UNIVERSITY OF GHANA
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EFFECT OF FARMER-BASED ORGANISATIONS ON MAIZE FARM PRODUCTIVITY IN OHVN ZONE IN MALI

BY

ADAMA BOUARE

(10601958)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS

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DECLARATION

I, Adama Bouare, the author of this thesis titled "Effect of Farmer-Based Organizations on maize farm productivity in OHVN zone in Mali" do thereby certify that, except for references to other people's work duly cited, this work was done by me in the Department of Agricultural Economics & Agribusiness, University of Ghana – Legon.

This work has never been presented either in whole or part for any degree in this University or elsewhere.

Adama Bouare	……	……..
(Student)	Signature	Date

This thesis has been presented for examination with our approval as supervisors

Prof. Daniel B. Sarpong	……	……..
(Major Supervisor)	Signature	Date
Dr. Henry Anim-Somuah	……	……..
(Co-Supervisor)	Signature	Date

DEDICATION

This work is dedicated to my lovely mother, Madam Bouare Worokiatou Dembele, for all of her support and her blessing throughout this programme. I also dedicate it to my sublime wife Mme Bouare Oumou Touré

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« Glory be to the Almighty Allah »

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ABSTRACT

In Mali, the agricultural sector occupies about 80% of the population and contributes to around 33% of the country's GDP. The rural population represents about 60% of the Malian population and 33 % of the population live under the poverty threshold. The agricultural sector which employs the largest population is dominated by smallholder farmers who have limited access to production resources such as agricultural inputs and agricultural information and marketing activities. Consequently, smallholder farmers fail to achieve high productivity and hence have low incomes. To relax these constraints, smallholder farmers are encouraged to join farmer groups where stakeholders could easily get access to them and therefore implement mechanisms that can help them to improve their productivity and at the same time their livelihood. For example, during the implementation of the Millennium Challenge Program in Mali, the cooperative approach was used to reach smallholder farmers through their Farmer-Based Organization. This study highlights the effect of farmer-based organization on maize farm productivity in OHVN zone in Mali using a cross-sectional data from 405 maize farmers in this area. Descriptive statistics was used to characterize farmers in the study. The maximum-likelihood binary logit was used to examine the factors that influence maize farmers' decision to participate in maize farmer-based organization in OHVN zone. Then, the effect of maize farmer-based organization on productivity was analysed using the augmented Cobb Douglas production function approach. The constraints that maize farmers faced in agricultural production in the study area were also analysed. The logistic regression result shows that access to fertilizer, access to credit, access to extension service, age of farmer, access to improved seeds, education, and incomes (farm and non-farm) positively influence farmers' decision to join maize FBO. From the productivity analysis, it was found that the maize FBO membership positively influences the maize farm productivity. Other variables such as access to improved seeds, access to extension service and education have also a significant positive relationship

with the maize farm productivity. The constraints assessment indicates that the level of support from government is low and the availability of fertilizer and the access to it are limited. Based on these results, the study concludes that the likelihood of farmers to join FBO increases by the expected access to fertilizer, credit, improved seed and extension services by being a member of an FBO. Farmers who belong to maize FBO are found to be more productive relative to those who are not members. The key recommendation of the study is that the government, NGOs, and other stakeholders should put emphasis on the organizational level of farmers and the operationalization of the FBOs and encourage the participation of small-scale farmers in FBO since the FBO membership has a significant effect on the productivity level of farmers. Since the expectation of farmers to access resources through FBO encourage them to join FBOs, the government, NGOs, and other stakeholders should make available fertilizers, improved seed and extension services whilst financial institutions should guarantee the access to credit through farmer-based organizations. Finally, the government and stakeholders should increase the level of support and/or make sure that the supports provided reach small-scale farmers.

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ABBREVIATIONS

APC	Associations des producteurs des Coton
AOPP	Association des Organisations Professionnelles Paysannes
AP	Average Productivity
AV	Associations Villageoises
CA	Coopérative in Agriculture
CIRAD	Centre International de Recherche Agricole et de Devoppement.
CMDT	Compagnie Malienne de Développement des Textiles
CPC	Coopérative de Producteurs de Coton
EIG	Economic Interest Group
FAO	Food and Agricultural Organizations
FBO	Farmer Based Organizations
GSCVM	Groupement des Syndicats de Cotonniers et Vivriers du Mali
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institut d'Économie Rurale
IMF	International Monetary Fund
INSTAT	Institut National de la Statistique
LOA	Loi d'Orientation Agricole
LPM	Linear Probability Model
MFP	Multiple Factor Productivity.
MP	Marginal Productivity
OHADA	Organisation pour l'Harmonisation en Afriques du Droit des Affaires
PFP	Partial Factor Productivity
RGPH	Recensement General de la Population et de l'Habitat
TFP	Total Factor Productivity
NGO	Non-Government Organizations
NPK	Nitrogen (N), Phosphorus (H) and Potassium (K).
OHVN	Office de la Haute Vallée du Niger
RTS	Return To Scale
SCPC	Sociétés Coopératives des Producteurs de Coton
SYCOV	Syndicat des producteurs de coton et de vivriers
WLS	Method of Weighted-Least Squares

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The development and success of any agricultural project start from the organisation of the producers into different groups of farmers. During the implementation of the Millennium Development Programme in Africa, the cooperative approach was adopted to achieve the Millennium Development Goals and promote decent work in Africa, with the aim to promote self-help initiatives and mutual assistance in communities (Wanyama, Develtere, & Pollet, 2009).

Development cannot be effective without good organization at the grassroots level. Therefore, organizing producers into groups for better production must be a major concern for all. The World Bank, at the beginning of structural adjustment, stated that all governments should get out of agricultural operation and "put farmers in charge" (Rondot & Collion, 2001).

Farmer-based organisations are defined as an association of farmers who combine their efforts to perform business activities by pooling resources and joint management (Kovavic, Juracak, & Zutinic, 2000). According to Stockbridge, Dorward, & Kydd, (2003), to improve rural service delivery, economic growth, and poverty reduction among farmers, Governments and NGOs encourage the establishment of FBOs as a strategy to enable smallholder farmers to benefit from the support of agricultural institutions. These FBOs represent the link between the producers and the supporting programmes, and it also serves as a voice of the smallholder farmers through which they express their needs that can be found difficult as an individual.

In developing countries, especially in sub-Saharan African countries, agriculture is a major source of revenue, livelihood and constitute the principal foreign exchange earner (Badian et al. 1995). Mali is not an exception. Thus, in Mali about 60% of the population live in rural areas (FAO, 2016) where the main activity is agriculture dominated by smallholder individual

farmers producing staple crops such as maize, sorghum, millet, rice, and using traditional methods and low resource technologies, with limiting access to agricultural inputs and services. The smallholder farmers in Mali face challenges resulting from the weakness of the individual farmer which serve as constraints to increase their productivity. These constraints are access to agricultural inputs, agricultural credit, agricultural training, effective incentive from the State among others, to improve their productivity and increase agricultural output and meet the production needed.

Thus, to tackle these challenges, the Malian government has taken the initiative to organize the producers at the grassroots level called "Ton Villageois" (Association of Villagers) since the 1970s through the cotton sector to better structure the Malian farmers (Bélières, Benoit-cattin, Barret, Djouara, & Kébé, 2008). The emphasis, however, was on cotton production with the aim of self-management of the producer organizations by the farmers whilst organisations around other crops had been neglected.

From independence (1960) to the present day, the three successive republics (from centralized state to liberalization) have placed a strong emphasis on agriculture as the country's basic development sector (Samake et al, 2007). Each of these republics endeavour to empower producers by promoting the cooperation of the producers. The problem to date has been the focus largely on the cotton sector, which is co-managed by the CMDT and the OHVN, whilst the smallholder farmers dominate in food crops production such as maize, sorghum, millet, and rice.

The World Bank's Development Report (World Bank, 2008) indicates that the democratic openness has allowed producer organizations to grow and influence governance over time. In Mali, however, the transformation concerns the entire rural development sector, with public initiatives to modify institutions at the national, sectoral and local levels, with greater

involvement of producers and their professional organizations (Agricultural Orientation Law: French acronym: LOA).

In recent years, the interest in maize production by producers has increased. This has resulted in increased formation of Farmer-Based Organizations across the country. This may, on one hand, be due to the high yield of maize, which can reach up to 9Tonnes/ha depending on the variety (Maize programme IER, 2015). On the other hand, NGOs, agribusiness enterprises and agricultural research centres are promoting maize production. These organisations are promoting maize production because it has a relatively short vegetative cycle (70 – 120 days depending on the variety) as well as high yield which can be adopted as a strategy to be safe from climate vagaries but also a solution for food security in the region. In figure 1.1, the trend in the harvested area of maize in Mali shows that the harvested areas of maize have increased between 2000 and 2014.

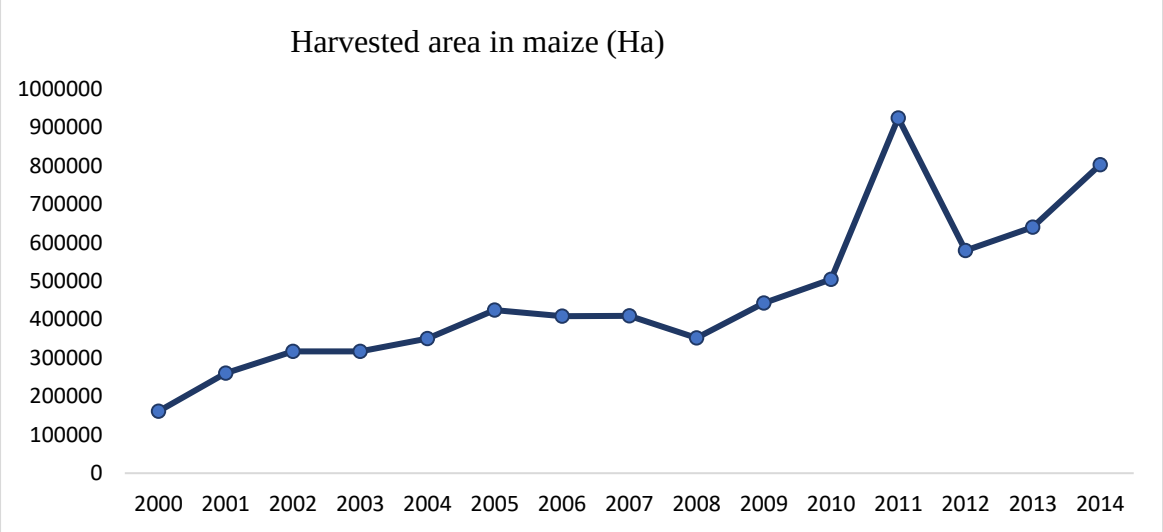

Figure 1. 1 Trend of harvested area of maize maize production in Mali Source: FAO country Stat

This shows that maize production has become incontestably one of the major staple crops in Mali in addition to rice, millet and sorghum. But the question is that how do farmers perceive maize farmer organizations to improve their productivity and their incomes? How far has government paid attention to smallholder farmers producing maize in term of their organizations like the cotton sector? However, there is a need to access how membership of

maize farmer-based organizations can help improve productivity of small maize farmers in Mali

There is no a specific policy in Mali to organize maize producers in maize farmer-based organizations to reduce hunger and starvation in Mali but the agricultural orientation law (LOA) widely encourage Family Farms (Exploitation Familiale) and the establishment of producer's groups. In order to assist farmers in accessing agricultural inputs, agricultural assets and information, Organization for Harmonization of Business Law in Africa (French acronym: OHADA) has recently started organizing maize producers into maize FBO where most of villages have received the official receipt (certificate) of their cooperatives.

In addition to access agricultural inputs, agricultural assets and information, a farmer can derive a number of benefits from being a member of a farmer based organization, such as obtaining loans, labour pooling, personal knowledge, education awareness, recognition, training general, education accounting, training in cultivation or food-processing, savings activities, animal husbandry, knowledge about government or outside services, group efforts (general/ house/wells), subsidies/obtaining goods at lower prices, obtaining land and income opportunity.

1.2 Problem Statement

Agriculture is the major economic activity in sub-Saharan Africa countries employing the large number of the labour force. In these countries, agriculture is mostly rural based and is dominated by large number of individual smallholder farmer characterized by traditional cropping methods, low productivity, low yield and low income (Sheahan & Barrett, 2017). These features of the smallholder farmers may on one hand be due to poor organisation of the producers limiting their power of claim, and on the other hand, by government policies regarding agricultural sector. According to Develtere et al., (2008) and Emana (2009), it has been shown in many developing countries that cooperatives are one of development strategies

that may empower communities to exit poverty. Hence, farmer organizations are a way for smallholder farmers to combine their efforts in order to enhance their agricultural production so as to meet their socio-economic ends.

Poverty reduction policy must focus on those individuals who otherwise would not be able to climb out of poverty on their own (Carter & Barrett, 2006). In the rural areas, these organizations are very crucial and important for increasing agricultural productivity. Membership of farmer-based organizations serve as livelihood a strategy for the peasant to benefit from the support of the State and the NGOs intervening in the agricultural sector, especially regarding access to subsidized inputs and also to exchange their experiences. As mentioned by Randot & Collion (2001), donors and NGOs fear institutional failure in the public sector so they prefer to deal with farmers through farmer-based organizations (FBO). Farmer-based organizations help farmers in securing agricultural inputs that can encourage investment in agricultural production. They facilitate the introduction and dissemination of new technologies and new agricultural practices and access to improved high-yield seeds from agricultural research centres. FBOs have also a facilitating role in agricultural training of farmers on innovations in the agriculture sector, and sensitization of farmers regarding agriculture information and new agricultural practices.

These attributes of farmer-based organisations notwithstanding, in Mali, there is a lack of specific studies on the economic and social impacts of the farmer-based organizations (Bélières et al., 2008). According to Birchall & Branch (2004), very little literature on African cooperatives has been generated since the early 1990s despite the continuing debate in favour of cooperatives as the most suitable form of organization for alleviating poverty on the continent.

In Mali, these organizations, which are supposed to be a strong basis for the development of the country, are very weak in terms of structure and organization. According to Berthe & Keita (2009) because of structural weaknesses of agriculture sector in Mali, agriculture and food production cannot satisfy the national market. This structural weakness may be explained in one hand, by the management system of the agriculture sector by the government and other hand, by the poor organisation of the farmers limiting their access to the improved technologies, seed, information, and credit facilities.

The only FBOs that have been in existence since the restructuring of agricultural sector in mid-1980s are cotton producer cooperatives (CPC) in the Cotton Zone (CMDT and OHVN), because of efforts made in this sector by these two institutions to increase agricultural production in general and the contribution of the cotton sector in particular (Berthe & Keita, 2009).

Despite the efforts of these two institutions, these FBOs have lost much of their production capacity due to the decline in cotton yield (FAO, 2016) in recent years resulting from the change in climate and the declining of the quality of fertilizers used (according to cotton producers).

Most of the issues raised by the literature on what a small-scale farmer can face if not being a member of any farmer-based organizations are the limited access to agricultural inputs (such as fertilizer and improved seed), agricultural new technologies and innovations. They may also have a problem to access agricultural credit because there is no guarantee of reimbursement which can limit their access to agricultural assets and cause low productivity as well by remaining them into traditional cropping system. Sharing experiences is one of the most important attributes of farmer-based organisation, to fully get a benefit that this sharing, a smallholder farmer must have to be a member of a farmer-based organization.

1.2.1 Conceptual Framework

The concept behind this study is that the smallholder farmer is generally faced with constraints including traditional methods of cropping, low income, credit constraints, lack of training which consequently results in technical inefficiency, low productivity and for that matter low income. Figure 1.2 presents the conceptual linkages in these constraints. In order to remedy these constraints of the smallholder farmer, there is the need to put them into groups so as to facilitate their training process and other delivery support from government and other agricultural stakeholders such as the NGOs. When the smallholder farmer is supported by government and NGOs through credit facilities, promotion of extension visits, access to agriculture inputs, marketing of agriculture products it would go a long way to improve their productivity. The end results of this organisation of farmers into groups is that they would attain self- sufficiency in food production as well as increased income.

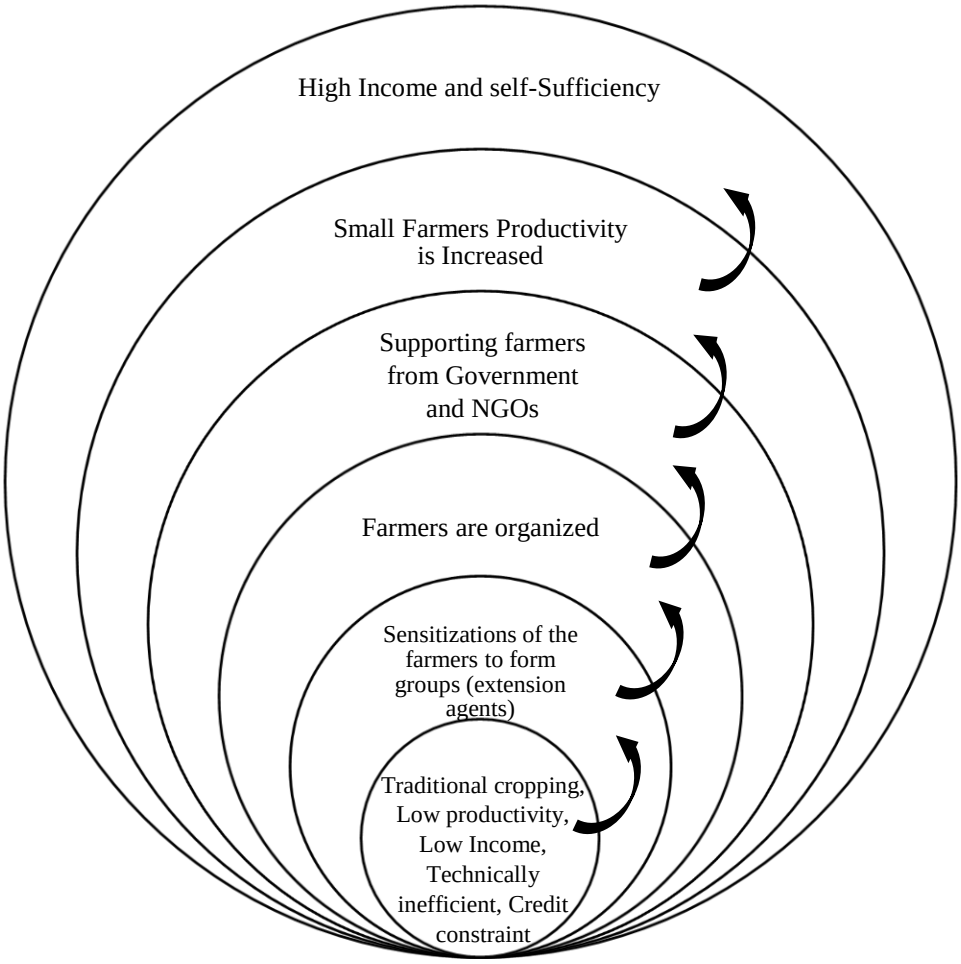

Figure 1. 2: Conceptual framework.

