EFFECTS OF CREDIT SUBSIDY ON SMALLHOLDERS MAIZE PRODUCTIVITY AND FARM INCOME IN CHÓKWÈ DISTRICT, MOZAMBIQUE

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DECLARATION AND RECOMMENDATIONS

DECLARATION

This thesis is my original work and has not been presented before for examination in any other university.

Signature ..... Date .....

SERGIO JORDAO AUGUSTO PONGUANE

KM15/13524/14

RECOMENDATION

This thesis has been submitted for examination with our approval as supervisors:

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DEDICATION

I dedicate this work to my wife Nézia Rúben Ponguane, my daughter Yasmine Sérgio Ponguane and my parents Mr. Jordão Agusto and Mrs. Hilária João for their support and prayers.

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ABSTRACT

Credit constraints hinder development of agriculture in developing countries, yet access is mainly associated with increased farm productivity and crop incomes. For over a decade, Mozambican smallholders have accessed a decoupled credit subsidy under the seven million program for agricultural development. However, little is known about the influence of the program on crop productivity and farm incomes in rural areas. This study therefore, examined whether there are productivity and income benefits for program beneficiaries in Chókwè district using maize crop as an example. To accomplish these objectives, a random sample of 159 farmers was interviewed using a structured questionnaire but only 107 farmers with complete data on credit subsidy and other socio-economic characteristics, farm outputs and incomes were used in the analysis. The econometric results were obtained using Endogenous Switching Regression (ESR) technique and its robustness compared with results from the Propensity Score matching model. The Endogenous Switching Regression results indicated that credit had significant and positive effect on maize productivity. Further, the age of the farmer, number of contacts with extension services providers, distance to input markets and source of income influenced decision to participate in the subsidy market. The same results were found using Propensity Score matching approach. An Analysis of Variance showed higher incomes for those participating in the program. These results suggest that a decoupled credit subsidy could influence both crop productivity and farmers' incomes when infrastructural and off-farm income differences are corrected. Consequently, the study recommends increased coverage of the subsidy program, extension advocacy and opening up of rural areas through quality roads to ensure agricultural productivity and increased farm incomes.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASCAs: Accumulating Savings and Credit Associations

BoM: Bank of Mozambique

CAP: Common Agricultural Policy

EU: European Union

FAO: Food and Agriculture Organization

FDA: Fundo do Desenvolvimento Agrario (Agricultural Development Fund)

FDD: Fundo do Desenvolvimento do Distrito (District Development Fund)

FFP: Fundo de Fomento Pesqueiro (Fishing Promotion Fund)

FFPI: Fundo de Fomento de Pequenas Industrias (Small Industry Promotion Fund)

INE: Instituto Nacional de Estatisticas (National Statistics Institute)

MAE: Ministério de Administração Interna (Ministry of Internal Administration)

MPD: Ministerio de Planificação e Desenvolvimento (Ministry of Planing and Development)

NGO: Non Government Organization

OIIL: Orçamento para o Investimento de Iniciativas Locais (Local Initiative Investment Budget)

PARP: Plano de Acção para a Redução da Pobreza (Poverty Reduction Action Plan)

PEDSA: Plano Estratégico para o Desenvolvimento Agrário (Strategic Plan for Agricultural Development)

RFA: Rural Finance Associations

ROSCAs: Rotating Savings and Credit Associations

USA: United States of America

WTO: World Trade Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Rising farm productivity and farm incomes are variously considered as important in the fight against prevalent hunger and malnutrition in rural areas of most developing countries. For instance, the Sustainable Development Goals (previously Millennium Development goals) recognize access to sustainable production and marketing systems as the basis for ensuring reduction in environmental degradation and consequently high production and low poverty levels.

