production. Also insecticide is negatively significant at 10%, meaning an increase in it reduces cost, this contradicts the *a priori* expectation of the variable.

The second part, as shown in table 4.7, estimates the inefficiency of farmers. The result indicates that market participation, is significant at 5% in determining farmers' cost inefficiency. This implies that farmers with high market participation are more cost efficient than farmers with no or low market participation, holding the other factors constant. That is, farmers with higher market participation are more conscious in

minimizing their cost of production (so as to maximize profit) than those with low or no market participation.

The farmers were found to be, on the average, about 70.5% cost efficient. The interpretation of this value is that, for farmers to operate more efficiently, they could reduce their production cost by 29.5% (that is, about GH₵399.40) without having to reduce their current level of output. Sex was not significant at 10%, but its negative sign indicates that, perhaps, male farmers are more cost effective than female farmers. Similarly, FBO membership and formal education are also not statistically significant at 10%, but are also negatively signed meaning that these variables reduce inefficiency.

The range of other incomes (ROI) and farmers' experience in rice farming are negatively signed and significant at 1% and 5% respectively. This implies that farmers of higher incomes from other sources as well as farmers of many years of rice farming are more cost efficient as compared to those farmers with lower incomes and lesser years of rice farming, holding the other factors constant.

Table 4.7: Coefficient estimates for determinants of farmers' cost efficiency

Cost frontier	Coefficients	z-Statistic
Ln(SeedUnitcost)	.03***	3.69
Ln(Organic FertilizerUnitcost)	.07*	1.67
Ln(FertilizerUnitcost)	.05***	2.86
Ln(InsecticideUnitcost)	-.01*	-1.71
Ln(HerbicideUnitcost)	.04**	2.22
Ln(Hired labourUnitcost)	.02*	1.87
Ln(PloughingUnitcost)	.10***	3.30
Ln(Farm sizeUnitcost)	.03**	2.49
_cons	7.57***	18.55
Cost inefficiency equation	Coefficients	z-Statistic
Market participation	-2.35**	-2.55
Sex	-.53	-1.52
Family labour	.12	-4.52
FBO member	-.48	2.01
ROI	-1.81***	5.71
Formal Edu.	-.21	1.44
Ln(FSOC)	.32	1.22
Rice Exp. Cat.	-.42**	-2.42
_cons	4.16***	5.13
Number of obs. = 371	Wald chi2(8) = 65.75	Prob > chi2 = 0.0000

Farmer cost efficiency	Mean	Standard deviation	Minimum	Maximum
70.5%	.7051126	.2108453	.1289753	.996156

Note: p-values are denoted as follows: * p < 0.1; ** p < 0.05; *** p < 0.01

Source: field survey, 2018

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This chapter covers the key findings of the study, the conclusions and the policy recommendations arising from the conclusions of this research. Limitation of the study and suggestions for future research are also presented. The study sought to empirically identify the determining factors of rice market participation and to further assess the level of market participation as well as examine its effects on farmers' level of production and cost efficiency. This study gathered and used a cross sectional data from 400 randomly selected rice farmers in Bolgatanga, Kassena-Nankana, Garu and the Builsa South Districts of the Upper East Region.

The econometric models employed in the study's analysis were, the fractional logit model which was used in estimating the determinants of market participation while the three stage least squares model and the stochastic cost frontier were used in assessing the effects of market participation on farmers' levels of production and cost efficiency respectively.

Proceeding from the investigation carried out in this research, the following key findings are established. The descriptive results from the survey show that 51.5% of the farmers sold more than 60% of their rice output. The study also found that 70.25% of the farmers described the prices as dissatisfactory and for that matter, a disincentive for production. This emphasizes the need for a guaranteed minimum price regime to be instituted since

better output price has been found to be key for an increased production levels and sales. Additionally, 90% of the farmers earn GHc 3,000.00 per annum or less from other alternative income sources. This further makes them vulnerable to exploitation by buyers.

The findings revealed that farmers with a higher level of market participation in the previous season produced more output than those with a lower level of market participation. Farmers' output level was also found to be positively influenced by prices offered in the previous season, among others. The level of output, market price, distance to market and the reason for cultivating rice (market orientation), among other factors, were also found to positively and significantly determine the level of market participation.