The OHVN zone is one of the three major agriculture sectors in Mali after CMDT and "Office of Niger". Agriculture and livestock are the main economic activities in OHVN zone, followed by trade, fishing and crafts. The OHVN zone is located in Koulikoro region surrounding the national capital which provides easy access to NGOs and the other delivery services of the country and the opportunity to enhance the farming activity in the area.

Currently, the interest in maize production is increasing and this is translated into the increased number of maize producers from 10,219 in 2013 to 20,652 in 2015 in the OHVN Zone (FAO Country Stat, 2016). Land allocated to the maize production is also increasing. Many new groups of maize producers are observed in most of the villages of OHVN zone. This phenomenon can be motivated on one hand by the presence of NGOs in this Zone and on another hand, by the high yield of maize but also by climatic vagaries.

Most of the NGOs are located in the areas near the national capital (in this case OHVN Zone) giving a comparative advantage to the OHVN zone in the agricultural production. To address the issues of enhancing FBOs and to overcome constraints faced by Maize FBO, the following questions have been raised:

i. What are the characteristics of the FBOs in the study area?
ii. What factors influence participation in maize FBOs in the OHVN zone?
iii. What is the effect of farmer-based organizations on maize farm productivity in the OHVN zone in Mali?
iv. What are the constraints the Maize FBOs in OHVN zone face in agricultural production?

1.3 Objectives of the thesis

The main objective of the study is to assess the effect of Farmer-Based Organizations on maize farm productivity in the OHVN area in Mali. The following specific objectives have been addressed to achieve this main objective:

1. To identify and characterize the Farmer-Based Organizations in the study area.
2. To analyse the factors influencing maize farmer participation in Farmer-Based Organisations in the study area.
3. To estimate the effect of the maize FBOs membership on the maize farm productivity in the OHVN area
4. To analyse the constraints faced by maize FBOs in agricultural production in the study area.

1.4 Justification of the study

The satisfaction of the national food market, the increase in the income and purchasing power of the rural population, the reduction of poverty are crucial issues in developing countries. Agriculture, which occupies almost 80% of the Malian population and is dominated by

smallholder farmers with considerable opportunities, has been the subject of strong motivation by the State authorities and NGOs since independence, but the effects are not very visible on the rural population, which remains more than 30% under poverty threshold (IMF, 2016). Berthe & Keita (2009) assert that, due to the structural weakness of the agricultural sector in Mali, agriculture and food production cannot satisfy the national market, exception made in cotton sector with more or less well-structured.

This structural weakness in agricultural production in Mali is due to several factors including poor organization and management of the producers, choice of agricultural policy, structural and institutional management among others. A good organization at the farm level represents an immense opportunity for small farms. These organizations are a path for smallholder farmers to combine their efforts to have access to agricultural credit, inputs, agricultural information, new technologies and access to the results of scientific research carried out by agricultural research centres such as IER, ICRISAT, CIRAD or other research centres to increase their productivity.

There is a lot of study on farmer-based organizations around the world. In Mali, many studies have been carried out on the profitability of agriculture and its role in the rural and economic development of the country by IER and other research centres and NGOs, but researchers did not focus on the aspect of farmer-based organizations and their effect on the trend of agriculture and the productivity of the smallholder farmer with low-income. Nevertheless, a few qualitative studies have been done on FBOs as reported by Bélières et al., (2008).

This study is focused on maize farmer-based organizations since the maize is ranked as the third major staple crop behind millet and sorghum. Both harvested area and production of maize have considerably increased since 1984 as showed in figure 1.3 below.

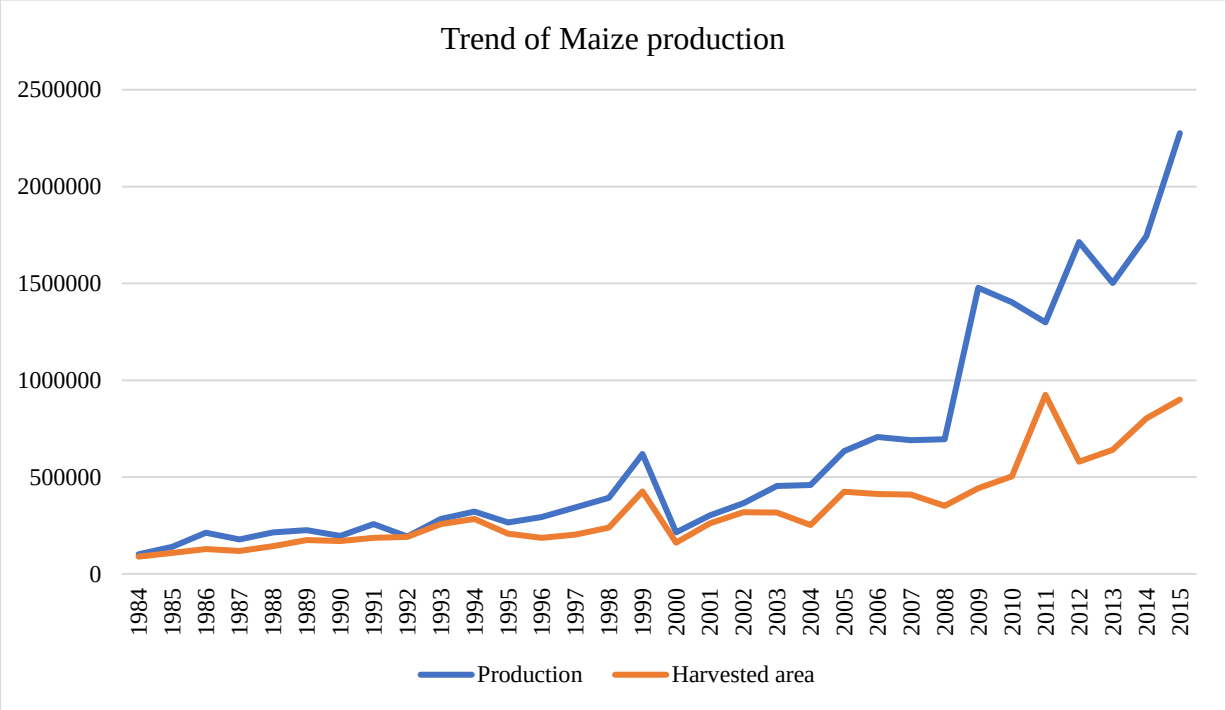

Figure 1.3: Trend of maize production in Mali **Source: FAO country Stat**

The result of this study represents a contribution to highlighting the effect of farmer-based organizations on maize smallholder farmers productivity and agricultural production. It is also aimed to make recommendations to State authorities on how best to enhance grassroots organizations. The findings of this study will strengthen smallholder production capacity, increase the income of the rural population, contribute to food security and reduce poverty.

1.5 Organization of the thesis

The study is organized in five chapters. Chapter One is the introduction which includes background of the study, problem statement, conceptual framework, research questions, research objectives and justification of the study. Review of the theoretical and empirical literature pertinent to the concern of the thesis is presented in Chapter Two. In Chapter Three, that is the methodology, consists of the theoretical framework, empirical model specification, data type, sampling and data collection method and the study area. Chapter Four reports on results of the study along with discussion. The fifth chapter presents the summary of the study and draws conclusions with policy implications based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews past studies undertaken by other researchers and other publications that are relevant to this study. It is organized in various subsections to cover the concept of farmer-based, maize production in Mali, measurement of productivity and decision-making theory.

2.2 Definition and concept of Farmer-Based Organization

An organisation in Agriculture is any association or group of farmers who are joining their efforts as unity so as to perform well in their farming activities, increase their level of production and get more profit from agriculture. In this sense, Kovavic, Juracak, & Zutinic (2000) defined cooperation in agriculture (CA) as any form of joint effort among farmers who aim to perform a business activity by pooling resources in joint management of a number of family farms. In the level of smallholder, joint actions undertaken in agriculture include participation in activities of different associations.

The farmer-based organization is also defined by Rwelamira (2015) as a participatory governance institution with basic structures formed by small farmers and processors as basic elements, representing their interests and with a certain level of responsibility towards them.

It is defined by Agricultural Orientation Law in Mali (LOA) adopted in 2006 as a group of natural or legal persons, with an agricultural vocation, who decide to unite in defence of their interests with public authorities and third parties, the provision of goods and services to their members and/or carrying out economic activities for the benefit of their members.

In many countries the concept of farmer-based organisations has been largely discussed as a key component to disseminate technologies among small scale farmers. Thus, it is aimed to promote business activities which they could be found difficult to perform on their own and

those which are better done when performed jointly. From an economical aspect, business cooperation of farms is a sort of merger of production resources, production and income of the farms. The concept of farmer-based organization was introduced in many countries during the colonial period as a way to ensure the supervision of indigenous populations (Salifu et al, 2012), .

In society, cooperation has always been fundamental for human, and plays a leading role in rural and agricultural development (Salifu et al, 2012). After independencies, the concept of farmer-based organization has been widely discussed in almost all part of the African continent as a grass root on which the development of countries should be held (Hedlund, 1988).

For example in Uganda, every farmer above 18 years old is required to enroll so as to benefit supporting system provided by the government (Mwaura, 2014).

In Mali, the agricultural orientation law (LOA) put a particular emphasis on the farmer-based organization. It points farmer cooperatives as key a component of the development and encourages the establishment of farmer-based organizations for the empowerment of smallholder farmers.

2.3 Types of Farmer-based organizations

The types of farmer-based organizations are diverse, and they are created for different purposes. These various types of farmer-based organisations include self-help groups known as mutual help, mutual aid or support groups are based on the community forces; farmers' groups which are community-based or commodity-based organisations aimed to gathered farmers around a commodity; farmer-based organisation that interest on the external resources; there is also local groups or larger network organisations. The objectives of FBOs are different and they operate at different levels such as local, national and/or international levels. The functions of FBOs are many and here are some of them:

- Advocating and lobbying for political rights;
- Representation on advisory bodies;
- Providing technical or economic services to their members and;
- Providing support for governments' initiatives to develop the local.

The FBOs are also designed to interact with each other and form political alliance and services so as to facilitate the development acts that could be undertaken. According to Belieres et al.., (2007), in Mali different FBOs have been established by different institutions, thus, we have:

i. Organizations initiated by the State:
   - Construction of a new cooperative sector: transformation of AVs and APCs into Cooperative Societies of Producers (SCPC).
   - Chambers of Agriculture: direct interlocutors between public authorities, donors, and farmers.

ii. Organizations based on civil society initiatives:
   - The unions at the initiative of the farmers: organizations initiated to claim the right of farmers e.g. SYCOV, GSCVM, AOPP.
   - The FBOs established by NGOs: Various organizations such as associations, EIGs and NGOs have also been developed on the initiative of local leaders and/or national organizations or international.

iii. The organisations initiated by the CMDT: At the end of 2003, there were around 7,000 cotton producers' organizations in the whole country, about 20% of which were APCs (Bélières et al, 2005)

2.4 Role of the farmer-based organization in the agricultural production

In developing countries, institutional development is less advanced. The traditional institutions that have a long history sometimes take precedence over national institutions and have a great hold on individuals in their societies, therefore if developing countries want to get out of the precarious conditions they are currently facing, they must adopt the mechanisms for the creation of new institutions to ensure the coordination of economic activities beyond the local borders knowing states and markets have failed to achieve this. It is relevant to ask whether the types of institutions characterized by market economies have a role to play. Farmer organizations are obviously a way to solve the coordination problems that developing countries are facing (Stockbridge et al., 2003).

A good producer organization will establish the true internal and external relationships necessary to obtain credible commitments from the parties for cooperation on mutually beneficial actions and investments.

The role of the farmer-based organization are diverse, however, Rondot & Collion, (2001) sum up the potential role of FBOs as follows: “the new mode of economic and social regulation is based on the FBO. In a number of countries, governments are putting less emphasis on the hierarchy of coordination imposed in the past. As a consequence, the FBOs among other forms of coordination have been introduced to actors as new forms of coordination whether in term of regulation of sector or territorial or at local, regional, or international levels. However, producers through their organizations will be more empowered and will even participate in the decision process regarding the definition and implementation of local development plans, the setting up of supply or marketing services, the formulation of public agricultural policies or the structuring of a production/processing industry etc... More interest has been developed in FBOs in recent years by certain institutions because of its importance in networking and its role in

the management of prevailing economic opportunity and constraints by enforcing institutional capacity".

2.5 Challenges of farmer-based organizations

Farmer-based organizations are numerous, diversified, and historically charged with the more or less representative, sometimes instrumentalized and not always ready, or made, to assume the responsibilities that, their "partners" would like to see them assume. At the same time, these organizations are becoming formidable issues of economic and political power (Bélières et al., 2008). However, they must meet the challenge of transferring many economic functions and are now projected into contractual negotiations and sectoral policies to which they are not prepared. At the same time, they face growing social demands linked to the deterioration of many national situations (BOSC et al., 2002).

There are many primary level agricultural cooperatives in developing countries, but many of them have been financially vulnerable and ineffective. Strategies have been developed to strengthen these organizations (Chamala & Shingi, 1997). In Mali, the policies implemented give FBOs a participating role in various consultation frameworks where sectoral policies are discussed, and the co-management of agricultural sector is prepared to ensure the participatory conduct of rural development projects (Bélières *& al*, 2008).

Among the many problems faced by farmer-based organizations, it is worth to mention the persistence of their low commercial efficiency; small capitalization; heavy debt and limited solvency; the weak entrepreneurial capacity of managers and board members; and the imbalanced organizational structures of the movement (Birgegaard and Genberg, 1994). Some analysts have argued that these organizations are ill-prepared to face the challenges of the liberalized economy, suggesting that their chances of survival in the new era are minimal and likely to disappear (Wanyama, Develtere, & Pollet, 2009).

2.6 Reasons for failures of farmer-based organizations

A lot of cooperatives and programs that have been implemented by the governments and agencies, with the help of foreign donors, failed to meet their objectives or expectations over the time due to some major reasons well-known and documented (Holmen, 1990). Below are some of these reasons:

- During the creation of cooperatives, a short-term incentive was offered by authorities resulting from the lack of preparations in large scale. For example, the availability of loans in cash or in kind in short-term that would otherwise not be available in long term.

- In many countries, the model of cooperation on farmers imposed under the pressure of administration and politic have created monopolies for the supply of inputs and the marketing of products or sometimes making membership mandatory.

- The focus has been made on national development rather than the interests of individual members by cooperative promoters in many cases.

- Cooperatives were designed primarily as instruments of government to execute plans made by government officials, funded by government funds and therefore controlled by the government.

- The population called to organize (mainly the peasants) were considered incapable to organize themselves without any external assistance, surveillance, guidance and control.

- Organizational models were not favourable and there were few incentives to motivate members to actively participate in cooperatives.

- The contribution of cooperative members and their responsibility were basically nominative, however, there were engagements from members, thus, have no interest to cooperate.

- Sometimes, the rules, referring to which their cooperatives are operating are not known (e.g. language used or the literacy level of members) which result the no control over members of offices and or cooperatives employees often chosen, elected, seconded or appointed by the government in non-democratic manner.

- The control of government is often ineffective due to either it does not reach the societies because of non-qualified controllers or due to the fact that it does not prevent the bad behaviour because of vested interests, and that government agents team up with influential leaders to their advantage.

- Influential leaders for their own benefit.

- The earnings that could be derived by cooperatives are often thumped by low price of products and high price of inputs, by embezzlement and non-detection or non-punishment of corrupt practices, or still low because of losses from lack of or bad quality of storage facilities, transport and processing capacity.

In such circumstances, it is not surprising that people refuse to join farmer-organizations or, if they are forced to join, show little motivation in actively participating in their affairs. Such "Organizations" deserve the bad reputation they themselves have acquired.

2.7 Background of farmer-based organization in Mali

The farmers organizations have been implemented by the Malian governments as development pattern resulting from structural adjustment and disengagement of state of production and market activities.

When structural adjustment in the mid-1980s and the withdrawal of the government to production and marketing activities, the Malian government was interested in peasant organizations from colonization to reorganize and restructure for fulfilling the commitment of the State to withdraw from the production and marketing features of agricultural products.

According to Kébé et al (1998), "the associative movements in Mali have been encouraged and structured since the colonial period with a view to ensuring the supervision of the indigenous peoples". However, traditional communal forms (the Ton) of social organization (collective activities, socio-cultural activities, village defence) constitute the basis from which the modern village FBOs were established. The power relations have evolved towards a relative autonomy of the leaders in relation to the village authorities. Beyond the village level, professional organizations constitute an institutional legacy of colonization, initiated with "indigenous societies of foresight and continued by cooperatives, trade unions, recognized associations and chambers. In this tradition, the groupings of persons are established around the trades and the differential (categorical) interests.

Under the First Republic, associative, cooperative rural groups were driven political power subservient to the ideological project of "cooperatives" of production and one political party system (Coulibaly, 1998). The cooperative movement remained linked to the political and administrative apparatus under the one political party regimes until 1991 (Geronimi et al., 2005). A denied time at the beginning of the Second Republic, cooperative ideas of organization of individual producers reappear in the early 1980s, based on the revaluation of traditional forms, given the Status of " Ton Village " defined by the 1988 Act as a form of organization "superior" to that of Village Associations set up by the CMDT and evolving without legal personality. This law attributed the designation of Village Associations (VA) to "cooperatively oriented" groups, which had aspired to be transformed into "Ton Village".