Agriculture contributes significant portion of most African countries gross domestic product, informal employment, food and farm incomes for more than a half of rural population (Dorward *et al.,* 2010). Therefore, it is believed that by increasing the production potential per land unit and with access to ready markets, rural populations could experience less hunger and high incomes (Chirwa & Dorward, 2013). However, this requires increased investments in research and development, and use of new farmer friendly technologies in agriculture which in turn increase productivity and ensure food security and better returns. Nevertheless, smallholder farmers face low producer prices and hence incomes, and find it constraining to purchase costly farm inputs and adopt new technologies. This is mainly due to the bureaucracy in procuring formal credit that demands collateral, high interest rates and the risk-averse behavior by agricultural farmers to demand credit considering the risk associated with failure to repay.

Countries that depend on agriculture or that protect infant agricultural sectors use some form of subsidy to cushion farmers against high prices and to increase farm outputs, however subsidies may negatively affect productivity when they distort production structure which lead to allocative inefficiency through investment in subsidy-seeking activities that are relatively less productive (Alston & James, 2002).

In the context of World Trade Organization (WTO) agenda agricultural subsidy has a negative effect on agricultural markets. In order to avoid the negative effect of coupled subsidies, governments of many countries have shifted from coupled to decoupled subsidies that are independent from farm production and input use decision (Rizov, Pokrivcak,& Ciaian, 2013).

1.1.1 Overview of Agricultural Sector in Mozambique

In Mozambique there are almost 36 million hectares of arable land with only 4 million or about 11% in productive use (CEPAGRI, 2009). The wide diversity of soil and climate conditions is suitable for large variety of crops. 90% of cultivated land is occupied by smallholder farmers with an average of less than 2 hectares per household. It is estimated that about 3.3 million hectares of land can be irrigated but currently only 3% is under irrigation (MINAG, 2012). The most important scheme is in Chókwè district with about 30.000 ha of equipped area. 95% of cultivated land is for staple crops and is dominated by smallholder farmers, while 5% is for cash crops (Kalaba, Kapuya, & Mapila, 2011).

Maize, Cassava and beans occupy around 60% of cultivated land by smallholder farmers. The major cash crops include sugarcane, cotton, tobacco and cashew nut (FAOSTAT, 2014). In spite of the fact that soils and climate conditions offer wide range of opportunities, agricultural sector in Mozambique is characterized by low yields mainly due to limited use of purchased inputs such as improved seeds, fertilizers and pesticides. Agricultural systems are predominantly rain fed and less than 5% use fertilizer (Kalaba *et al*., 2011).

Most staple crops produced by smallholder farmers are for home consumption while coconut and cashew nut are important source of foreign exchange earnings (Kalaba *et al.*, 2011, Mucavele, 2009). Though most crop yields in Mozambique are low, agriculture is an integral part of Mozambican economy; it contributes a quarter of the gross domestic product (GDP) and provides livelihoods to more than 80% of the population (IFAD, 2010).

Mucavele (2009) states that the long run goals of the agricultural sector in Mozambique consist of improving food security and reduce poverty by supporting smallholder farmers to increase sustainable agricultural productivity.

According to Sitoe (2005) there are seven key elements hindering the progress of agricultural sector in the country, mostly dominated by smallholder farmers; these include: Low use of improved technologies (improved seed, fertilizers and pesticides), inequalities in access and use of land, poor infrastructures for irrigation, poor access to input markets, low access to financial services by producers, low quantities produced by smallholder farmers and scattered producers.

1.1.2 Agricultural Policies in Mozambique

Since 1999 the government of Mozambique in partnership with national and international organizations has been developing a set of strategies to boost agricultural production and productivity, such strategies focus on executing the poverty reduction plan (Kalaba *et al*., 2011).

The National Program for Agricultural Development (ProAgri I) was scheduled to run for five years from 1998 to 2003 but it was extended to the end of 2005 for the first stage, the second phase (ProAgri II) from 2007 to 2010. This program is a key element of absolute poverty reduction plan strategy (MINAG, 2012). The aim of ProAgri is to provide financial and technical assistance for agricultural development. Numerous donors pooled funds to support financial activities and, in order to ensure technical, extension services and overcome agricultural research problems; the Institute of Agricultural Research was created in 2005.