The cost efficiency level of the farmers is found to be about 70.5%. This means that the farmers can further reduce their cost of production by 29.5% without reducing the level of their output. Market participation, the range of other incomes and rice farming experience are significant in reducing farmers' cost inefficiency. Whereas the quantities of seed, manure, chemical fertilizer, herbicides, the number of hired farm laboure used, farm size and the cost of ploughing are significant in determining the cost frontier of rice farmers in the Upper East Region. The association of a farmer to an FBO was found to not be influential in rice market participation. The FBOs were not effective with respect to collective marketing, regardless of the purpose for which it was established.

5.2 Conclusions

From the findings, a strong case can be established in support of the fact that rice is a commercial commodity produced as a cash crop in the Upper East Region. It is evident from this study that a large proportion of rice farmers in the region have a high level of market participation despite the dissatisfactory prices offered them. This, they say, largely discourages them in their quest to commercialize their production. The study confirms that farmers' socio-demographic characteristics, output levels and pricing related variables are major determinants of the level of market participation among rice farmers in the Region. Similarly, the study confirms that market participation is a significant determinant of the level of rice production and cost efficiency in the region. It further stands to reason that the FBOs in the region lack either the capacity or resources (or most likely, both) to undertake collective marketing.

5.3 Policy Recommendations

Drawing from the conclusions of this research, the following recommendations are proposed:

It has been shown that rice is a commercial crop in the region, therefore, productivity enhancing technologies such as labour-saving simple farm equipment, improved seed, fertilizer and other agro-inputs should be made both physically and financially accessible to famers at district offices of MoFA, in collaboration with Agric-based Non-Governmental Organizations to increase the production of rice in the region. The fertilizer subsidy and the Planting for Food and Jobs programmes should be strengthened to improve effective targeting of the resource-poor farmers.

To ensure increased market participation among farmers, there should be an effective linkage of the various FBOs to the National Food Buffer Stock Company (NAFCO) and the Ghana School Feeding Programme along with an effective and proactive monitoring and supervision to ensure a sustained market that recompense farmers.

Farmers should be facilitated to form and sustain effective FBOs to take up the advantages of collectively marketing and accessing other farm support services. Finally, farmers are commended to participate in trainings on production so as to improve upon their output levels and productivity for better market participation.

5.4 Limitations of the Study

One of the major limitations of the study was time and resources constraint. As such, the sample size may be small in relation to the entire rice farmer population of the Upper East Region. This might have an influence on the inferences made about the population. Also, due to time and resource constraints, the study is limited to farmers' challenges in accessing regular markets and good prices without considering the same for the aggregators who have also lamented about their challenges in selling to the major off-takers and processors.

5.5 Suggestions for Future Research

The study suggests that future researchers should look at the marketing constraints of the paddy aggregators - both as buyers and sellers. Future studies should also consider increasing the sample size by including more districts from the Upper East Region for fair representation of the entire study area.

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Appendix A

INFORMED CONSENT

Dear valued respondent, I am undertaking this survey as part of my academic requirements at the University for Development Studies for my thesis. This research is designed to examine the factors that influence farmers' market participation and how it (market participation) affects rice production and profitability in the Upper East Region.

Please note that you are at liberty to either respond or decline to this questionnaire. Are you willing to respond to this questionnaire? Yes [ ] No [ ]

If you agree to participate, please be assured that your responses to these questions will be treated as confidential, and only for the purpose intended in this survey.

Questionnaire number: Date of interview: …../……/…….

Name of interviewer:_____ Name of community:_____

Section 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS

1) District: 1. Bolgatanga [ ] 2. Kassena-Nankana [ ] 3. Builsa South [ ] 4. Garu [ ]
2) Age of respondent:……..
3) Sex of respondent: 1. male [ ] 2. Female [ ]
4) Marital status: 1. Married [ ] 2. Single [ ] 3. Widowed [ ] 4. Divorced [ ]
5) Household size:…….
6) Have you had formal education: 1. Yes [ ] 2. No [ ]
7) If yes, please state how many years of education:……

Section 2: PRODUCTION

8) Is rice farming your main occupation? 1. Yes [ ] 0. No [ ]
9) How many is the total size of your rice farm? (Acres)……..