The two most important initiatives among many others regarding the change in agricultural sector in Mali (J. Bélières et al., 2008):

- The decentralization adopted in the 1992 Constitution and implemented with the first elections in 1999. Transfers of skills between the State and local authorities are underway

with some achievements (drinking water, health, education) but also The fields of natural resource management and economic development. Thus, the role of the Commons in collective investments of agricultural interest and the "support/advice" services to producers remains to be clarified (J. F. Bélières,…et al, 2008).

- The Agricultural Orientation Law (LOA), adopted in 2006 and developed with a concerted process entrusted to the recently created National Coordination of Farmers' Organizations (CNOP). It aims to promote "a sustainable, modern and competitive agriculture based, first and foremost on recognized and secured agricultural family farms ..." It deals with the major areas of agricultural development and enshrines consultation as a privileged mode of relationship between the State and the agricultural profession. A Higher Council for Agriculture is responsible for monitoring its implementation.

The Agricultural Orientation Law (LOA) has come to reinforce the previous laws on agricultural sector by giving more power to the farmers with the freedom of creation of the producers' organisation even with 5 people (Global Water Initiative, 2017).

2.8 Evidence of FBO in Mali

Since the adoption of the Agricultural Orientation Law (LOA) in 2006, the number of farmers' organizations has increased in Mali (Bélières et al., 2008), but their operating is still being desired (Global Water Initiative, 2017).

The oldest organizations of the independent state of Mali go back to the 1980s under the name of "Ton Villageois" or village associations (AV) (Belieres et al, 2007). These former AVs subsequently became agricultural cooperative societies with the autonomy of operation of input management as well as production.

CMDT and OHVN are the two main partner institutions of these cooperative societies insuring them the access to agricultural inputs. These two institutions have contributed significantly to

the creation and autonomy of the status of the cooperative societies since 2001 (SAMAKE et al, 2007; Bélières et al, 2008).

The CMDT and the OHVN are responsible for providing agricultural inputs (fertilizers, pesticides, herbicides) to cotton producers (grouped into cooperative societies) in the form of campaign credit which will be reimbursed after the sale of production through the cooperative societies (Fofana et al 2010). The cooperative societies will be guarantors of the granted credit by CMDT or OHVN. Both institutions (CMDT and OHVN) deploy extension agents wherever the cotton is grown in Mali. These agents are responsible for the technical monitoring of farming activities with producers to ensure a better yield of cotton per hectare.

Evidence is that, the access to inputs from these institutions is conditional to cooperative membership and production of cotton i.e. all who are not members of the cooperative and who do not grow cotton, are not entitled to agricultural inputs provided by the institution in charge. They are also excluded from the visit of extension agents those who are not members of cooperative and are not growing the cotton.

CMDT and OHVN are also responsible for purchasing cotton production from producers through their cooperatives at a price of more or less 250F/kg. The campaign credits granted at the beginning of the season to the cooperative (total sum of the individual credits) are automatically deducted from the total amount of the sale of the cooperative's production and the difference is paid into the accounts of the cooperative society. More details are given by (Bélières et al., 2008 ; Belieres et al., 2007 ; samake Amadou, Belieres Jean-François, BOSC Pierre-Marie, 2007 ; Fofana, Abdoulaye, Sanogo, & Langyintuo, 2010)

2.9 Farmer-based organizations of maize producers.

The organizations of maize producers emerged following the adoption of the Agricultural Orientation Law in 2006 and the OHADA Law in 2010 (Global Water Initiative, 2017).

The OHADA law promotes maize production with the aim of bringing together maize sector actors for a better functioning of the maize production chain in Mali, the vision being the increase in maize production.

According to the law of OHADA since 2014, each village is required to create a cooperative of maize producers in its enclosure. These village cooperatives will form maize producers from the commune and the circle through the union of cooperatives. The unions of the cooperatives of these circles will constitute the regional federation of maize producers' cooperatives. All the regional federations together form the national federation of maize producers. Four regions are currently concerned namely Sikasso, Segou, Koulikoro and Kayes.

The benefits of being a member of a Maize Farmers' Cooperative are: access to inputs (seeds, fertilizer, herbicides) and the guarantee of financing according to the OHADA. Services to members include input supply and product marketing.

Inputs (2 bags of NPK 50kgs each and 1 bag of Urea 50kgs and 25 kg of seeds per hectare) are provided to producers in the form of campaign credit, such the case of CMDT and OHVN with the cotton cooperatives. Currently the financial needs are managed through a partnership with Kafo Jiginew (financial institution). The loans are covered by a guarantee fund deposited by the technical partner SASAKAWA Global 2000.

The repayment of the bank loan concerns the amount of the debt plus interest, its payment is in kind (at the rate of 8 bags of 100 kg of maize per hectare) after fixing the price of maize according to the market price. The Cooperative is responsible for the transportation costs to the storage centre. Profit is shared between investment funds (capital) and members (which is not yet realized). But currently in the OHVN area, these texts are much more on paper than in the field.

2.10 Production of maize in Mali

In Mali, cereals constitute the main share of the agricultural production (about 78%) but the productivity remains low (Traoré, Mamy, Bélières, & Hilhorst, 2011). According to FAO, Mali is ranked as West Africa's third largest producer of maize even though it stands fifth in the area harvested. It is showed in FAO data (2010-2013) that the annual production of maize was about 1.5 million metric tons with the total area harvested close to 0.7 million hectares. The mean yield of maize in Mali is about 2.35 t/ha and this is classified as the highest average yield amongst 15 countries that produce maize in the sub-region, compared to 1.78 t/ha for Ghana, 1.65 t/ha for Burkina Faso, 1.94 t/ha for Cote d'Ivoire and 1.80 t/ha for Nigeria (Abate, Coulibaly, Menkir, & Wawa, 2015). The average yield gain is estimated to be 121.4 kg/ha/year between 2000 and 2013.

Mali is pointed to have the fastest growing area of maize and its production among its neighbour countries. The annual growth rate in area and production between 1980 and 2013 for maize in Mali is estimated to be 6.6% and 9.0% respectively. In comparison to other countries such as Nigeria, Ghana and Benin where the area and the production growth rate were found to be 4.1% and 5.6%, 2.7% and 4.9%, and 2.7% and 4.6%. The growth rates of maize yield were estimated in Mali and Ghana to be 2.2% each, while Benin and Nigeria had 1.9% and 1.5% respectively (DTMA, 2015).

The maize was ranked as seventh crop in 1980 in Mali, after millet, sorghum, groundnut, rice, cowpea and fonio. A decade later it becomes fourth behind millet, sorghum and rice. From 2010 it is ranked as the third after millet and sorghum. Since then, it is pointed as the fastest growing staple in Mali. From 1980 to 2013, the annual growth rate of cultivated land area in maize was estimated to be 6.6% as stated above, compared to other crops such as rice, groundnut, sorghum, millet and cowpea where the annual growth rates were 4.7%, 3.6%, 2.7%,

2.6% 2.5% respectively (DTMA, 2015). In sum, the area expansion and production of maize are showing the steady progress over the time in Mali.

In Mali, the maize producers are basically smallholder farmers holding an average land area of less than 3 hectares. Labour force is most often constituted with the family labour but the share of female labour is the most important (60% of labour), in addition to processing and marketing. The part of the family assumption remains the largest share of maize produced in Mali, approximately 70-60% of the grain produced is used as food for households whereas the remaining 30-40% is commercialized. The per capita average consumption is estimated to be about 53 kg/person/year (DTMA, 2015).

The larger production and consumption of maize started from the mid of 1990s (Diallo, 2011). Knowing this potential of maize, better organization of maize farmers will help developing its subsector and increase the productivity of smallholder farmers. Therefore, this will implicitly and explicitly increase the income of maize farmers, reduce the poverty threshold in rural area by creating profitable opportunities for other actors (traders, marketers, processors, industries, and consumers) in the subsector.

2.11 Productivity Measurement

Productivity can be defined as a measure of the output achieved relative to the resources used in production. The measure of productivity has been done in a number of ways as identified by Coelli et al. (2005). For instance, productivity can be measured in terms of Marginal Productivity (MP) or Average Productivity (AP).

Average Productivity (AP): output produced per unit of a variable input used whiles keeping all other inputs used in the production of the output constant. Average productivity is also referred to as partial factor productivity, that is, all input variables used for the production of the output are not considered in this measurement and as such the measurement is not a

complete measure of productivity. This give rise to productivity as; output per labour; output per seed and output per fertilizer used, that is average productivity of labour, seed and fertilizer respectively. AP can be expressed as;

$$AP = \frac{y_i}{x_i} \quad \text{.....2.1}$$

Where;

AP = Average productivity

y_i = Output of the ith producer and

x_i = the ith input

Marginal Factor Productivity: This measure describes the rate of change of output per unit change in the level of input. That is to say that by how much does output changes as the level of an input is altered in the production process. For example, the rate at which output of maize would change when the level of fertilizer is increased by a unit.

Input used, it is referred to as MP expressed as;

$$MP = \frac{\partial y_i}{\partial x_i} \quad \text{.....2.2}$$

Where;

MP = Marginal Productivity

∂y_i is the change in the i-th output and;

∂x_i is the change in the ith input (x).

Measuring productivity in terms of the AP and MP does not require the specification of any functional form. According to Coelli et al. (2005) the use of these two measures of productivity is limited and can mislead or misrepresent the performance level of the firm in question.

Another way to measure productivity is to measure it in terms of Partial (single) Factor Productivity (PFP) or Multiple Factor Productivity (MFP) (Schreyer, 2001)

Single (Partial) Factor Productivity (PFP) is said to be the traditional way of measuring productivity as the computation is comparatively easier to calculate. It considers the contribution of single input to total output achieved. The computation is made easy because there is only one input variable and therefore no aggregation of inputs is required as it is done in the TFP approach where input aggregation is a requirement. It is expressed as;

$$PFP = Y / X_i \quad \text{.....2.3}$$

Where:

Y is the total output produced and

X_i represent the level of input i, used during the production process.

Multiple Factor Productivity

MFP measures productivity of combined inputs relative to total output. It required that all inputs are specified in the same unit of measurement for its computation and this made the computation cumbersome. The specification of the inputs into one unit is needed because inputs are normally measured in different measurement units and could only be aggregated if they are converted to only one unit. Mathematical expression for the measure is expressed in equation 2.4 below;

$$MFP = Y \Big/ \sum_{i=1}^{n} X_i \quad \text{.....2.4}$$

Where;

Y = total output

X_i = all inputs used in the production process

Total Factor Productivity.

Total Factor Productivity (TFP) is the ratio of total output produced with respect to all inputs used in the production. This measurement is known to provide a wide basis for improving

specific input used since it does not show interaction between each input and output. TFP is also expressed as shown below;

$$TFP = \sum_{i=1}^{n} Y_{it} \Big/ \sum_{i=1}^{n} X_{it} \quad \text{.....2.5}$$

Where;

Y_{it} = the sum of total of output of the ith producer produced in period t,

X_{it} = the total sum of all inputs used in period t.

Basically, two approaches that is, frontier and non-frontier are mostly used in the estimation of total factor productivity. In the frontier approach, there is the need for specification of a functional form whiles the non-frontier approach requires no functional form for its computation. Both approaches are further classified into parametric and non-parametric (Kiani et al. 2008). Whiles the parametric methods apply econometric estimation techniques to estimate the parameters from a specified production function, the non-parametric approach also applies mathematical approach that is results from economic theory are used to derive empirical measures.

From the classification of these methods of productivity measures by (Kiani et al. 2008), one of non-parametric frontier approaches used for TFP measure is the Malmquist productivity index. According to Coelli et al. (2005) this index can be measured using the radial distance of the observed outputs and input vectors in period t and s with respect to a reference technology. They asserted that the distance function can either be output orientated or input orientated given rise two measure of the Malmquist TFP index that is, output-orientated TFP indices and input-orientated TFP indices.

Kiani et al. (2008) noted that in the stochastic and deterministic models of frontier parametric approach, the level of productivity of a production technology is determined using elasticity of

production and return to scale (RTS). Debertin (2012) defined elasticity of production as a measure of the percentage change in output relative to the percentage change in input as the level of the input use is changed. He noted that the advantage of this approach in measuring productivity is that it does not require the convention of inputs and outputs into specific unit since elasticity is a ratio of two percentages. RTS is calculated by summation of the individual input elasticities. In the work of Binam et al. (2008); and Onumah et al. (2013), this approach had been adopted to measure productivity in a production technology.

2.12 Theoretical Foundation of decision to join a Group.

These are theories that underline the influence of an individual's decision to join a particular association or group in the society as well as their decision to quit or stay in an association. Two theories including; multiple selves' theory and social capital theory are explained below. Whiles the multiple selves' theory concerns with an individual behaviour, the social capital theory concerns with accumulation of social relations resources that facilitate the group action.

2.13 'Multiple Selves' Theory

Multiple selves' theory states that the human behaviour is captured essentially by a multiplicity of selves. Every human being is made up of different selves and an action by any individual is said to be the outcome of the bargaining process of the different selves of that individual. This self-concept can be explained as an individual's belief about his or her own personal qualities and abilities. From the work of Teraji (2009) the individual self-concept otherwise known as their identity has a significant effect on the way we behave.

Teraji (2009), noted that due to different selves found in each individual person, there is always an internal conflict within an individual when they are to make a choice. The empirical variations in economic choice has led to construction of multiple -self theories to explain the definitional unity of self (Lea & Webley, 2005). Stets & Burke (2003) also described the self-

system as multifaceted and adding that an individual's overall self is typically represented as a set of categories, each of which is a distinct self.

Moldoveanu & Stevenson, (2001) cited the self as a unified system and the self as fragmented entity as the two models of the self. However, it has been emphasized that, a multiplicity of selves is composed of a wide variety of unrelated and conflicting roles and that people with multiple selves may make more rational and more adaptive decisions in economic affairs than people with a single unified self in some situations (Lester, 2003).

People have different possible selves and this refers to the representations of the self in the future which help people to achieve a desired goal. Whiles self that represents the attributes that are currently possessed by an individual is referred to as actual self, the ideal self refers to a representation of the attributes that we wish or hope to possess. The latter is said to "self-guide" is a self-motivating standard and are associated with promotional goals that we strive for. People are motivated to achieve a state of congruence between their self-concept and the ideal self-guides by comparing the two concepts (Teraji, 2009).

The multiple selves' theory relates to farmers decision to join an FBO such that the farmer may have to consider his or her current level of production, output, productivity, access to timely and relevant information, revenue, income and profit which serve as his actual self. The farmer then compares his actual self to the level he/she wants to achieve (the "ideal self- guide") with regards to criteria mentioned above before making a decision to join an FBO or not. The decision to join the FBO would then be dependent on the benefits the FBO would offer to the farmer in question, that is, if the benefits can enable he/she progress from the actual self to the ideal self, then the farmer would join otherwise he or she would not join.

2.14 Social Capital Theory

Social Capital refers to accumulation of resources in social relations that facilitate collective and group action. Examples of these resources include; trust, norms and networks of association that enhance group action. The concept of social capital had been explained by different studies including (Gillinson, 2004 ; Gatzweiller, 2002; and Akpabio, 2005).

Adhikari and Goldey, (2010) asserts that whiles others sometimes criticize social capital for using "economic language for making a social idea more important; others see the term capital as betraying the value of the social dimension by invoking an economic justice". However, in the process of uniting people in a group to perform common varied activities involving savings and credit, demand, trust, norms and behaviours of cooperation.

Arokoyo (1998) and Francis et al., (1996) noted that even though there are a lot of farmers' organizations (FBOs) that exist in sub-Saharan Africa, but these FBOs are very weak in terms of popular grassroots organizations. The situation is suggested to be due to the fact that no attempts are being made to develop social capital at the community level, all over the world (Grootaert, 1998).

2.15 Threshold Theory of Decision Making

The product of a decision is considered dichotomous between two mutually exclusive alternatives in the threshold theory of decision making. The dichotomous nature of such a decision implies that there exists a "breaking point" or threshold in the dimension of the explanatory variable below which a stimulus elicits no observable response (Kau & Hill, 1971). A reaction therefore occurs only when the strength of the stimulus reaches the threshold level. In this case any additional increase in the stimulus strength does not lead to any effect on the observed response. Kau & Hill (1971) noted that Predicting and explaining these kinds of economic decisions and behaviours requires specialized models to identify the relevant

economic stimuli, to provide information on the magnitude of their effects, and to estimate the threshold levels of responses. The farmers' decision to join an FBO is a choice between two mutually exclusive alternatives. The farmer either joins the FBO or not and this makes the theory applicable to farmers' decision to join FBOs.

Estimating Models of Decision Making

The estimation of a decision to join or not to join a group is done using discrete choice and quantal choice models. Hoddinott, (1994) noted that modelling the decision to join a group, an association or a programme is derived from the threshold theory of decision-making. Discrete choice econometric models have been widely used in estimating models that involve discrete problems (Guerre & Moon, 2006 and Feder et al., 1985).

From the work of (Verbeek, 2008 and Gujarati, 2004) three different types of models have often been used in estimating discrete choice models which include; Linear Probability Model (LPM), Logit Model and Probit Model. The choice of any of these models for any analysis depend on a number of factors including but not limited to; distributional assumptions underlying the sample, objectives of the study, fitness of the model of the given data (Maddala, 1983; Adejobi & Kormawa, 2002 and Nzomoi et al., 2007). Notwithstanding the above, the choice of each model is determined by its own set of assumptions and therefore have limitations to that effect. More so, depending on the objectives of the study, the researcher designs certain specific methodologies that are more applicable.

The Linear Probability Model had been found to come with some shortfalls which makes it application in empirical study unsuitable. For example, Maddala (1983), noted that LPM is not able to constrain the predicted probability to fall within a range of (0, 1) as guaranteed by probability theory. There is also a problem of heteroscedastic of the error term when the LPM is used. The heteroscedastic nature of the error terms makes tests of significance of estimated

coefficients impossible since the error term becomes the same. Although, the method of Weighted-Least Squares (WLS), in which, each of the parameters in the LPM is multiplied by the error variances, has been used to overcome this heteroscedasticity, the procedure is susceptible to specification errors (Maddala, 1983).

The logit, tobit and probit models were proposed by Maddala (1983) to overcome the challenges faced by the LPM. The Logit and Probit models overcome the shortfalls of the LPM by transforming the underlying latent process with a logistic and a normal distribution function respectively and they are usually preferred in empirical analyses. However, the two models are constrained in situations where the distribution of the error term given by the regressors has a known parametric form, especially when the error term is normal and homoscedastic.