In 2000 the government launched the Action Plan for the Reduction of Absolute Poverty (PARPA); this plan is a strategic framework involving many sectors of the economy. In agricultural sector its aim consists of (i) improving access to technology, information and extension, (ii) promote construction and rehabilitation of agricultural infrastructures, (iii) improve access to agricultural market information, (iv) increase availability and access to agricultural inputs (MINAG, 2009). This plan forced the government to assess how programs and strategies affect marginalized groups (Mucavele, 2009).

In 2007 the Rural Development Strategy was approved and its main objective was to promote good governance, promoting initiatives for rural and sustainable development. In the same year a long run strategy Green Revolution and Action Plan was approved to increase agricultural production and productivity through use of improved technology (PARPA, 2009). It is a multidimensional strategy to fight against hunger and poverty. In order to accelerate the implementation of this strategy, the Action Plan for Food Production was approved in 2008 as a government response to the global increase of grain's prices and shortage of food stuffs. It was a 3 year plan 2008-2011 targeting especially to reduce the deficit in food production through investment in production, storage, processing and marketing (MINAG, 2008).

In order to align the country' strategies with the Comprehensive African Agriculture Development Program (CAADP) in 2009 the government approved the Strategic Plan for

development of the Agricultural Sector (PEDSA: 2011-2020). The main objective of the PEDSA is to contribute to ensure food security, farm income in sustainable and competitive manner, observing social and gender equity (PEDSA, 2008). The plan defines four pillars to materialize its objective: first, is productivity consisting of increasing agricultural productivity, competitiveness to ensure food security secondly is market access to ensure improvement in rural infrastructures to enable better access to input and output markets then natural resources for sustainable use and management of natural resource (land, water and forest) and finally institutions that will ensure capacity building in rural and agricultural institutions**.**

It has been more than a decade since the implementation of the first program and smallholder farmers in Mozambique still face constraints in accessing and affording credit. However, since 2006 the government has been loaning smallholder farmers' farm credit through the district development fund (FDD) under the administration of local boards. This facility allocates annually, 7 million meticais (or about $220,000) to each district. The aim of the loan is to spur production and farm incomes through farming and engaging rural populations in gainful farm labour. As a subsidy, FDD loan could generate differential benefits to smallholder farmers on the said aims. Therefore, this study seeks to find whether small-scale farmers are benefiting from farm level credit subsidy, and to what extent by assessing how government intervention in incomplete input markets through provision of informal subsidized credit affects smallholder farmers in terms of productivity and farm incomes.

1.2 The Statement of the Problem

Credit is a major agricultural development constraint in most developing countries due its cost, incomplete credit markets and fear of bankruptcy among farmers. The decoupled credit subsidy among Mozambican farmers is administered by local authorities which might create bi-partisanship. Further, higher monitoring costs could make it difficult for the authorities to control whether the credit subsidy is used for the intended purposes. This creates heterogeneity in access and use at the farm level and could consequently generate varied influences on farm productivity and incomes. A dearth of empirical studies on the relationship between the decoupled credit subsidy, productivity and farm incomes exists. Therefore, the aim of this study was to analyse the subsidy's influence on agricultural productivity and farm incomes using maize as an example.

1.3 Objectives of the Study

1.3.1 General Objective

The overall objective of the study was to investigate how farm level credit subsidy affects smallholder farmers in the improvement of household livelihoods.

1.3.2 Specific Objectives

The specific Objectives of this study were:

i. To evaluate the influence of credit subsidy under the Seven million program on maize productivity among beneficiaries in Chókwè district.

ii. To compare farm incomes between users and non-users of credit subsidy under the Seven million program in Chókwè district.

1.4 Research Questions

i. Does the credit subsidy under the Seven million program have an influence on maize productivity in Chókwè?

ii. Does income level differ between users and those not using credit subsidies under the Seven million program?