10) Do you use improved rice varieties? 1. Yes [ ] 0. No [ ]

11) What system of rice production do you practice? 1. Rain fed [ ] 2. Irrigated [ ]

12) Experience in rice farming (in years):……

13) Did you cultivate other crops in the last season? 1. Yes [ ] 0. No [ ]

14) If yes, what is the total land size of all those crops? (Acres)…….…

15) Experience in farming (in years):……

16) Do you access extension services? 1. Yes [ ] 0. No [ ]

17) If yes, what is the frequency? 1. …….. Weekly [ ] 2. …….monthly [ ] 3. ……..Quarterly [ ] 4. …… Others (specify ……..)

18) Have you received any training on rice production? 1. Yes [ ] 0. No [ ]

19) Number of rice production trainings attended in the past 5 years:……..

20) Did you access credit last season? 1. Yes [ ] 2. No [ ]

21) If yes, which type of credit: 1. Cash [ ] 2. Input [ ] 3. Service [ ]

22) If you accessed credit, was it timely? 1. Yes [ ] 2. No [ ]

23) If no, why? 1. I didn't seek/apply for it [ ] 2. I didn't meet the requirements [ ]

24) Did you access hired labor last season? 1. Yes [ ] 2. No [ ]

25) If yes, was it timely? 1. Yes [ ] 2. No [ ]

26) If yes, which type of labour did you access? 1. Hired [ ] 2. Family [ ] 3. FBO members?

27) If no, why? 1. High cost of labour [ ] 2. Unavailability of labour [ ]

28) Did you access fertilizer last season? 1. Yes [ ] 2. No [ ]

29) If yes, was it timely? 1. Yes [ ] 2. No [ ]

30) If no, why? 1. High cost [ ] 2. Unavailability of fertilizer [ ] 3. No interest in fertilizer [ ]

31) What is the quantity of your harvest in the last season (Kg)? ……

Section 3: MARKET PARTICIPATION

32) What is the main reason you cultivated rice in the last growing season? 1. For sale [ ]
2. For household consumption [ ] 3. Both [ ]

33) If for sale, were you willing to sell at the prevailing market price? 1. Yes [ ] 2. No [ ]

34) Where did you sell your rice? 1. In the community market [ ] 2. Farm gate/Community [ ] 3. Contract purchase 4. Buyer bought from my house

35) If you sold in the community market, what is the average walking distance from market to your house? (In minutes)…….

36) Did you access transport for your last season produce to the market? 1. Yes [ ] 2. No [ ]

37) What is the form of access to the transport? 1. Own [ ] 2. Hired [ ]

38) If the transport is hired, please state how much it cost you GHc……..

39) What is your opinion about the transport cost? 1. Satisfactory [ ] 2. Dissatisfactory [ ]

40) Were you in contract farming last season? 1. Yes [ ] 2. No [ ]

41) If yes, what is the type of contract farming? 1. To supply produce [ ] 2. Credit support [ ]

42) What is your opinion about the contract? 1. Satisfactory [ ] 2. Dissatisfactory [ ]

43) Were you able to sell some of your produce last season? 1. Yes [ ] 0. No [ ]

44) If yes, were you able to sell your desired quantity? 1. Yes [ ] 0. No [ ]

45) If you were not able to sell, what were the reasons? (Tick all that apply) 1. Poor prices [ ] 2. No surpluses [ ] 3. No interest in selling [ ] 4. Lack of buyers for produce [ ]

46) Are you able to choose between buyers? 1. Always [ ] 2. Sometimes [ ] 3. Never [ ]

47) Based on the last season's sales, how do you describe the prices that buyers offered you? 1. Satisfactory [ ] 2. Dissatisfactory

48) How do you set the prices of your rice for sale? 1. Based on market demand [ ] 2. Based on production cost [ ] 3. Based on negotiation with buyer [ ] 4. Price was determined by buyer

49) Do have access to market information? 1. Yes [ ] 0. No [ ]

50) Do you access institutional assistance in selling your paddy? 1. Yes [ ] 0. No [ ]

51) Are you a member of a Farmer group or organization? 1. Yes [ ] 0. No [ ]

52) If yes, what is your organization into? 1. Production [ ] 2. Marketing [ ]

Section 4: INCOME CHARACTERISTICS

53) What was your income from last season rice production? (GHC)…….