2.16 Literature on Source of Data

The study of a farm productivity of farmer-based organization membership involves the understanding behind the farmer choice being a member and various factors that can influence the productivity of the farmer, however to do this, the source of data becomes very important. Two main dependant variables are involved to understand this effect. The first dependant variable is dichotomous that is to say the decision to join or not to join an FBO. Therefore, there is need to sample both sides of the dependant variable. The dichotomous variable is widely used by researchers to bring out understanding on different situations such as participant and non-participant, member and non-member, adopter and non-adopter, migrant and non-migrant, owner and non-owner etc. (Addai, Owusu, & Danso-abbeam, 2014; Alassaf, Majdalwai, & Nawash, 2011; Awotide, Abdoulaye, Alene, & Manyong, 2015; Cornelißen & Sonderhof, 2009 ; Dong, Lu, & Featherstone, 2010 Elias, Nohmi, Yasunobu, & Ishida, 2013 ; Yehuala, 2008; Mwaura, 2014; Onogwu, 2017). The idea is to bring out the understanding on the decision making that can be influenced by various factors.

The second dependant variable is the productivity of maize farm which is measured in term of output per unit of land area. Various scholars defined productivity in their own views but (Singh & Dhillion, 2000) suggest that the yield per unit area should be considered in the measurement of agricultural productivity. Many other researchers suggest different measurements of agricultural productivity. For example Dharmasiri, (2009) used average productivity index (API), "ratio of index of local agricultural output to the index of total input used in farm production" was suggested by Shafi, (1984). Most of the researchers measure the productivity as quantitative variable but some researchers have categorized it into categorical variable such as (Onogwu, 2017) where the dependent is set as a dummy variable referring to the level of the value of output.

The analysis methods of productivity are numerous and number of them were reviewed by Coelli,… et al (2005). This study employed the augmented Cobb Douglas production function proposed by Sanidas & Park (2011) and Ekbom, (1998). The idea is to bring out the effect FBO membership on the maize farm productivity, therefore there is a need to sample both input variables that directly influence productivity and socio-economics variables that directly or indirectly affect farm productivity. Some researcher found a significant relationship between FBO membership and farmers' productivity such as Onogwu, (2017), Addai et al., (2014).

2.17 Factors influencing maize farm productivity

The factors that influence the productivity of maize farm include inputs variables and socio-economic characteristics of farmers. These variables are defined below.

Inputs variables

Labour: the labour is widely defined by the most researcher as the number of person working on the farm during the typical days (FAO, 2005), . It is referring to the total number of person-days spend on-farm during one working day including family labour and hired labour.

Seed: the seed is defined as the sum of quantity of improved seed and local seed used to produced. It is measured in terms of kg per hectares.

Household size: The household size vary across the definition used in the survey designed (Jack, 2009). Several definitions of household size were proposed by researchers based on some keywords such as residency, common food consumption, shared income or production decision.

The definition proposed by the National Institute of statistics in Mali during the General Census of Population and Habitat in 2009 is based on two categories of household: Ordinary and Collective household.

- The ordinary household is a set of related or unrelated individuals, recognizing the authority of a person called household head and most often sharing meals from the same pot. A family may be a household, but a household is not necessarily a family.
- The collective household is a group of two or more persons who do not meet the criteria established by an ordinary household, and who live together in a dwelling or room individually or collectively, for reasons of study, health, work, travel, incarceration, discipline or common interest. This category includes: hospitals or health centres with hospitalization, schools with internships (high schools and colleges, normal schools, institutes etc.), rehabilitation centres, hotels convents and other religious communities, military camps, prisons, etc.

FAO (2005) defined the "household as a small group of persons sharing the same living accommodation and, pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food".

Furthermore, four definitions of household were proposed Beaman & Dillon (2009):

1- A household is composed of the group of people living in the same dwelling space and acknowledge the authority of a man or women who is the head of household
2- A household is composed of the group of people living in the same dwelling space who eat meals together and acknowledge the authority of a man or women who is the head of household.
3- A household is composed of the group of people living in the same dwelling space who have at least one common plot together or one income generating activity together (for example, herding, business or fishing) and acknowledge the authority of a man or women who is the head of household
4- A household is composed of the group of people living in the same dwelling space who eat meals together and have at least one common plot together or one income generating activity together (for example, herding, business or fishing) and acknowledge the authority of a man or women who is the head of household.

Despite the fundamental importance of the unit of analysis in any type of research, the "household" remains somewhat of a "black box" for economists (Jack, 2009). Efforts to standardize the definition using the commonly accepted "common pot" definition still meet operational complications in the field as noted by Udry (1996).

Access to credit: Access to credit may affect farm productivity because farmers facing capital constraints would tend to use lower levels of inputs in their production activities compared to those not constrained (Awotide et al., 2015)

According to Kelly et al. (2012: 47), "access to credit is a more important determinant of fertilizer use than the fertilizer price itself."

Farm size: this is the total number of hectares cultivated by a farmer. Banerjee (1999) indicates larger land plots tenants are more efficient because the degree of freedom attached to large land therefore the ownership enhances productivity. Other farmer characteristics, such as gender,

also play a role in productivity differences for different size farms, as women farmers tend to have smaller plots (Unal, 2008). The access to economic opportunities differs from being a female farmer that may result in different crop choice and, later, differences in output per acre (Agarwal 1994; Alderman et al. 1995; Deere and Leon 2001; Masterson 2005).

Income: Income measurement has always been a big challenge in a rural area in developing countries especially in Mali where the country is viewed as one of the poorest countries in the world.

Income is defined as the earning of household in term of money in any form. In this study, the income is divided into two categories; farm income and non-farm income.

- Farm income includes all earning from the sale of agricultural products whether the sale of livestock or the sale of part of the output product
- Non-farm refers to any income obtained off of the farm activity including wage-paying activities, self-employment in commerce, manufacturing, migration earnings and other services (Reardon et al., 1998).

2.18 Summary

The discussions in this chapter highlight a review of Farmer-Based Organisations and maize production in Mali. Empirical studies on methods of analyses frequently used in studies of decision making and productivity measurement were reviewed. Various previous findings related to this present study were highlighted in this chapter. The review indicates that the decision to join FBO by farmers could be influenced by various factors such as age, education, access to fertilizer, access to credit, access to agricultural extension services, farm size, gender among others while the productivity is influenced by input variables including labour, fertilizer and seed and socio-economic characteristic such as education, age, land ownership, access to

credit, access to improved seed variety and access to agricultural extension services among others. The logit, probit and tobit models were employed in previous studies to analyse decision making. The productivity was measured using various methods such as Marginal Productivity or Average Productivity. There is a lack of literature on the effect of farmer-based organisation membership on crops productivity in Mali especially in OHVN zone. This study contributes to fill this information gap.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the adapted methods as well as the study area. The theoretical framework and empirical analysis, the sources of data and the procedure for collected data are also presented in this section.

3.2 Study area

This study was undertaken in OHVN in Mali where the dominated crops are sorghum, maize cotton, millet and rice. The main activity of the OHVN is focused on cotton cultivation around which farmers are organised. Beside farmer-based organisations for the cotton production

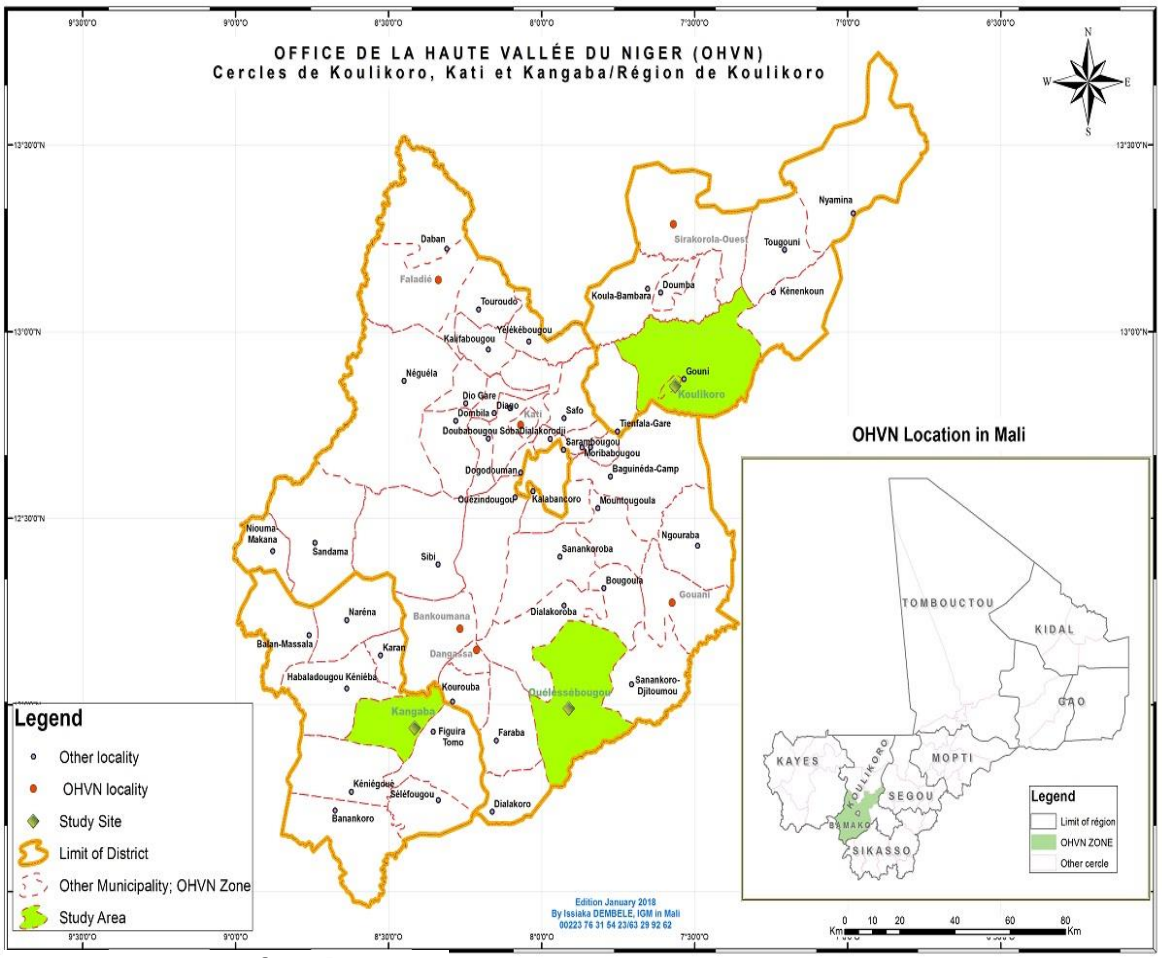

Figure 3. 1: Map of study area

Source: Institut Geographie du MALI

which is affecting other crops, it is noted that several other FBOs are intervening in the production of the different crops such as FBOs for maize production, FBOs for sorghum production, Women farmer organisations for vegetables production.

OHVN (Office of Upper Niger Valley) zone is one of the three major agricultural sectors in Mali after CMDT and Office du Niger. OHVN is located in Koulikoro region and intervenes in three (3) districts (circles): Koulikoro, Kati and Kangaba. It is constituted with 9 rural development sectors (Ouelessebougou, Dangassa, Kati, Gouani, Kangaba, Koulikoro, Sirakorola, Bangoumana, Faladiè). It works in coordination with the National Management of Agriculture of Kolokani (french acronym is DRA-Kolokani).

The area covers about 26,000 km² whom 75% of land are arable and includes 796 villages and 707 cultural hamlets. The area comprises 54 municipalities, of which 3 are urban, and are managed by the OHVN (Plan de campagne OHVN 2013-2014). The total population is estimated to be 1,211,522 including 617876 (whether 51%) women and 674,157 active population including 340,556 women. The total number of household is estimated to be 48,930. Agriculture and livestock are the main economic activities, followed by trade, fishing and crafts (revue de la campagne 2016/2017 de l'OHVN).

3.3 Scope of study

The objective of this study is to analyse the effect of farmer-based organisation on the maize farm productivity in OHVN zone in Mali. To meet this objective, first of all, the factors that influence farmers' decision to participate in farmer-based organisation were analysed, then, factors that affect the productivity of maize farm were also determined.

The study focuses on the maize farmers in the OHVN zone in Mali. Most of the farmers are cultivating staple crops such as maize, sorghum, millet and rice. Other cash crops such as cotton, groundnut and cowpea are also produced in the area. The production of maize is currently dependent on the use of fertilizers, and improved varieties of seed which make the

crop production a capital-intensive crop, therefore, most of the farmers who are smallholders may see themselves unable to increase productivity due to financial constraint. Thus, this study focuses on the maize production in the area. Maize production is receiving attention in the Malian agriculture since its annual area growth rate was estimated to be 6.6% between 1980 and 2013 (Abate et al., 2015). This situation motivates investors and inputs dealers to intervene in this sector. Most of the smallholder farmers are unable to access credit individually. However, being a group is likely to give farmers more chance to access credit and inputs needed to produce the maize. For that purpose, it is strongly important for them to form groups that could be seen as a guarantee for investors, NGOs or others inputs dealers to provide them reliable aid for better production. In this sense, this study is looking at what could be the effect of being a member of a maize producer groups on their productivity to be able to draw conclusions leading to better recommendations. In addition to that, the factors influencing their decision and constraints they are facing are also identified.

The study is not focused only on those FBOs which are registered but on any form of maize farmer-based organisation which aimed to help members in their maize production. To assess the effect of FBO membership on maize farm productivity, the information about the use of inputs and determinants of decision making were collected from both members and non-members of FBOs.

3.4 Source of data

Multistage sampling technique was used to collect cross-sectional data from 405 farmers randomly selected across OHVN zone in Mali to estimate the effect of the farmer-based organization on maize farm productivity using augmented Cobb Douglass production function model. Primary data from structured questionnaire was used.

3.4.1 Sampling technique

Multi-stage sampling technique was used. The first stage involved three (3) sectors (Ouelessebougou, Koulikoro and Kangaba) which were selected in OHVN zone. This first stage is purposive sampling. The three sectors were selected based on the trend of maize production and maize FBOs established in these areas. In the second stage, five villages were randomly selected from each of the three selected sectors in the area to take part of this study. The third stage utilized the simple random sample to select participative farmers in the study from each selected village (including both members and non-members of FBO). In total, 135 farmers were selected from each sector to constitute a sample size of 405 farmers in the study area. The sample of 405 farmers is based on the Cochran equation developed in 1963 to yield a statistic sample where the starting sample is 385 elements with the margin of 5%. If the interval of confident is determined (in this case 95%), the degree of precision is known (5%) and the maximum of variability is estimated to be 0.5, so the initial sample to be statistically justified is:

$$n_0 = \frac{z^2 pq}{e^2} = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2} = 384.16 \quad \ldots\ldots 3.1$$

$$q = 1 - p$$

Thus, the statistic sample size starts from 385 farmers which is the reason behind the choice of 405 farmers to make room for non-response.

3.5 Analytical & theoretical framework

3.5.1 Analysis of Productivity

This study is based on the augmented Cobb Douglas function (Sanidas & Park, 2011) which includes organizational effect, educational level and other factors to explain the output.

According to Coelli et al. (2008), the output produced Y is expressed in terms of the use of a set of input variables X but the assumption is that, the use of these inputs is under effective control of the decision maker. The functional relationship that relates the output and the inputs used can be expressed as:

$$Y_i = f(\beta_i, X_i, \delta_j, Z_j, \varepsilon_i) \quad \text{.....3.2}$$

Where *Y* is the productivity of maize farm measured in term of output per unit of land area, Xs are the explanatories variables; β_i and δ_j are the parameters of the function to be estimated; Zs are socio-economic characteristic or exogenous variables of the model and ε_i is the error term depicting unobserved variables. According to Cainelli (2008), the outcome of production can be explained not only by the factors that directly affect production but also the factors that indirectly impact the production. Using the Cobb-Douglass form, the relationship between the dependent (output) and independent variables as shown in the equation 3.2 can be expressed as the equation 3.3 below; where β_0 is the intercept or total factor productivity.

$$y=\beta_0 \prod_{i=1}^{N} x_i^{\beta_i} e^{(\delta_j z_j + \varepsilon_i)} \quad \text{.....3.3}$$

Gujarati and Porter (2009) noted that the model as shown in equation 3.3 has a nonlinear relationship between the output and the input variables. They asserted that when the model is log transformed, the model becomes linear in parameters as shown in the model 3.4.

$$ln\, y = \beta_1 + \beta_i\, ln\, x_i + \delta_j z_j + \varepsilon_i \quad \text{.....3.4}$$

If *k* inputs variables and *N* socio-economic variables are used in the loglinear model, it is thus specified as:

$$ln\, y = \beta_0 + \beta_1\, ln\, x_1 + \beta_2\, ln\, x_2 + \beta_3\, ln\, x_3 + \ldots + \beta_\kappa\, ln\, x_\kappa + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \ldots + \delta_N z_N + \varepsilon_i \ldots\ldots\ldots\ldots 3.5$$

If the log–linear regression model involves a number of variables, the coefficient of each of the X variables indicates the (partial) elasticity of the dependent variable Y with respect to that variable.

Properties of the Cobb Douglas production:

1. β_i are the partial elasticities of output with respect to the input, that is to say, it measures the percentage change in output in responses to 1 percent change in the input, holding the other variables constant.

2. The sum of β_i ($\sum_{i=1}^{i=\kappa} \beta_i$) depicts the return to scale. The return to scale indicates the response of output to a proportionate change in the inputs. If this sum gives 1, then it shows a constant return to scale, that is to say, all inputs doubled will result a double in the output, λ increase of inputs will result λ increase in output. If the sum is less than 1, it indicates the decreasing returns to scale, that is to say, doubling the inputs will less than double the output. Finally, if the sum is greater than 1, it reveals an increasing return to scale, means that doubling the inputs will more than double the output.

3.5.2 Analysis of decision making

Following the work of Hill and Kau (1973), the model for decision making can be specified as:

$$Y_i = \beta_i x_i + \mu_i \ldots\ldots\ldots\ldots 3.6$$

Where y, is the dependent variable denoting the farmer's decision to join an FBO, hence $y_i = 1$ if the farmer joins and $y_i = 0$ if he/she does not join; and x_i is a vector of the farmer's socioeconomic characteristics, institutional and other factors, and β_i is a vector of estimated parameters.

When the dependent variable is specified to take the value of 1 if a positive decision occurs and 0 if otherwise, the dichotomous decision to join an FBO model for the ith-farmer is specified as follows:

E(μ_i) = 0, then $E\ (Yi \mid Xi) = \beta_0 + \beta iXi = \hat{y}_i$ …….3.7

$$Y_i = \begin{cases} 1\ if\ x_i\beta \geq \hat{y}_i \\ 0\ if\ x_i\beta \geq \hat{y}_i \end{cases} \text{……..……..3.8}$$

$i = 1, 2, 3, ...N$ Observations

Where;

y_i takes the value of 1 if the farmer joins the *FBO* and *0* if the farmer does not. Therefore, the probability that *a* farmer joins a *FBO* is given as:

P_i =prob(y_i=1)=F($x_i\beta_i$)…….....3.9

In which case the probability that a given farmer does not join any FBO is specified as the equation 3.10:

$1 - P_i$ =1-prob(y_i=1)=1-F($x_i\beta_i$).....…….....3.10

Where $F(x_i\beta_i)$ in both equation 3.9 and 3.10 denotes the cumulative distribution function evaluated at the value of the argument.

The error term is assumed to be normally and independently distributed (i.e. $N(0,\sigma)$) to follow a logistic distribution.

The probability that a farmer joins a FBO in equation 3.9 can be rewritten can be expressed as:

$$P_i = \frac{1}{1 + e^{-(\beta_0 + \beta_i x_i)}} \text{……3.11}$$

It can be written as:

$$P_i = \frac{1}{1 + e^{-Z_i}} = \frac{e^Z}{1 + e^Z} \text{……..……3.12}$$

Zi ranges from $-\infty$ to $+\infty$, Pi ranges between 0 and 1 and that Pi is nonlinearly related to Z_i (i.e., Xi). But Gujarati and Porter (2009) noted that, Pi is "nonlinear not only in X but also in the βs" which imposes the use of different model from the familiar OLS. The model can be linearized as follow:

The probability that a farmer will not join the FBO in equation 3.10 can be rewritten as:

$$1 - P_i = \frac{1}{1+e^{Z_i}} \ldots 3.13$$

Therefore, the ratio of probability in favour of joining the FBO is given as *Odds-Ratio*:

$$\frac{P_i}{1-P_i} = \frac{\frac{1}{1+e^{-Z_i}}}{\frac{1}{1+e^{Z_i}}} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \ldots 3.14$$

$P_i/(1-P_i)$ is odds ratio in favour of decision to join the FBO.

Taking the natural log of equation 3.14 gives:

$$ln(\frac{P_i}{1-P}) = Z_i \ldots 3.15$$

Thus, it can be written as:

$$Logit(Y) = ln(\frac{p_i}{1-p_i}) = \beta_0 + \sum_{i=1}^{N} \beta_i X_i + \mu_1 \ldots 3.16$$

From the estimation viewpoint, the log of the odds ratio, is not only linear in X, but also linear in the parameters. The positive value of logit means that if the regressor (X) increases, the odds ratio of joining the FBO (Y=1) will increase in contrast, if the value of logit is negative, an increase of regressor (X) will decrease the value of odds ratio that a farmer will join the FBO (Y=1).

3.6 Empirical Specification of the Model

3.6.1 Analysis of farmers socio-economic characteristics in the study area

Descriptive statistics (tabulation, frequency distribution and percentages) was used to analyse the data collected on the characteristics of the farmers in the study zone.

3.6.2 Estimating factors influencing farmers decision to join FBO

The logit model was employed to analyse farmers' decision to join FBOs. This logistic analytical tool had been found to best fit factors influencing smallholder farmers participation in FBOs (Onogwu, 2017; Yehuala, 2008). The model is specified as:

$$Y_i = \beta_0 + \beta_1 ACCFert + \beta_2 Acc + \beta_3 AEA + \beta_4 Gen + \beta_5 Age + \beta_6 AgeYouth + \beta_7 AISeed + \beta_8 Pr\,i\,m\_Edu + \beta_9 JHS + \beta_{10} SHS + \beta_{11} HH\_Sise + \beta_{12} Farm\_size + \beta_{13} Farm_{Exp} + \beta_{14} Lan\_Own + \beta_{15} Maize\_\,Pr\,o_{Exp} + \beta_{16}\,ln\,F\,Income + \beta_{17}\,ln\,N\,FIncome + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.17$$

Where Y is dummy variable and denotes 1 if farmer belongs to maize FBOs and 0 if he/she does not, β_0, β_1, …, β_{17} are the parameters of the function to be estimated and μ_i is the disturbance error. The size distribution of variables such as incomes (farm income and non-farm income) tend to be skewed, however logarithmic transformations of such variables reduce both skewness and heteroscedasticity (Gujarati & Porter, 2009). The description and a priori expectation of the variables of the equation 3.17 are shown in Table 3.1.

3.6.3 Estimating the effect of maize FBO membership on maize farm productivity

Following Sanidas & Park (2011), augmented Cobb Douglas production function was used to estimate effect of maize FBO membership on maize farm productivity. The model is expressed in equation 3.18: The model was log transformed to make it linear.

$$ln\,y = \beta_0 + \beta_1\,ln\,F\,ert + \beta_2\,ln\,L\,ab + \beta_3\,ln\,S\,eed + \delta_1 FBOM + \delta_2 Accredit + \delta_3 AEA + \delta_4 AIseed + \delta_5 AgeYouth + \delta_6 Edu\_\,Pr\,i\,m + \delta_7 Edu\_JHS + \delta_8 Land\_Own + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.18$$

Where *Y* is the productivity of maize farm. It is measured in terms of output per unit of land area; β_0 is the intercept or total factor productivity, βs and δs are the parameters of the input variables and exogenous variables of the function to be estimated respectively. Table 3.1 presents the description and a priori expectation of the variables used in equation 3.18.

Table 3. 1: Summary of variables used to analyse objectives two and three

Variable	Description	Measurement	Expected Sign
Output	Productivity (output/ha)	Kg/ha	
Exp. variable	Explanatory variables		
Fert	Fertilizer	Kg/ha	+
Lab	Labour force	Man-days	+
FarmS	Farm Size	hectares	+
Seed	Seed	Kg/ha	+
FBOM	Farmer based organization membership	1=yes 0=No	+
ACC	Access to credit	1=yes 0=No	+
AgeYouth	Age youth	1=below 35 years 0=otherwise	+/-
AGE	Age of farmer	years	+/-
GEN	Gender	1= male 0= female	+/-
HHS	Household size	number	+/-
Educ_Prim	Primary education	1=stop schooling at primary educational level 0=otherwise	+
Educ_JHS	Junior high school	1=stop schooling at junior high school level 0=otherwise	+
Educ_SHschool	Senior high school	1=stop schooling at senior high school level 0=otherwise	+
Exp	experience in maize farm	years	+
AEA	Access to Extension Agent	1=yes 0=no	+
AIS	Access to Improved Seed	1=yes 0=no	+/-
Land_Own	Land Ownership	1=yes 0=otherwise	+/-
AFert	Access to fertilizers	1=yes 0=no	+/-
FIncome	Farm Income	1=yes 0=no	+/-
NFIncome	Non-Farm Income	Franc CFA	+/-

Hypothesis testing

The main hypothesis of this study is:

H_0: FBO membership has no effect on the maize farm productivity

Ha: FBO membership has a positive effect on the maize farm productivity

Validation of Hypothesis: Z-test was used to validate the null hypothesis (H_0):

$$Z\_cal = \frac{\beta_i}{SE(\beta_i)} \quad \text{.....3.19}$$

Z-cal= calculated value, βi= estimated parameter for the i^{th} explanatory variable and SE (βi) is the standard error of the ith parameter.

Decision rule: If Z-cal ≥ Z-crit, the null hypothesis (Ho) is rejected in favour of the alternative (Ha) otherwise we fail to reject it.

3.6.4 Description of Variables of the Models

Lab: is labour force used by in maize farm in term of man per day

Seed: quantity of seed (whether improved or conventional) kg/ha

MFBOM: maize farmer-based organization membership. It is measured as dummy variable and take the value of 1 if farmer is member or 0 if farmer is not member.

Gen: Gender, the essence of that is to determine if gender is affecting maize production in the study area and to measure the average productivity between male and female

AIS: Access to improved seed. Improved seed are known as high yield seed.

AEA: Access to agricultural extension agent refers to the contact between the farmer and extension agent in order to provide agricultural information, agricultural advises and disseminating of new technologies and innovations.

Education (EDU): It is divided into three dummy variables. Primary school (1=if the farmer has stopped schooling at primary education, 0=otherwise), Junior high school (1= if the farmer has stopped schooling at junior high school 0=otherwise) and Senior high school (1= if the farmer has stopped schooling at senior high school, 0=otherwise)

Experience in maize production (Exp): is the number of year that a farmer has been cultivating the maize in continuity.

Land ownership (LO): refers to farmers who own their production land different from rental or borrowing.

Household size (HHS): It is defined as a group of persons sharing the same living accommodation and pool some, or all, of their income and wealth. Certain types of goods and services, mainly housing and food are consumed collectively (FAO, 2005).

Access to credit (ACC): The access to credit refers to any form of access to credit whenever the credit is obtained whether from formal financial institution, farmer-based organization, local savings and credit unions, maize or other FBOs, friend and/or family members etc and it is used as a dummy variable (1=Yes 0=No).

3.7 Constraint facing by FBOs in agricultural production

The Kendall's coefficient of concordance (W) was used in this study to identify the factors that may constrains maize farmer-based organization in agricultural productivity. The Kendall's coefficient of concordance (W) measures in a degree of concordance/agreement among m set of n ranks (Kendall & Smith, 1939). The coefficient of the concordance is the ratio of variance between the sum of ranks to the variance. It is used as an index to analyse the variability of the ranks of each factor/attribute being ranked. According to Mattson (1986), the variability among these sums of rank is maximum if there is a perfect agreement among judges.

The analysis is a factual method that is used to distinguish and rank a given set of variables into the most pressing and afterward measures the level of agreement among judges.

Most often, the factors are classified from most pressing constraint to the least pressing constraint in numerical way such as 1, 2, 3,.., n in that order. The least scored factor is set as the most pressing constraint while the one with highly scored is ranked as the least pressing constraint.

Given T representing the sum of ranks of each factor to be ranked, the variance is given by

$$Var_T = \frac{\sum T^2 - (\sum T)^2/n}{n} \quad \ldots\ldots\ldots\ldots 3.20$$

Then, the maximum variance is given by:

$$\frac{m^2 n(n^2-1)}{12} \quad \text{.....3.21}$$

- n is the number of constraints being ranked
- m denotes the number of judges, here the number of farmers

The value of W ranges between 0 and 1, it is the ratio of the sum of ranks of each factor being ranked (Var_T) and the given maximum variance.

The simplified equation gives:

$$W = \frac{12[\sum T^2 - (\sum T)^2/n]}{m^2 n(n^2-1)} \quad \text{.....3.22}$$

Where W is the coefficient of concordance and ranges from 0 to 1.

- T is the sum of ranks of each constraint being ranked.
- m represents the number of judges or respondents (farmers).
- n is the number of factors (constraints) being ranked.

Hypothesis and significant test for W

The null hypothesis and alternative hypothesis are as follow:

H_0: there is no agreement among the rankings of constraints facing by FBO in OHVN zone in Mali

H_1: there is agreement among the rankings of constraints facing by FBO in OHVN zone in Mali

The F distribution was used to test the significance of the coefficient of concordance (W)

$$F = \frac{[(m-1)W_c]}{(1-W_c)} \quad \text{.....3.23}$$

Wc is the calculated coefficient of concordance

The degree of freedom for the numerator is $(n-1)-2/m$, and

The degree of freedom for the denominator is $(m-1)[(n-1)-2/m]$

Decision rule:

If the calculated F is greater than the critical value of F from F table, we reject H_0 otherwise we fail to reject it.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and discussion related to the specific objectives of the study. First of all, socio-economic characteristics of farmer-based organization is briefly described. This is followed by analysis of factors influencing farmers' participation in maize farmer-based organization in the study, then the effect of farmer-based organization on maize farm productivity was analysed. The analysis of constraints facing by maize farmer-based organization in agricultural production in OHVN area, Mali, are presented.

4.2 Socio-economics characteristics of farmer-based organization in the study area

The study shows socio-economic characteristics of farmers organizing in maize farmer-based organization in the study area according to gender, age, education, household size, farm size, experience in farming activities and incomes from the field survey using structure questionnaire as follows.

4.2.1 Distribution of the farmers according to gender

Table 4.1 shows that the majority of respondents (99.51%) are male against only 0.49% of female confirming that maize is a male-dominated crop in Mali (Fofana et al, 2010). From the total of 405 farmers interviewed, 194 farmers are found to be members of maize farmer-based organization which represent 47.9%. Among FBO members, only one farmer is female. The farmers who are not members represents 52.10% of total survey (211 farmers include one female).

Table 4. 1: Distribution of the Farmers According to Gender

	Respondents			
Gender	FBO Members	Non FBO members	Pool	Percent
Male	193	210	403	99.51
Female	1	1	2	0.49
Total	194	211	405	100

Source: field survey, February 2018

4.2.2 Distribution of the Farmers According to Age

The distribution of respondents according to their age ranges from 18 to 85 years with the mean of 54.71 years. This average age is higher than the national average age of household head which is 49.4 years while Samaké et al, (2013) found an average age of farmers between 57-58 years in rural areas.

Table 4.2 indicates the group age of farmers in conformity with Mali youth-adult classification. It can be observed that 26.67 % of the farmers falls between the age group of 56-65, followed by the age group between 46-55 years (23.70%) of the farmers. The farmers who are beyond 65 years represent 21.98%. The younger farmers whom group age is between 15-35 years represent 7.90%. This distribution depicts that about 49% of farmers in the study area are above 55 years. Some prior studies found a similar range of farmer age in sub-Saharan countries (Heide-Ottosen, 2014)

In terms of farmer-based organization membership, where 194 farmers (47.9%) out of total interviewed are members, the most representative group age is 56-65 (34.02%), followed by group age of 45-56 (24.23%). Thus, the younger farmers (below 36 years) represent only about 4% while 23.71% of FBO members are beyond 65 years.

Table 4. 2: Distribution of the Farmers According to Age

	Respondents					
Age	FBO Members		Non-FBO members		Pooled	
Maximum	85		85		85	
Minimum	18		25		18	
Mean	57.15		52.47		54.71	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
15 - 35	8	4.13	24	11.38	32	7.9
36 – 45	27	13.92	53	25.12	80	19.75
46 – 55	47	24.23	49	23.22	96	23.70
56 – 65	66	34.02	42	19.91	108	26.67
> 65	46	23.71	43	20.38	89	21.98
Total	194	100	211	100	405	100

Source: field survey, February 2018

4.2.3 Distribution of the Farmers According to their level of education

A total of 165 respondents corresponding to 40.74% have attained some form of formal education whereas 156 respondents representing 38.52% of farmers did not follow any form of education. Non-formal educated farmers represent 20.74% of farmers corresponding to 84 farmers. This finding differs from the data of INSTAT (2009) on education where about 69% of the population are not educated and around 28% have followed non-formal education.

In Table 4.3, it is showed that 24.69% of farmers have stopped schooling at primary school, 21% have benefit non-formal education, 9.14% attained junior high school, 5.93 % have been in senior high school and only 0.99% of farmers in the study area have followed a tertiary educational level.

Of the maize FBO members, the frequency distribution shows that 31.44% of maize FBO members did not benefit in any form of education, while 29.38% ended up at primary school, non-formal education beneficiaries represent 22.68% and only 1.55% received a tertiary education level.

Table 4. 3: Distribution of the Farmers According to their level of education

	Respondents					
	FBO Members		Non-FBO members			
Education	Frequency	Percentage	Frequency	Percentage	Pooled	Percent
None	61	31.44	95	45.02	156	38.52
Primary	56	29.38	44	20.38	100	24.69
Junior high school	16	7.73	21	10.43	37	9.14
Senior high school	14	7.22	10	4.74	24	5.93
Tertiary	3	1.55	1	0.47	4	0.99
Non-formal education	44	22.68	40	18.96	84	21.0
Total	194	100	211	100	405	100

Source: field survey, February 2018

4.2.4 Distribution of the Farmers According to Household size

The household size is defined by National Institute of Statistic of Mali as an individual or a group of related or non-related individuals living under the same roof and recognizing the authority (or not in some cases) of a person called the head of the household (INSTAT, 2011). Two types of households are distinguished: The ordinary household and the collective household.

- The ordinary household is a set of related or unrelated individuals, recognizing the authority of a person called household head and most often sharing meals from the same pot. A family may be a household, but a household is not necessarily a family.
- The collective household is a group of two or more persons who do not meet the criteria established by an ordinary household, and who live together in a dwelling or room individually or collectively, for reasons of study, health, work, travel, incarceration, discipline or common interest. This category includes: hospitals or health centres with hospitalization, schools with internships (high schools and colleges, normal schools, institutes etc.), rehabilitation centres, hotels convents and other religious communities, military camps, prisons, etc.

This work is based on the first category of household, that is to say, the ordinary household where the household is referring to the traditional family in rural area in Mali constituted with one or more single households pooling together their efforts to grow the family land and sharing meals from the same pot.

Table 4. 4 indicates that the maximum household size in the study area is 19 persons while the minimum is 2 persons. The mean of household size is about 5 persons with a standard deviation of 2.13. This mean of household is lower than the national average which is 6.2 according to (INSTAT, 2009).

The different studies in Mali report different household size based on the definition used in the survey design. For example, Beaman & Dillon (2009) found a household size range between 11 and 12 persons depending on the definition used while the Malian Agricultural Census reports a mean household size of 6 persons. Furthermore, the Demographic and Health Survey in 2007 reports a household size of 5.7 and the household size 8.5 was reported by the Rapid Household Survey (2006).

Moreover, it can be observed in Table 4.4 that the majority of household size (about 67%) falls between group household below 6 persons, followed by group household of 6-10 persons (28.64%). It can also be observed that 0.49% (6) of households inquired are beyond 15 persons. About 70% of farmers who belong to maize farmer-based organization have a household size less than 6 persons while 27.84 % fall between 6-10 persons. The big households (above 10 persons) represent about 2 % of the household of maize FBO members.