54) Do you have other sources of income other than rice production? 1. Yes [ ] 0. No [ ]

55) If yes, then choose as many as apply 1. Other crops [ ] 2. Livestock [ ] 3. Monthly salary/wage [ ] 4. Trade [ ] 5. Others [ ] ***(please specify)***……..

56) Please indicate the range of your extra income (per annum):

1. GHs 1,000.00 and below [ ]
2. Above GHs 1,000.00 to 3,000.00 [ ]
3. Above GHs 3,000.00 to 5,000.00 [ ]
4. Above GHs 5,000.00 to GHs 7,000.00 [ ]
5. Above GHs 7,000.00 to GHs 9,000.00 [ ]
6. above GHs 9,000.00

Section 5: COST OF PRODUCTION

57) Kindly fill the table below on the inputs used in cultivating rice in the last season (cost in GHC)

Input	**Only rice farm**		
	Total quantity used	*Unit cost (GHC)*	*Amount (GHC)*

Farm size (acres)			
Land Preparation			
Family labour			
Hired labour			
Ploughing /Rotovation			
Weeding			
Family labour			
Hired labour			
Harvesting			
Family labour			
Hired labour			
Threshing and Bagging			
Family labour			
Hired labour			
NPK			
Urea/SA (Prilled)			
Urea (briquettes)			
Organic fertilizer			
Local Seed			
Improved seed			
herbicides			
Insecticides			
Water levy per plot			

Section 6: RETURNS FROM RICE PRODUCTION

58) Please fill the table below based on your last rice cropping season

Plot no.	Plot size	Quantity harvested (Kg)	Sold (Kg)	Consumed (Kg)	Gifts (Kg)	Seed (Kg)	Storage (Kg)	Price per Kg	Total proceeds
1									
2									
3									
4									
5									

THANK YOU FOR YOUR TIME.

Appendix B

Results from the Fractional logit model

```
Iteration 0:   log pseudolikelihood =  -255.6202
Iteration 1:   log pseudolikelihood =  -239.0056
Iteration 2:   log pseudolikelihood = -238.85475
Iteration 3:   log pseudolikelihood = -238.85472
Iteration 4:   log pseudolikelihood = -238.85472

Fractional logistic regression                  Number of obs     =        396
                                                Wald chi2(16)     =     608.03
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -238.85472               Pseudo R2         =     0.0975
```