Table 4. 4: Distribution of the Farmers According to Household size

Household Size	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	16		19		19	
Minimum	2		2		2	
Mean	5.03		5.28		5.16	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 6	136	70.10	142	67.30	278	68.64
6 – 10	54	27.84	62	29.38	116	28.64
11 – 15	3	1.55	1	2.84	9	2.22
>15	1	0.52	1	0.47	2	0.49
Total	194	100	211	100	405	100

Source: field survey, February 2018

4.2.5 Distribution of the Farmers According to total land size

The maximum total land size holding in the study area is 60 ha, the minimum farm size holding is 2 ha. The mean farm size for agricultural production is 12.43ha with a standard deviation of 9. The frequency distribution of the farmers according to land size holdings in study area showed that one hundred and forty-five (145) farmers hold a farm size between 5-9 hectares corresponding to 35.8% out of 405 farmers, followed by eighty-five (85) farmers (20.99%) holding a land size between 10-14 hectares. However, 7.65% of farmers corresponding to thirty-one (31 farmers) have more than 29 hectares for agricultural production.

In term of households who belong to maize farmer-based organizations, it is depicted that the majority of FBO members (63.91%) have less than 15 hectares as total farm size for agricultural production. Twenty-two (21) farmers corresponding to 11.34% who belong to farmer-based organization hold more than 29 hectares for agricultural production. About 5% of FBO members are holding less than 5 hectares. The mean of total farm size for FBO members is about 14.5 hectare compared to those who are not members of maize farmer-based organization whom the mean of total farm size for agricultural production is about 11 hectares.

Table 4. 5: Distribution of the Farmers According to total land size

Farm Size	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	60		50		60	
Minimum	3		2		2	
Mean	14.34		10.67		12.43	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 5	10	5.15	38	18.01	48	11.85
5 – 9	62	31.96	83	39.34	145	35.80
10 – 14	52	26.80	33	15.64	85	20.99
15 – 19	22	11.34	22	10.43	44	10.86
20 – 24	20	10.31	22	10.43	42	10.37
25 – 29	6	3.09	4	1.90	10	2.47
>29	22	11.34	9	4.27	31	7.65
Total	194	100	211	100	405	100

Source: field survey, February 2018

4.2.6 Distribution of the Farmers According to Farming experience

The distribution of the farmers according to farming experience in agricultural production is showed in Table 4.6. The highest number of years in agricultural production is 70 years while the minimum is 4 years and the mean is 34.13 years.

From this table, it is observed that the group of 30-39 years in farming activities represents about 24% of total farmers interviewed while less than 5% have a farming experience below 10 years.

Table 4. 6: Distribution of the Farmers According to Farming experience

Farming experience	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	70		70		70	
Minimum	4		4		4	
Mean	34.01		34.25		34.13	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 10	9	4.64	9	4.27	18	4.44
10 – 19	20	10.31	22	10.43	42	10.37
20 – 29	35	18.04	41	19.43	76	18.77
30 – 39	48	24.74	49	23.22	97	23.95
40 – 49	43	22.16	40	18.96	83	20.49
50 – 59	30	15.46	36	17.06	66	16.30
> 59	9	4.64	14	6.64	23	5.68
Total	194	100	211	100	405	100

Source: field survey, February 2018

The highest experienced (more than 59 years) represents about 6% of total respondents.

Farmers who are members of FBO corresponding to 194 farmers, about 48% of them have a farming experience between 30-49 years, the least experienced with less than 10 years are 4.64% while the highest experienced represent similar percentage (4.64%).

4.2.7 Distribution of the Farmers According to maize Farm size

The mean maize farm size is 2 hectares with a maximum of 10ha and 0.25ha as a minimum. Those who are members of maize FBO have a mean maize farm size of 2.28ha while the mean maize farm size of non-members is 1.72 ha.

It is revealed in Table 4.7 that the majority of farmers (about 53%) in the study area have less than 2 hectares as maize farm corresponding to a total of 216 farmers. The largest maize farm size in the study area is 10 hectares. The farmers who hold a maize farm size between 2.0-3.99 are estimated to be 34.32%. In general, this shows that about 88% of farmers hold less than 4 hectares of maize farm land.

The farmers who belong to FBO holding less than 2 hectares and between 2.0-3.99 hectares represent respectively 43.30% and 42.78%. About 6% of FBO members have a farm size of maize between 6 and 8 hectares. Only one member is growing 10 hectares of maize.

Table 4. 7: Distribution of the Farmers According to maize Farm size

Maize farm size	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	10		8		10	
Minimum	0.25		0.25		0.25	
Mean	2.28		1.72		2	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 2	84	43.30	132	62.56	216	53.33
2 – 3.99	83	42.78	56	26.54	139	34.32
4 – 5.99	14	7.22	16	7.58	30	7.41
6 – 7.99	6	3.09	6	2.84	12	2.96
8 – 9.99	6	3.09	1	0.47	7	1.73
=10	1	0.52	0	0	1	0.25
Total	194	100	211	100	405	100.00

Source: field survey, February 2018

4.2.8 Distribution of the Farmers According to Farming experience in maize production

Table 4.8 depicts the experience of farmers in maize production. The highest experienced farmers have an experience of 50 years in maize production, the least experienced (minimum) in maize production is 1 year. The mean experience in maize production is around 10 years with a standard deviation of 8.77. It is observed that most of the farmers (about 57%) in the study area have experience of less than 10 years in maize production. However, 16.30% have an experience between 10-14 years, followed by the group experienced 20-24 years corresponding to 10.12%. More than 30 years' experience is held by 7.41% of total farmers. About 55% of FBO members have experience of less than 10 years in maize production. However, 6.70% have more than 29 years in maize production.

Table 4. 8: Distribution of the Farmers According to Farming experience in maize production

Farming experience in maize production	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	50		44		50	
Minimum	1		1		1	
Mean	10.70		9.85		10.26	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 5	51	26.29	72	34.12	123	30.37
5 – 9	56	28.87	53	25.12	109	26.91
10 – 14	33	17.01	33	15.64	66	16.30
15 – 19	17	8.76	18	8.53	35	8.64
20 – 24	22	11.34	20	9.48	42	10.37
25 – 29	2	1.03	4	1.90	6	1.48
> 29	13	6.70	11	5.21	24	5.93
Total	194	100	211	100	405	100.00

Source: field survey, February 2018

4.2.9 Distribution of the Farmers According to Farm Income

The average farm income earned in 2017 by maize farmers in the study area is about 888,600 Franc CFA which is equivalent to about 1,270 US dollars with a standard deviation of 1,008,841. The maximum and minimum income in farming activities are 6,963,100 and 52,500 respectively. It is showed in Table 4.9 that the majority of farmers (55.06%) have a farm income not above 500,000 F CFA (around 886 US dollars), followed by 23.95% who earn from farming activity an income of between 500,000 to 1,000,000 F CFA. About 3% of the respondents have a farm-income above 5 million of Franc CFA.

Regarding FBO members, as a pool distribution, about 43% gain a farm income less than 500,000 F CFA, 27.32% earn a farm income of between 500,000 to 1,000,000 Franc CFA.

Table 4. 9: Distribution of the Farmers According to Farm Income

Farm Income (*10000)	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	696.31		271.56		696.31	
Minimum	5.50		5.25		5.50	
Mean	111.35		62.46		88.86	
Group	Frequency	Percentage	Frequency	percentage	Frequency	Percent
< 50	84	43.30	139	65.88	223	55.06
50-100	53	27.32	44	20.85	97	23.95
100- 200	32	16.49	24	11.37	56	13.83
200-300	10	5.15	4	1.90	14	3.46
300-400	7	3.61	0	0	7	1.73
400-500	2	1.03	0	0	2	0.49
>= 500	6	3.09	0	0	6	1.48
Total	194	100	211	100	405	100

Source: field survey, February 2018

4.2.10 Distribution of the Farmers According to Non-Farm Income

The non-farm income distribution is shown in Table 4.10. The non-farm income refers to any income obtained off of the farm activity including wage-paying activities, self-employment in commerce, manufacturing, migration earnings and other services (Reardon et al., 1998).

The minimum and maximum non-farm income found in the study is 52,500 and 8,000,000 Franc CFA respectively. The mean non-farm income is 456,500 Franc CFA with a standard deviation of 688,622.

From Table 4.10, it is observed that the majority of farmers (about 81%) have a non-farm income below 500,000 F CFA (886 US Dollars). This implies that the main source of income of farmers is from farming activities. The table also revealed that 0.5 percent of farmers corresponding to only 2 farmers (non-members of FBOs) are earning over 5,000,000 F CFA (8,865 US Dollars).

Table 4. 10: Distribution of the Farmers According to Non-Farm Income

Non-Farm Income (*10000)	Respondents					
	FBO Members		Non-FBO members		Pooled	
Maximum	310		800		800	
Minimum	5.25		5.62		5.25	
Mean	44.52		46.77		45.65	
Group	Frequency	percentage	Frequency	percentage	Frequency	Percent
< 50	152	78.35	176	83.41	328	80.99
50-100	28	14.43	21	9.95	49	12.10
100- 200	9	4.64	10	4.74	19	4.69
200-300	4	2.06	2	0.95	6	1.48
300-400	1	0.52	0	0	1	0.25
400-500	0	0	1	0.47	1	0.25
>= 500	0	0	1	0.47	1	0.25
Total	194	100	211	100	405	100.00

Source: field survey, February 2018

4.3 Analysis of factors influencing maize farmer participation in maize farmer-based organization

The Table 4.11 shows the binary logistic regression results of the factors determining maize farmer participation in maize farmer-based organization in Office of Upper Niger Valley zone (French acronym OHVN), Mali using maximum likelihood method. The variables that are significant which influence farmers' decision to join maize farmer-based organization include access to agricultural extension agents, access to formal credit or loan, access to improved seed of maize, access to fertilizer to produce maize, income earned from farming activities and non-farm income which include the earning from other economic sectors such as trade, mining, administration. The variables that are not significant include youth age, junior high school, household size, farm size, farming experience and land ownership.

Table 4. 11: Factors influencing maize farmer participation in maize farmer-based organization

Dependent Variable: Maize Farmer-based Organization Membership

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.573174	2.009800	-2.275438	0.0229
AccFert	1.530971**	0.615276	2.488266	0.0128
Accredit	1.142856***	0.292015	3.913686	0.0001
AEA	1.799352***	0.345586	5.206672	0.0000
Gender	-1.375445^{ns}	1.601374	-0.858916	0.3904
Age	0.041105***	0.015015	2.737621	0.0062
Age youth	-0.336030^{ns}	0.603010	-0.557254	0.5774
AISeed	0.808941***	0.274393	2.948113	0.0032
Primary Education	0.875867**	0.347756	2.518626	0.0118
Junior High School	0.483054 ^{ns}	0.470183	1.027375	0.3042
Senior High School	1.527282**	0.653873	2.335749	0.0195
HH_Size	-0.070209 ^{ns}	0.065570	-1.070758	0.2843
Farm_Size	0.012049 ^{ns}	0.016417	0.733914	0.4630
Farming Experience	-0.014326 ^{ns}	0.011355	-1.261675	0.2071
Lan_Own	0.024132 ^{ns}	0.366583	0.065829	0.9475
Experience in maize prod.	0.019227 ^{ns}	0.017035	1.128704	0.2590
LnFIncome	0.086916**	0.035481	2.449629	0.0143
LnNFIncome	0.060646**	0.025579	2.370917	0.0177

McFadden R-squared	0.3316	Mean dependent var	0.479012
S.D. dependent var	0.500177	S.E. of regression	0.393508
Akaike info criterion	1.009424	Sum squared resid	60.08134
Schwarz criterion	1.177489	Log likelihood	-187.4084
Hannan-Quinn criter.	1.075947	Deviance	374.8169
Restr. Deviance	560.7354	Restr. log likelihood	-280.3677
LR statistic	185.9186	Avg. log likelihood	-0.462737
Prob(LR statistic)	0.000000		

Obs with Dep=0	211	Total obs	405
Obs with Dep=1	194		

=significance level (=10%, **=5% and ***=1%), ns=not significant
Source: field survey, February 2018

The first column of the table shows the variables used in the regression. The second column is the coefficients explaining the percentage change of the dependent variable if one independent variable changes by one unit holding other variables constant (for continuous independent variables) (Gujarati, 2004).

To test that the coefficients in the regression are not different from zero (which is the null hypothesis) and the coefficients are different from zero (which is the alternative hypothesis), the log likelihood ratio tests was performed. Therefore, from the result, the LR statistic of 185.9186 with a logistic distribution at 17 degrees of freedom was significant at one percent. The significance of LR statistic is explained by at least one of the explanatory variables has a significant effect on the maize farmer participation in maize farmer-based organization. It also means the explanatory variables jointly influence maize farmer participation in maize FBO. It has been found that the variables such as access to credit, access to agricultural extension agents, access to improved seed and age are significant at 1% while access to fertilizer, primary education, senior high school, farm income and non-farm income were significant at 5% and age youth, primary education and senior high school are significant at 10 %. The remaining variables do not have a significant effect on maize farmer's decision to join maize FBO.

The McFadden R-squared of 0.3316 means 33.16% of variation in farmer's decision to participate in maize FBO is explained by the regressors. However, according to Gujarati & Porter (2009), since it measures the goodness of fit, there is no particularly meaningful R^2 in binary regressand models.

4.3.1 Marginal effect of significant variables

According to Cornelißen & Sonderhof (2009) the coefficients in the non-linear regression model, such as probit and/or logit model, cannot be interpreted as a partial effects. To fully interpret the binary logit regression result, the marginal effect of variables was computed as show in Table 4.12.

According to Adkins & Hill (2011), the marginal effect is the probability associated to the change in dependent variable in response to the change in independent variable holding others constant.

In this model, the marginal effect shows the effect of a change in farmer decision, everything else held constant, on the probability that a farmer chooses to participate to maize farm-based organization.

Table 4. 12: Marginal effect of variables

Marginal effects after logit y = Pr(MFBOM) (predict)= 0.45913498

Variable	Coefficients	dy/dx	P>|z|	Mean
Access to fertilizer	1.5310**	.2516	0.016	0.9111
Access to credit	1.1429***	.2839	0.000	0.3481
Access to ext. agents	1.7994***	.3854	0.000	0.7062
Age	0.0411***	.0098	0.008	54.7111
Gender	-1.3754^{ns}	-.3120	0.274	0.9951
Age Youth	-0.3360^{ns}	-.0642	0.658	0.0790
Access to improved seed	0.8089***	.2385	0.000	0.4395
Primary Education	0.8758**	.2178	0.007	0.2049
Junior high school	0.4831 ^{ns}	.0552	0.639	0.0914
Senior high school	1.5273**	.2541	0.062	0.0518
Household size	-0.0702 ^{ns}	-.0329	0.051	5.0752
Total Farm size	0.0121 ^{ns}	.0026	0.521	12.4281
Farming Experience	-0.0143 ^{ns}	-.0043	0.126	34.5901
Land Ownership	0.0241^{ns}	.0047	0.958	0.8247
Experience in Maize Prod	0.0192^{ns}	.0044	0.300	9.6333
Farm income	0.0869**	.0159	0.067	11.4183
Non-Farm income	0.0606**	.0139	0.029	9.6497

The significant variables influencing farmers participation in maize farmer-based organization are: age, access to fertilizer, access to improved seed, access to extension agents, access to credit, primary education, senior high education, farm income and non-farm income.

Age: The age is found to positively influence participation in maize farmer-based organization at 1% significant level, meaning that the willingness to join maize FBO increases with the age. The marginal effect shows that if the age of farmer increases by one year the likelihood to join maize farmer-based organization will increase by 0.98% all things being equal. However, the youth (below 35 years) has negative effect on farmers' decision to join maize based-organization but it is not significant. The implication is that, the probability that younger farmers (<35 years) participate in maize farmer-based organization is about 6.42% lower than adult farmers participation. So, the younger farmers are less likely to join farmer-based organization which could be explained by the new trend of young farmers towards the traditional gold mining sites with the abandonment of agricultural practices as indicated by Diarra (2013)

Access to fertilizer: The access to fertilizer is used as dummy variable and it is referring to farmers who have access to chemical fertilizer to produce maize. From the result of the binary logit regression, the access to fertilizer have a positive and significant effect on farmers' decision to join farmer-based organization at 5% significant level. The marginal effect indicates that if the access to fertilizer increases by one-unit percentage the likelihood of farmer to participate maize farmer-based organization will increase by 25.16% holding other variables constant. This imply that the farmer is motivated to join maize farmer based-organization since being a member of FBO will help him to get access to fertilizer because the access to fertilizer in sufficient quantity seems to be difficult as individual farmer with limited financial resources.

Access to improved seed: The improved seed is referring to new high yield varieties of maize seed made available by IER, ICRISAT or other agricultural research centre to farmer to increase agricultural production. The access to improved seed denotes the ability of farmer to get access to the available improved seed at the market price, through FBO, other farmer or relatives. Table 4.12 indicates that the access to improved seed is positively influencing

farmers' decision to participate in FBO at 1 percent significant level. Thus, it shows that the likelihood of farmer to join maize FBO increases by about 23.85% if the access to improved will increase by one-unit percent, all things being equal. This likeliness could be explained by the effect of the improved seed on productivity level as reported by Besong (2011). This imply that since the farmer have a conviction that being a member of FBO will secure his access to improved seed, he likely to participate in farmer-based organization.

Access to agricultural extension agents: The role of extension agents is to provide agricultural information and advice. They have also the role to train farmers in agricultural practice and introduction of extension programme. They are viewed as key elements of the successfulness of extension programmes by most of the governments (FAO, 1990). Here, the access to extension agents is used as dichotomous variable and it has been found to have a positive significant effect on farmers decisions to join maize FBO at 1% significant level showed in the Table 4.12. The marginal effect depicts that if the access to extension agent increases by one-unit percent the likelihood of farmer to be a member of maize FBO will increase by 38.54%, holding other variables constant. the implication is, more the farmer gets access to extension agent more the advice from extension agent are likely to motivate farmer to join maize FBO.