MarkPart	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
LnOutput	.8648742	.070406	12.28	0.000	.7268809	1.002867
RiceExp_Cart	-.0941708	.0245067	-3.84	0.000	-.1422031	-.0461386
Sex	.1385796	.0677119	2.05	0.041	.0058668	.2712925
LnQty_Consumed_Y3	-.8243936	.0824612	-10.00	0.000	-.9860146	-.6627726
Edu_Level	.0420807	.0411747	1.02	0.307	-.0386201	.1227816
Selling_Price_Y3	.2882049	.0797597	3.61	0.000	.1318787	.444531
Contract_farming	.303082	.109619	2.76	0.006	.0882327	.5179312
FBO_member	-.0579982	.0663469	-0.87	0.382	-.1880358	.0720393
TransAccess	.6807396	.2582716	2.64	0.008	.1745365	1.186943
Choosing_Buyers	-.207523	.0778341	-2.67	0.008	-.360075	-.0549709
Price_setting	-.1351694	.0264146	-5.12	0.000	-.1869411	-.0833977
RMC	.2288965	.0924503	2.48	0.013	.0476973	.4100958
RFCR	.4208633	.0747741	5.63	0.000	.2743087	.5674179
Rice_system	-.2999542	.0439397	-6.83	0.000	-.3860743	-.2138341
LnDTM	-.1002013	.0537666	-1.86	0.062	-.2055819	.0051792
ROI	-.1454732	.0369405	-3.94	0.000	-.2178752	-.0730712
_cons	-1.120373	.434065	-2.58	0.010	-1.971125	-.2696218

```
.  margins, dydx(*)

Average marginal effects                        Number of obs     =        396
Model VCE    : Robust

Expression   : Conditional mean of MarkPart, predict()
dy/dx w.r.t. : LnOutput RiceExp_Cart Sex LnQty_Consumed_Y3 Edu_Level Selling_Price_Y3
               Contract_farming FBO_member TransAccess Choosing_Buyers Price_setting RMC
               RFCR Rice_system LnDTM ROI
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
LnOutput	.1800442	.0135814	13.26	0.000	.1534252	.2066631
RiceExp_Cart	-.0196039	.0050964	-3.85	0.000	-.0295926	-.0096152
Sex	.0288487	.0141287	2.04	0.041	.0011569	.0565404
LnQty_Consumed_Y3	-.1716172	.016298	-10.53	0.000	-.2035606	-.1396738
Edu_Level	.0087601	.0085616	1.02	0.306	-.0080203	.0255405
Selling_Price_Y3	.0599967	.0165421	3.63	0.000	.0275749	.0924186
Contract_farming	.0630937	.022957	2.75	0.006	.0180989	.1080886
FBO_member	-.0120737	.0138339	-0.87	0.383	-.0391877	.0150403
TransAccess	.1417122	.0532665	2.66	0.008	.0373117	.2461127
Choosing_Buyers	-.0432009	.016102	-2.68	0.007	-.0747602	-.0116415
Price_setting	-.0281387	.0054588	-5.15	0.000	-.0388378	-.0174396
RMC	.0476503	.0192379	2.48	0.013	.0099446	.085356
RFCR	.0876127	.0154537	5.67	0.000	.0573241	.1179013
Rice_system	-.0624426	.0089849	-6.95	0.000	-.0800527	-.0448325
LnDTM	-.0208593	.0111832	-1.87	0.062	-.0427779	.0010593
ROI	-.0302837	.0076453	-3.96	0.000	-.0452682	-.0152992

Results from the three stage least squares model

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
Output	355	16	.4204336	0.7567	1061.14	0.0000
MarkPart	355	16	.1293325	0.5906	422.97	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Output						
MarkPart	.5367867	.3079034	1.74	0.081	-.0666928	1.140266
Sex	-.0559905	.0505977	-1.11	0.268	-.1551602	.0431792
LnHH_size	.05385	.0456042	1.18	0.238	-.0355325	.1432326
Prev_prices	.0000183	5.01e-06	3.65	0.000	8.47e-06	.0000281
Edu_Level	-.0293464	.0306545	-0.96	0.338	-.0894282	.0307354
RMC	.2646498	.0770556	3.43	0.001	.1136237	.4156759
RFCR	.2374328	.07925	3.00	0.003	.0821057	.39276
Water_supply	.2109543	.0544624	3.87	0.000	.1042099	.3176987
Rice_system	.1285434	.0350559	3.67	0.000	.059835	.1972517
Purpose_FBO	-.0079168	.0410242	-0.19	0.847	-.0883227	.072489
ROI	.1158516	.0275666	4.20	0.000	.061822	.1698813
LnTotalFert	.4468708	.0471409	9.48	0.000	.3544764	.5392652
HLabour_access	.1574172	.0653778	2.41	0.016	.0292791	.2855554
LnFarmSize	.0983971	.0483078	2.04	0.042	.0037156	.1930786
LnFSOC	-.0348906	.0131899	-2.65	0.008	-.0607423	-.0090389
RiceExp_Cart	-.0005135	.0222353	-0.02	0.982	-.0440938	.0430669
_cons	3.310832	.2483411	13.33	0.000	2.824093	3.797572
MarkPart						
LnOutput	.1356571	.0301126	4.51	0.000	.0766376	.1946766
RiceExp_Cart	-.0136709	.0064108	-2.13	0.033	-.0262359	-.0011059
Sex	.0265835	.0147383	1.80	0.071	-.002303	.0554699
LnQty_Consumed_Y3	-.1305401	.0231535	-5.64	0.000	-.1759202	-.08516
Edu_Level	.0075199	.009238	0.81	0.416	-.0105862	.0256259
LnSelling_Price_Y3	-.0417709	.0483932	-0.86	0.388	-.1366198	.0530781
Contract_farming	.049659	.0252014	1.97	0.049	.000265	.0990529
FBO_member	-.0244272	.0147145	-1.66	0.097	-.053267	.0044126
TransAccess	.1321705	.0386077	3.42	0.001	.0565007	.2078402
Choosing_Buyers	-.0371854	.0154348	-2.41	0.016	-.0674371	-.0069338
Price_setting	-.0271912	.0061976	-4.39	0.000	-.0393382	-.0150442
RMC	.0380313	.0230732	1.65	0.099	-.0071912	.0832539
RFCR	.1019904	.0196552	5.19	0.000	.063467	.1405138
Rice_system	-.048911	.0114877	-4.26	0.000	-.0714265	-.0263955
LnDTM	-.0048251	.0119828	-0.40	0.687	-.028311	.0186608
ROI	-.031616	.0096083	-3.29	0.001	-.0504479	-.0127841
_cons	.4235847	.1293947	3.27	0.001	.1699757	.6771937

Endogenous variables: LnOutput MarkPart
Exogenous variables: Sex LnHH_size Prev_prices Edu_Level RMC RFCR Water_supply Rice_system Purpose_FBO ROI LnTotalFert HLabour_access LnFarmSize LnFSOC RiceExp_Cart LnQty_Consumed_Y3 LnSelling_Price_Y3 Contract_farming FBO_member TransAccess Choosing_Buyers Price_setting LnDTM

Results from the stochastic frontier analysis model

Stoc. frontier normal/half-normal model — Number of obs = 371
Wald chi2(8) = 65.75
Log likelihood = -369.64069 — Prob > chi2 = 0.0000

LnProCost	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LnProCost						
LnSeedUnitcost_Y3	.0340359	.0092292	3.69	0.000	.0159471	.0521247
LnOrgFertUnitCost_Y3	.0696136	.0417156	1.67	0.095	-.0121475	.1513747
LnFertUnitcost_Y3	.0454815	.0158802	2.86	0.004	.0143569	.0766061
LnInsecticideUnitcost_Y3	-.013774	.0080527	-1.71	0.087	-.0295569	.002009
LnHerbUnitcost_Y3	.0346148	.0155892	2.22	0.026	.0040606	.065169
LnHLb_Unitcost_Y3	.0157184	.0084054	1.87	0.061	-.0007559	.0321927
LnPloughingUnitCost_Y3	.1000507	.0303084	3.30	0.001	.0406472	.1594542
LnFarmUnitcost_Y3	.0246876	.0099329	2.49	0.013	.0052196	.0441557
_cons	7.573637	.4082794	18.55	0.000	6.773424	8.37385
lnsig2v						
_cons	-1.084272	.1012604	-10.71	0.000	-1.282739	-.8858054
lnsig2u						
yhet	-2.346587	.9215487	-2.55	0.011	-4.152789	-.5403844
Sex	-.5302044	.3498375	-1.52	0.130	-1.215873	.1554645
OTL	.1204926	.2110079	0.57	0.568	-.2930753	.5340604
FBO_member	-.4762	.3383252	-1.41	0.159	-1.139305	.1869053
ROI	-1.812232	.3518914	-5.15	0.000	-2.501927	-1.122538
Formal_Edu	-.2058978	.3247564	-0.63	0.526	-.8424086	.430613
LnFSOC	.315159	.2531306	1.25	0.213	-.1809678	.8112858
RiceExp_Cart	-.4181667	.1727236	-2.42	0.015	-.7566986	-.0796347
_cons	4.16142	.8118155	5.13	0.000	2.57029	5.752549
sigma_v	.5815048	.0294417			.5265708	.6421697

. sum CE

Variable	Obs	Mean	Std. Dev.	Min	Max
CE	371	.7051126	.2108453	.1289753	.996156