Access to credit: The access to credit refers to any form of access to credit whether or not it is obtained from formal financial institution helping the farmer to improve the farm scale and productivity. However, the access to credit positively affects farmers' participation in maize FBO at 1 percent significant level. This result is similar to a study conducted by Addai, Owusu, & Danso-abbeam (2014). It can be observed in Table 4.12 that the willingness to join maize FBO will increase by 28.39% if the access to credit increases by 1-unit percent. This may explain the fact that it is difficult as an individual to secure the credit which is possible within the group. Having a credit at beginning of agricultural campaign increases farmers purchasing

power and the affordability of agricultural inputs, therefore being a member of FBO help them to overcome this issue and be ready to begin the agricultural campaign. Hence access to credit will relax the credit constraints of farmers.

Education: used as dummy variable certain level of education such as primary education and senior high school were found to have a positive influence on farmers' participation in maize FBO at 5% significance level each. It is showed in Table 4.12 of marginal effect that farmers who attempted the primary education are about 21.78% more likely to join maize FBO than those who did not get this level of education and those who reached senior high school the likelihood to participate in farmer based-organization is about 25%, all things being equal. This imply that the education is a factor which influence farmers in their decision in agricultural production (Alassaf et all, 2011). However, the more the farmer is educated the more he is likely to be a member of an FBO seeing advantages that can be obtained through FBO membership.

Income: Income from farm and non-farm were found to have a positive effect on farmers participation in maize farmer-based organization at 5%significant level each. It is shown in Table 4.12, that if the farm income and non-farm income of farmer increases by 1% each, the willingness of farmer will increase by 8.69% and 6.10% respectively. Hence, the marginal effect shows that farmers who have high farm income are about 2% more willing to participate in maize farmer-based organization while those who have high non-farm income are about 1.4% more likely to join maize FBO. The implication of this is that, income has always been a big challenge in rural areas in developing countries especially in Mali where about 33% of population are living under poverty threshold ($1.90) and the majority of this population are living in the rural area (FAO 2017; World Bank reports, 2017). Income is therefore viewed as one of the key elements that encourages farmers join to farmer-based organization. The reason is that, any organization whatever is its institution status is a subject to some fees to be a

member and continue to benefit from that organization. Global Water Initiative (2017) reports that maize FBO membership entrance fee is 2000F, social share is 5000F and annual contribution is 2000F which make a total sum of 9000F to be a member. Even though the due of being membership is not much as well, the periodically contribution is likely to worry the low-income farmers and constitute a challenge for them to be a member.

Other variables such as gender or land ownership do not have a significant effect of participation in maize farmer-based organization. This may be due to traditional social organization of Malian society where the household heads are basically the males and the staple crops such as maize, sorghum, millet are usually produced by males. About the land ownership, in Mali majority of farmers are owner of their land inherited from family land. In this survey about 82% of farmers in the study area claimed to be owners of their land.

4.4 Empirical results of Effect of farmer-based organization membership on maize farm productivity

The agricultural productivity is defined by many scholars in different ways. In agriculture as well as in economics sector, it is defined as "output per unit of inputs or output per unit of land area". In this this study the productivity is measured in term of output per unit of land area (hectare). Table 4.13 presents the log-linear regression result of augmented Cobb Douglas production function.

The result indicates a positive relationship between inputs and output variables. This means that all inputs variables have a positive effect on maize farm productivity in the study area. The socio-economic characteristic such as maize FBO membership, access to credit, access to extension agent, access to improved seed and education were also found to positively affect maize farm productivity.

The F-test with 12 degree of freedom reveals that the overall model is significant at 1% significant level meaning that the explanatory variables jointly explain the dependent variable (output per unit of land area).

Table 4. 13: Factors influencing maize farm productivity.

The dependent variable is ln(output/ha)

Variables	Coef.	Std. Err.	t	P>|t|	Marginal Effects
LnLabour	0.0853***	.0.0325	2.62	0.009	.0853
LnFertilizer	0.2306***	0.0541	4.26	0.000	.2306
LnSeed	0.6116***	0.0905	6.76	0.000	0.6121
MFBOM	0.1682***	0.0588	2.86	0.004	0.1716
Accredit	0.1544***	0.0562	2.75	0.006	0.1548
AEA	0.1104*	0.0592	1.87	0.063	.1071
AISeed	0.2295***	0.0556	4.13	0.000	0.2281
AgeYouth	-0.0172	0.0889	-0.19	0.846	-0.0182
Educ_Prim	0.0948*	0.0586	1.62	0.106	0.0949
Educ_JHS	0.1635**	0.0827	1.98	0.049	0.1646
Land_Own	0.0290	0.0638	0.46	0.649	0.0339
_cons	-.4083	0.0908	-4.50	0.000	

Source	SS	df	MS		Number of obs = 405
					F (11, 393) = 18.93
Model	46.514048	11	4.21		Prob > F = 0.0000
Residual	87.3563379	393	.223		R-squared = 0.3463
					Adj R-squared = 0.3280
Total	133.870386	404	.331362341		Root MSE = 0.47189

=significance level (=10%, **=5% and ***=1%)
Source: field survey, February 2018

The R-squared of 0.3475 explains that about 35 percent of variation in the maize farm productivity in study area is explained by the inputs and exogenous variables used in the model.

The result also exhibits a decreasing return to scale that is to say the sum of coefficients of input variables (fertilizer, seed and labour) is less than 1. In this case the sum of coefficients of

input variables is 0.93 which means that a percentage increase in all inputs will result in a 0.93% increase in productivity level. This implies that the maize farmers in the study area are in the stage two of the production function where increases in the level of all inputs used in production results in a lesser proportional increase in the level of productivity (output).

In the Table 4.13, Column one shows the variables used to analyse maize farm productivity including fertilizer, labour and seed as input variables, access to credit, access to improved seed, access to extension agents, youth age, education (primary and secondary), and land ownership as exogenous variables. The second column depicts the coefficient of regressors of model equation indicating the partial slope coefficients and measure the elasticity of productivity with respect to input variables. The next column gives the standard error of each variables. The following column gives the calculated t-statistic values to test null hypothesis that a regressor does not have a significant effect on maize farm productivity. The last column gives the probability associated to the significance level of coefficients.

The result shows a positive relationship between the output and input variables. The significant variables including fertilizer, labour, seed, access to credit, access to improved seed, access to extension agents and education are discussed as follow.

Labour: The variable labour measured in terms of man-days is mainly from family labour. The minimum and maximum labour per hectare are 6 and 315 man-days respectively with a mean 104.7 man-days.

The labour has a coefficient of 0.085 with a calculated t-statistic of 2.62 and standard error of 0.033. It is positively significant at 1% significant level. The positive sign of the coefficient exhibits the positive relationship between labour and maize farm productivity. The implication is that one percent additional labour is likely to increase maize farm productivity by about 0.0805%. In Mali the family labour is very crucial in agricultural production since the majority

of agricultural population are using traditional method (animal traction, hand weeding) to farming.

Table 4. 14: Summary of output and inputs variables

Variables (per hectare)	Members			Non-Members			Pooled		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Output (kg)	300	1524.1	4800	0	1154.8	4200	0	1331.7	4800
Labour	7.5	95.2	272	6	114.2	315	6	104.7	315
Seed (kg)	6.7	17.28	40	7	19.2	40	6.7	18.60	40
Fertilizer(kg)	0	193.25	400	0	133.1	400	0	165.3	400

Source: field survey, February 2018

The minimum zero of the output is explained by the fact that the farmer did not harvest the maize farm because of premature stop of the rainfall and/or the damage caused by animals in the area.

Fertilizer: The fertilizer is referring to chemical fertilizer. It has a mean of 165.3 kg/ha with a maximum and minimum of 400 kg/ha and 0 kg/ha respectively (Table 4.14). The min 0 kg/ha of fertilizer could be explained by the fact that most of the smallholder farmers are credit constraint and they are unable to buy fertilizer to produce maize. It has a positive significant effect on the maize farm productivity in the study area. The coefficient of the variable fertilizer is 0.231 with standard error of 0.054 and calculated t-statistic of 4.26. This coefficient exhibits the mean elasticity of maize farm productivity in responses to use of fertilizer. Hence, the result implies that if the quantity of fertilizer used increases by 1% the productivity of maize farm will increase by 0.23%. This positive relationship between productivity and fertilizer used is consistent with the previous work in this area (Randrianarisoa & Minten, 2005; Alia, 2017)

Seed: The minimum and maximum of quantity of seed per hectare are 6.7 kg and 40 kg respectively with 18.6 kg as mean per hectare. This result does not range between the recommendation of Maize Programme of IER. The Maize Programme of IER recommends the use of between 15 kg to 25 kg of maize seed per hectare depending on the variety. The linear

regression result indicates the positive effect of the variable seed on maize farm productivity. It has a coefficient of 0.612 with the standard error of 0.091 and calculated t-statistic of 6.76. This coefficient implies the inelasticity of productivity in response to the use of one percent increase of the seed quantity and significant at 1% significant level. The farmers are using two types of seed including local or conventional seed and improved seed (providing high productivity according to maize programme of IER). To further examine the productivity of seed, the variable "access to improved seed" was introduced in the regression. This variable has also a positive relationship with the maize farm productivity as expected. It has a coefficient of 0.23, standard error of 0.056 and t-test calculated of 4.13. The access to improved seed has a significant positive effect on maize farm productivity at 1% significant level. This result is similar to the finding of Elias et al., (2013). The implication of this result is that, the more the farmer gets access to improved seed the higher is his/her productivity. It also implies how high the farmer who have access to improved seeds are more productive than those who did not. The significance of the variable seed and the access to improved seed could help draw recommendations for policy action.

Maize farmer-based organization membership (MFBO): A total of 194 farmers out of 405 sample were found to belong to maize farmer-based organization in the study area which represents a proportion of about 48% of interviewed farmers. As expected the maize FBO membership has a positive relationship with the maize farm productivity. The coefficient of maize FBO membership is 0.1682 and it has a standard error of 0.0588. The t-statistic is 2.86 which means that the maize FBO membership is significant at 1%. The coefficient of FBO membership indicates the implies difference in productivity between members and non-members of FBO. It also implies how likely the farm's productivity will increase by being FBO member. This result is consistent with the result of similar works conducted recently by Onogwu (2017) in Nigeria, Mwaura (2014) in Uganda, . Onogwu (2017) found the effect of

FBO membership to be significant at 1% on smallholder farmers' productivity in Nigeria. In contrast, Addai, Owusu, & Danso-Abbeam (2014) reported that FBO membership does not have a significant effect on the technical efficiency of maize farmers in Ghana.

Access to credit: The access to credit refers to when farmer requests for credit or loan and it is given to him/her. As expected the access to credit is positively influencing maize farm productivity. It has a coefficient of 0.1544, standard error 0.0562 and t-statistic 2.75. This result shows that the more the farmer has access to credit the higher is the productivity. This finding is consistent with the similar studies conducted by Guirkinger & Boucher (2008);), but the access to credit may not have a direct relationship with the farm productivity. Thus, the access to credit indirectly affects positively maize farm productivity through agricultural technologies adoption, increased capital for farm investment, hired labour, and improved household welfare through improved health care and better nutrition (Awotide et al., 2015).

Education: The education refers to the level of education attained by the maize farmer. It had the expected positive effect. It is used as qualitative variable (1=yes 0=otherwise). Both primary education and junior high school were found to be significant at 10% and 5% significant level respectively. The primary education and junior high school have a coefficient of 0.095 and 0.1635, standard error 0.059; 0.083 and a calculated t-statistic of 1.62, 1.98 respectively. The implication of this result is that the education help farmer in their decision or in the efficient use of the given technologies and resource allocation which greatly impact the productivity level. Education has been found to positively affect farmers' productivity by many other studies such as (Onogwu, 2017; Mwaura, 2014; Jamison & Lau, 1982).

Access to extension agents (AEA): About 71% of farmers were found to have contact with the extension agents. The regression result shows the access to extension agents have a positive significant effect on maize farm productivity at 10% significant level with a coefficient of 0.11,

standard error 0.059 and calculated t-statistic 1.87. This result implies that the access to extension services helps farmers to achieve high productivity level by making an appropriate decision during the choice of technologies and adoptions of the new strategies. This finding is confirm by others research results on farmers' productivity such as Elias et al., (2013) ; Addai et al., (2014) ; and Jamison and Lau (1982).

Youth age: The youth age did not have a positive effect on maize farm productivity. It had the expected positive sign. It was found to negatively influence maize farm productivity. It means that being a younger farmer will decrease maize farm productivity. This could be explained by either inexperience of younger farmer or by the fact that the main focus of the youth is not agricultural production. This result is in contrast with other findings such as Elias et al., (2013); Unal (2008) and Dong, Lu, & Featherstone, (2010) who found that the productivity is decreasing when the farmer is getting aged.

Land ownership: Even though the land ownership was not significant, it had the positive sign as expected. This implies the positive relationship between land ownership and the maize farm productivity. However, increase the land ownership among farmers will increase maize farm productivity. This result is similar to the findings of Koirala & Hall, (2014) who showed that the land ownership is an important factor determining rice farmers' productivity in Philippines.

4.5 Constraints faced by maize FBOs in agricultural production

The constraints that the farmers face in the agricultural production were classified into two categories (local factors and institutional factors) based on the literature. These factors may constraint farmers to achieve a high productivity level.

4.5.1 Local factors

Local factors were identified as factors that farmers could have control over. From the literature these local factors may influence the productivity of farmers.

Table 4. 15: Ranking of the local factors constraining farmers' productivity

Constraints	Member		Non-Member		Pooled	
	Mean	Ranks	Mean	Ranks	Mean	Ranks
Availability and access to fertilizers	1.85	1st	1.54	1st	1.69	1st
Access to loan to produce maize	3.50	2nd	3.63	2nd	3.56	2nd
Availability and access to improved seed	3.66	3rd	3.88	3rd	3.78	3rd
Access to Equipment	4.67	4th	3.79	4th	4.21	4th
Poor market (lower price of product and high price of inputs)	4.81	5th	4.65	5th	4.73	5th
Lack of formal education	5.07	6th	5.59	6th	5.34	6th
Poor quality of roads	7.12	7th	7.42	7th	7.28	7th
Access to land	7.44	8th	7.41	8th	7.43	8th
Harmful insect, rambling of animals	8.42	9th	8.25	9th	8.33	9th
Distance from market	8.47	10th	8.83	10th	8.66	10th
N		194		211		405
Kendall's W[a]		.555		.624		.587
Chi-Square		969.844		1185.901		2139.389
Df		9		9		9
Asymp. Sig.		.000		.000		.000

Source: field survey, February 2018

Therefore, farmers were asked to rank these factors from the most pressing constraint to the least pressing constraint based on the perception of each farmer. The result from the ranking of these factors is presented in Table 4.15.

The Kendall's coefficient of concordance (W) analysis indicates a 58.7% percent agreement among the farmers of the ranking of the local factors influencing maize farm productivity.

The coefficient of concordance (W) is significant at 1% level.

The most pressing constraint is found to be the availability and the access to fertilizer. From the survey, most of the farmers were claiming the lack of sufficient quantity of fertilizer in the market. Even though the farmer may have the means to buy the fertilizer, the depletion of the market stock will prevent the farmer obtaining a sufficient quantity therefore the productivity is limited. The next pressing constraint is the access to loan or credit. Most of the farmers are credit constraint and, the poverty is really observed among farmers since 38% of the interviewed farmers earn less than 500 000 Franc CFA which is equivalent of around 886 US dollar as income for the household per year. However, the access to credit could relax this financial constraint faced by farmers. The least pressing constraint classified by the farmers is the distance from the market place. The distance from market was not seen as part of major constraints that can influence the productivity among farmers. The reason behind this is that almost each location has nearest market in which farmers could obtain needed inputs and materials.

In sum 10 ranks including availability and access to fertilizers, access to loan/credit, availability, access to improved seed, access to equipment, poor market (lower price of product and high price of inputs), lack of formal education, poor quality of roads, access to land, distance from market and other constraints (harmful insect, rambling of animals) were introduced to be classified based on the perception of the farmer and the ranked is showed in Table 4.15.

4.5.2 Institutional factors

The institutional factors identified through literature are factors that the government or stakeholders can undertake to enhance the productivity among the farmers. Following the same path as local factors, farmers were required to rank the institutional factors based on their perception about the challenges. Table 4.16 presents the result from the ranking of these factors. The Kendall's coefficient of concordance (W) analysis indicates that 58.8% percent agreement among the farmers of the ranking of the institutional factors influencing maize farm productivity. The coefficient of concordance (W) is significant at 1% level.

Table 4. 16: The ranking of institutional factors constraining farmers' productivity

Constraints	Member		Non-Member		Pooled	
	Mean	Ranks	Mean	Ranks	Mean	Ranks
Lack of support from government	1,74	1st	1.74	1st	1.74	1st
Lack of information	2,55	2nd	2.67	2nd	2.61	2nd
Lack of agricultural Training	3,13	3rd	3.10	3rd	3.11	3rd
Poor organization of the market	4,65	4th	4.40	4th	4.52	4th
Bank/Credit institutions	4,71	5th	4.61	5th	4.65	5th
Storage center	6,05	6th	6.56	6th	6.32	6th
Poor institutional relationship	6,39	7th	6.39	7th	6.39	7th
Lack of pilot producer in the village (field demonstration producer)	6,79	8th	6.53	8th	6.65	8th
N		194		211		405
Kendall's W[a]		,586		.594		.588
Chi-Square		796,287		877.859		1667.191
Df		7		7		7
Asymp. Sig.		,000		.000		.000

a. Kendall's Coefficient of Concordance

Source: field survey, February 2018

The most ranked constraint was found to be the lack of support from the government with a mean score of 1.74. The support from government refers to the subsidy of agricultural inputs and agricultural equipment. Most of the farmers are claiming that the subsidized inputs are insufficient and the conditions to access it are in the disadvantage of smallholder farmers. They also claimed that channels through which farmers are supposed to access subsidized inputs and equipment are obstructed. This support from government is crucial for small scale farmers to afford inputs in lower price since the most the rural population are living under poverty threshold (FOA). In this study, about 10% of farmers did not use fertilizer at all. About 95% of those who did not use fertilizer are found to be non-members of maize FBO. FBOs are considered as facilitating ministries to disseminate various supporting system, therefore, agreement can be made through maize FBO, to facilitate the access of small scale farmers to the support from government. The lack of information and the lack of agricultural training are ranked as 2nd and 3rd respectively which are limiting farmers' productivity. The agricultural information helps farmers to make accurate decision about farming activities and how best to manage cultural calendar of crops therefore, enhance the productivity. As the majority of farmers have not been in school, providing agricultural training would help farmers to capture the basic knowledge in production system and enhance their productivity. Yet, not having agricultural training will constrain the highest productivity to be achieved. The least ranked constraint is the lack of pilot peasant (field demonstration producer) in the village. The pilot peasant is not seeing as constraint that could influence farm productivity, this may due the fact that each farmer thinks he/she will increase this/her productivity level if he/she gets access to production inputs and having agricultural training and also if the major constraints are reduced.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary and major findings of the study and draws conclusions based on the major findings. Based on the conclusions that are drawn, policy recommendations are then made.

5.2 Summary and Major Findings

The study seeks to determine the effect of farmer-based organisation on maize farm productivity in OHVN Zone in Mali. To achieve this main objective, the specific objectives were the analysis of the socio-economic characteristics of the farmers in the study area; factors influencing farmers participation in maize farmer-based organisation; effect of maize farmer-based organisation on maize farm productivity and constrains faced by the farmers in agriculture production.

Data was collected using structured questionnaire from 405 farmers in the OHVN Zone in Mali across 15 communities. The sample consists of 194 maize FBO members and 211 non-members of maize FBO. In order to analyse the objectives, descriptive statistics were used to describe the socio-economic characteristics of the maize farmers. The logit model was employed to analyse the factors that influences farmers' decision to join maize FBO. To determine the effect of maize FBO on the maize farm productivity, the augmented Cobb-Douglas production function was adopted. Finally, analysing constrains faced by the maize farmers was achieved using the Kendall's coefficient of concordance.

The results of the descriptive statistics indicate that farmers who belong to maize FBO have relatively higher incomes than their counterpart farmers who are not members of the maize

FBO. From the logistic regression results, the marginal effect of access to fertilizer, access to credit, access to extension service, age of farmer, access to improve seeds, farm income and non-farm income were found to be 0.25, 0.28, 0.38, 0.01, 0.24, 0.02 and 0.014 in that order. This implies that farmers who get access to fertilizer, credit, extension, improved seeds are 25%, 28%, 38% and 24% more likely to join maize FBO. Also as age, farm income and non-farm income of the farmer increases, they are 1%, 2% and 1.4% respectively more likely to join maize FBO.

The estimates of the augmented production function indicate that all inputs variables (labour, fertilizer and seed) were found to have a positive effect on productivity level of maize farm. The coefficient of labour, fertilizer and seed were found to be 0.085, 0.231, and 0.612 respectively. The return to scale value was computed to be 0.928 which is less than 1 depicting the decreasing return to scale in agriculture production. Maize FBO membership was found to have a coefficient of 0.17 at a significant level of 1%, implying that farmers who belong to maize FBO productivity increases by 0.17%. Other factors such as access to credit, access to improve seed, access to extension service, primary education and junior high school were also found to positively influence productivity levels of maize farm.

The Kendall's Coefficient of concordance revealed that among the constraints ranked, the most pressing local constrains faced by the maize farmers in the OHVN Zone in Mali is availability and access to fertilizer and the least pressing constrain is the distance from market. There is a 55.5% agreement among the farmers on constrains ranked and it is significant at 1% significant level. Again, the most and least pressing institutional constraint factors were found to be lack of support from government and lack of pilot producer in the village (field demonstration producer). This analysis of institutional rankings indicates 58.6% agreement among the farmers.

5.3 Conclusions

From the analysis of the farmers decision to join FBO, it is concluded that factors including access to fertilizer, access to credit, access to extension service, age of farmer, access to improve seeds, education and incomes (farm and non-farm); positively influences farmers' decision to join maize FBO. Farmers in their youthful age are less willing to join maize FBO even though this variable was not statistical significant.

Maize FBO membership was found to have a positive relationship with maize farm productivity. That is, maize farmers who belong to maize FBO are more productive than their counterpart maize farmers who are non-members of maize FBO. Maize farmers in the OHVN Zone in Mali are producing at a decreasing return to scale. All input variables were found to contribute positively to productivity of maize farm. Other factors such as access to improved seeds, access to extension service, primary education and junior high school also have positive influence on productivity level of maize farm.

From the constraints analysis, it is concluded that there is a 55.5% agreement among farmers on the ranking of the local factor constraints that are faced by maize farmers in agricultural production and 58.6% agreement among maize farmers on the ranking of institutional factors that can hinder the agricultural production of maize farmers in OHVN Zone in Mali. These agreements were statistically found to be significant at 1%. Among the constraints, the availability and access to fertilizer and lack of support from government were pointed as the most important constraints of local and institutional factors, among others.

5.4 Policy Recommendations

The study recommends that the government through the Ministry of Agriculture, NGOs and other stakeholders should intensify agriculture extension service delivery among maize farmers since farmers who had access to extension service were found to be more likely to join maize

FBO. Credit facilities should be provided to farmers through FBO since farmers who expect to access credit through FBO were more willing to join maize FBO. Input facilities such as fertilizer and improved seeds should be made available through FBO in sufficient quantity because the expected access to these inputs by farmers increases their likelihood to join maize FBO. Also, the youth were less likely to join maize FBO, hence efforts should be directed towards encouraging the youth to participate in maize FBO.

The government through the Ministry of Agriculture, NGOs and other stakeholders should also encourage and facilitate the formation of maize FBO since it has a positive effect on maize farm productivity. More than half of the farmers interviewed were non-members of maize FBO implying that there is the need to encourage formation of more maize FBO since most of the farmers are non-members. Provision and accessibility to improved seeds and extension services by stakeholders are needed to increase productivity levels of maize farms since such factors were found to positively influence maize farm productivity levels.

From the conclusion drawn on the analysis of the local constrains faced by the farmers, it is recommended that stakeholders should make fertilizer more available and accessible. This could be done by making fertilizer available and subsidising its prices for the small scale poor farmer. The level of farmers training should be increased among maize farmers since it was found as the most second pressing need among the maize farmers in the OHVN Zone in Mali. Institutional support from government should be given to maize farmers in the OHVN Zone in Mali this would facilitate the availability of inputs and other agricultural services. This institutional support could enable the small-scale farmer through the farmer-based organisation to get machinery service.

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APPENDICES

Appendix I: Survey Questionnaire

UNIVERSITY OF GHANA, LEGON
DEPARTMENT OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS
Questionnaire on Effects of Farmer Based Organisations on Maize Farm Productivity Assessment in OHVN Zone, Mali

Serial Number…….

Section A. Background information

1. Name of Enumerator: _____
   Date of interview: …… /……. /20__

OHVN sector (write the number): /…… / (1- Ouelessebougou, 2- Dangassa, 3- Kati, 4- Gouani, 5- Kangaba, 6- Koulikoro, 7- Sirakorola, 8- Bangoumana, 9- Faladiè, 10- DRA Kolokani)

Country _____ Region (Write the number): /……/ (1=Kayes, 2=Koulikoro, 3=Sikasso, 4=Segou, 5=Mopti, 6=Tombouctou, 7=Gao, 8=Kidal, 9=Taoudenit, 10=Menaka)

District (cercle) /……./ (1=Kati, 2= Koulikoro, 3=Kanagaba)

Municipality (commune) _____ Village _____

Name of maize farmer (first name, last name): _____

Name of respondent (if different from the head of household): _____

Reason for responding _____

_____

Telephone Number: __(+223)_____

Section B: Socioeconomics characteristics of Maize Farmer (Head of household)

1. Gender of maize farmer: /….. / (male: 1, female: 2)
2. Age _____years
3. Marital Status (write the code): /……/ (1= married, 2=single, 3= divorced, 4=separated, 5=widow/widower)
4. What is your religion: /…..../ (1=Muslim, 2=Christian, 3=Traditionalist, 4= other, 5=None).
5. What is your ethnic group: /…… / (1=Bambara, 2=Foulani, 3= Soninké, 4= Malinkés, 5=Other (Specify) _____
6. What is your level of education? /……/ (1=None, 2= Primary school, 3=Junior secondary school, 4= secondary school, 5=tertiary) Other(Specify) _____
7. What is the number of years spent to attain that level of education? …… years
8. What is your primary occupation? /……/ (0=none, 1=Crop cultivation, 2=livestock, 3=trading, 4=artisan, 5=other (specify) _____
9. What is your secondary occupation? (1=crop cultivation, 2=livestock, 2=trading, 3=artisan, other (specify) _____
10. How long have you lived in this village/community? …….. years

Section C. Characteristics of the Household

11. What is your household size? …… persons
12. What is the composition of your household?

Person	Male ≥15	Female ≥15	Male <15	Female <15
Number				

13. How long have you been a farmer? …….. years
14. What is your total size of land holding? ……. hectares
15. What is the type of tenancy (write de code, more than one is allowed but should be specified) /……..... / _____
    1. Inheritance
    2. Family land (not permanent)
    3. Borrowed (specify: for a consideration or absence of consideration)
    4. Sharecropping
    5. Outright purchase
    6. Renting (cash payment)
16. Is your household growing any of the following crops?

Corps	Maize	Sorghum	Millet	Cotton	Groundnut	Cowpea	Rice	Others (specify
Tick it								

17. What is the area allocated to each of these crops during last season?

Crops	Maize	Sorghum	Millet	Cotton	Others
Area (Ha)					
Output					

18. How long have you been cultivating the maize (from your last break)? ……. Years

19. What is the harvested area of maize during the past three years?

Year	2017	2016	2015
Harvested area			
Output			

20. Does your household hold any of the following livestock? /……/ 1=Yes 0=otherwise

If yes, write the number, otherwise write zero

Livestock	Number
Cattle	
Sheep	
Goat	
Donkey	
Chicken	
Other (specify):	
Other (specify):	

Section D: Factors influencing farming activity

Sources of Income

Farming income

21. What is your household's source of income?

Crops	Unit sold (kg)	Price per unit (CFA)	Total amount
Maize			
Sorghum			
Cotton			
Millet			
Rice			
Cowpea			
Others (specify)			
Other (specify)			

Livestock	Number sold	Price per unit (CFA)	Total amount
Cattle			
Sheep			
Goat			
Donkey			
Chicken			
Other (specify):			
Other (specify):			

Non-farm income

22. What is your other sources of income different from farming? How much approximately did you receive from them this year?

Sources	**Amount**
Small trading	
Household members outside (migration)	
Others (specify)	

Labour forces

23. How many labour forces did your household employ for maize production in 2017? (write the total here) /……. / persons (including family and external)
24. How many days did you work on the maize farm during this year (2017) (all activities including)?

Labour force	Male ≥ 15	Female ≥15	Male <15	Female <15	External labour
Number					
Number of days					

25. Approximately how many hours did you work during the typically working day?

Labour force	Male > 15	Female >15	Male <15	Female <15	External labour
Number					
Hours per days					

26. How did you remunerate an external labour per day? …….. CFA
27. What are the equipment used by your household in production?

Equipment	Number	State (1= very good, 2=good, 3=poor, 4=very poor, 5=inoperable)
Tractor		
Cultivator		
Oxen plough		
Sower (sowing machine)		
Other (specify)		
Other (specify)		

Section E: Farmer based organisation membership

28. Are there maize's farmer-based organizations in this village? /…….. / 1=yes 0=No
29. If yes, how many (write numbers) …….. Maize FBOs
30. If no, Why? (state the reasons)

    ……..……
    ……...……
    ……..…
    ……...……
    …
31. Does your household belong to any maize farmer-based organisations? /…….. / 1=yes 0=No
32. If yes, what is/are its/their name(s)?

    1_____
    2_____
    3_____
33. Is this maize Farmer Based Organisation active at the current time? /…….. / 1=yes 0=otherwise
34. How long have you been a member of the maize Farmer Based Organisation? (Write number of years) _____years
35. Does your household or any member of your household belong to any other farmer-based organisation? /…….. / 1=yes 0=otherwise

If yes list them

1……....
2……....
3…….....
4…….....
5…….....
6…….....

36. Do you receive any of the following services from/ through the Maize Farmer-Based Organisation to produce maize this season (tick one per service)?

Service	Yes	No
Technical assistance/Training		
Access to inputs		
Machinery services/new technologies		
Equipment		
Credit in kind		
Credit in cash		
Collection services		
Working group		
Selection and/or packaging of products		
Processing		

Storage		
Marketing services		
Transportation of inputs and/or products		
Agricultural information		
Commercialisation		
Access to agricultural extension agent		
Others (specify)		

37. What other benefits do you derive from being a member of the Maize Farmer Based Organisation?

1. _____
2. _____
3. _____
4. _____
5. _____

38. What reason motivated you to join the maize farmer-based organisation?

Reasons	Rank
Access to loans and credit(cash/inputs)	
Technical assistance/training (e.g. Extension service)	
Access to fertilizers	
Access to improved seed	
Access to agricultural information	
Advice from friends/ other farmers	
Better prices of products	
Easy commercialisation of products	
Access to new technologies (e.g. new agricultural practice)	
Access to equipment (e.g. tractor)	
Other (specify)	
Other (specify)	
Other (specify)	

39. If you are not a member of any maize farmer-based organization what are the reasons?

Reasons	Rank
They are not efficient (how?)	
Not interested (why?)	
Due is too expensive	
Discrimination within group	
Financial issues	
Other (specify)	
Other (specify)	

40. Have you ever requested for a loan to produce maize before? /……/ 1=yes 0=otherwise

If yes, were you given the loan/…….. / 1=yes 0=otherwise

41. Have you been able to secure a loan through maize farmer-based organization? /…….. / 1=yes 0=otherwise
42. Would you be able to get access to a loan to produce maize at any time through maize farmer-based organization if you need it? /…….. / 1=yes 0=otherwise

If yes, where? (tick it)

1	Banks and other financial institutions	[ ]
2	Local Savings and Credit unions	[ ]
3	Maize Farmer based organisation	[ ]
4	Other Farmer based organisation	[ ]
5	Friends and Family members	[ ]
6	Other (specify)	[ ]

43. Do you have access to agricultural extension service? /…….. / 1=yes 0=otherwise
44. If yes, what was the frequency during this season (number of contacts with extension agent per year)? ……. Contacts
45. If you are not a member of any maize farmer-based organisations, would you be willing to join one in the future? /…….. / 1=yes 0=otherwise
46. Why? (state reasons) _____

_____

Section F: Inputs used

47. Did you get access to improved maize seeds during this season? /…….. / 1=yes 0=No
48. If yes, what quantity did you access? /…….. / kg
49. what quantity of seed did you utilize?

		Quantity (kg)
1	Improved seed	[ ]
2	Normal seed	[ ]

50. Did you get this seed from/through the farmer-based organisations (write the code 1=Yes 0=No)?

		Yes	No
1	Improved seed	[ ]	[ ]
2	Normal seed	[ ]	[ ]

51. Did you get access to fertilizer to produce maize during this season? /…….. / 1=yes
52. If yes, what quantity did access utilize?

53. What quantity did you utilize?

	Fertilizer	Quantity (kg)	From FBOs 1=Yes 0=No
1	NPK	[ ]	[ ]
2	DAP	[ ]	[ ]
3	Urea	[ ]	[ ]
4	Organic manure	[ ]	[ ]
5	Other (specify)	[ ]	[ ]

Section G: Constraints

54. What are the constraints that you are facing in agricultural production?

	Constraints	Rank
	Local factors	
1	Availability of fertilizer in sufficient quantity	
2	Availability of improved seed in sufficient quantity from research centre	
3	Access to loan (e.g. credit cash or in kind)	
4	Access to land	
5	Poor transportation (e.g. difficult access to market place because of poor quality of road)	
6	Poor markets (e.g. lower price of maize, the high price of inputs…)	
7	Distance from market place	
8	Lack of formal education among the farmers	
9	Equipment's' shop	
10	Other (specify)	
11	Other (specify)	

	Institutional factors	
1	Lack of information (e.g. poor contact with extension agents)	
2	Lack of supports from government (e.g. poor financial support, not enough subsided inputs)	
3	Lack of agricultural training	
4	Poor Institutional relationship (e.g. registration of FBOs, other services)	
5	Poor organisation of markets	
6	Bank/Credit institutions	
7	Storage centre	
8	Lack of pilot producer in the village for field demonstration	
9	Other (specify)	
10	Other (specify)	

Rank it from most influent factor to weakest factor

55. According to you what can your FBO do to improve your production?

_____
_____
_____
_____
_____
_____

56. According to you what can government do to improve your production?

_____
_____
_____
_____
_____

General comment

57. Do you have any other comment related to your FBO or your farming activity?

_____
_____
_____
_____
_____
_____
_____
_____
_____

Appendix II: Result of Translog functional form regression

The dependent variable is ln(output/ha)

Variables	Coef.	Std. Err.	t	P>|t|	Marginal Effects
LnLabour	0.1610	0.0385	4.18	0.000	0.1610
LnFert	0.2172	0.0614	3.54	0.000	0.2172
LnSeed	0.6233	0.0910	6.85	0.000	0.6233
SqrtLabour	0.1177	0.0328	3.58	0.000	0.1176
SqrtLnFert	0.0089	0.0667	0.13	0.893	0.0089
SqrtLnSeed	-0.2485	0.1020	-2.44	0.015	-0.2486
LabourFert	-0.3126	0.1436	-2.18	0.030	-0.3126
LabourSeed	0.1209	0.2261	0.53	0.593	0.1209
FertSeed	0.8825	0.3857	2.29	0.023	0.8825
MFBOM	0.1989	0.0585	3.4	0.001	0.1989
Accredit	0.1476	0.0550	2.69	0.008	0.1476
AEA	0.1031	0.0581	1.77	0.077	0.1031
AISeed	0.2414	0.0541	4.46	0.000	0.2414
AgeYouth	-0.0397	0.0870	-0.46	0.648	-0.0397
Educ_Prim	0.0588	0.0575	1.02	0.307	0.0588
Educ_JPrim	0.1524	0.0812	1.88	0.061	0.1523
LO_Own	0.0283	0.0627	0.45	0.652	0.0283
_cons	-0.4898	0.0691	-7.09	0.000	
Number of observations					405
F (17, 387)					14.73
Prob > F					0.0000
R-squared					0.3928
Adj R-squared =					0.3661