1.5 Justification of the study

At the turn of the century many leaders around the world decided to come together looking for solutions that would maintain human dignity and free the world from extreme poverty. The Millennium Development Goals (currently Sustainable Development Goals) with eight goals established a pattern for tackling the most pressing challenges and reduce extreme poverty around the globe (MDG, 2014). In 2000 the government of Mozambique launched the Poverty Reduction Action Plan (PARPA); this plan is a strategic framework involving many sectors of the economy. One of its aims in agricultural sector consists of increasing availability and access to agricultural inputs (MINAG, 2009). However, limited access to production credit continues to be the major limiting factor of small-scale farmers' productivity and income growth in

Mozambique since, they cannot afford yield-enhancing inputs such as seeds and fertilizers. Smallholder farmers form a large percentage of the farming population in Chókwè and more than 75% cannot access formal financial services (INE, 2012). Apart from production credit, smallholder farmers face budget constraint at the post-harvest period to pay storage facilities and they sell their produce at low prices missing opportunities to get higher returns (Meijerink & Onumah, 2011). Government intervention through provision of credit subsidy under the seven million program seems to be a good alternative for addressing such bottleneck in the production side.

The providers of the funds (Government and donors) however need to know whether the program had impacted positively on beneficiaries, consumers and other stakeholders, hence impact assessment forms a basis for asking more funds. Given the cost nature of the programme it is indispensable to assess its effect and effectiveness.

This study therefore provides useful information on how agricultural subsidies, particularly under the Seven million program affects maize productivity and farm income in Chókwè. This knowledge will support policymakers in re-assessing the implementation of the program and formulating policies that promote sustainable production and strengthen market participation among the poor and marginalized smallholder farmers. It also provides helpful information for academicians in related-research areas that are not covered by this study.

1.6 Scope and limitations of the study

This study was conducted with the knowledge that not all smallholder farmers have access to the loans under the Seven million program. Therefore, only smallholder farmers eligible for loaning under the Seven million program in chókwè district were considered. Further, a large dataset could not be obtained due to poor record keeping among farmers, time and financial constraints. As a result, out of 159 farmers interviewed during the survey, only data from 107 farmers were utilized for analysis. However, the results may be generalized to other regions benefiting from the decoupled credit subsidy.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section provides a critique of the existing literature on agricultural subsidies. It begins with an overview of agricultural Finance in Mozambique; describes the Seven million program and its implementation. It then provides an overview of agricultural subsidies taking an example of three countries well succeeded in agricultural finance namely the USA, France and Brazil and finally presents some empirical studies on agricultural subsidies.

2.2 Agricultural Finance in Mozambique

2.2.1 Supply of agricultural finance

In Mozambique the financial sector is regulated by the Central Bank of Mozambique (BoM), it includes commercial banks, micro banks, credit cooperatives, microcredit operators and rural financial associations (Hunguana *et. al*, 2012).

Apart from these actors, the Mozambican agricultural and rural financial sector includes informal agents and government funds (7 million) as well. There are at the moment 18 commercial banks with 462 branches in Mozambique (BoM, 2012).

Though all commercial banks finance agricultural production through standards loans sometimes with specific products aimed at the sector (such as lines of credit), only four are dedicated to microfinance, most of the time cited as suitable for small entrepreneurs. According to the BoM (2012), 111 branches out of 462 are located outside the provincial capital cities operating throughout 58 districts out of 128. In addition to the commercial banks up to 2012 there were seven credit cooperatives distributed in five provinces. Three out of seven credit cooperatives offer savings in addition to credit. Data available from the Central Bank show that in 2012 there were 155 microfinance operators (including NGO, associations and individuals who have obtained licences to operate in microcredit services). The microfinance operators provide product mix including agricultural loans. Among the financial institutions noted above only micro banks do not provide loans for agricultural production. In addition to formal finance in Mozambique there are many organisations promoting Accumulating Savings and Credit

Associations (ASCAs), Rural Finance Associations (RFA), Xitique[1], 14 government funds (INE, 2012). The sector-specific funds focus on financing a variety of areas including agriculture.

2.2.2 Demand for Agricultural Finance

According to Hunguana *et al*., (2012), credit products for the agricultural value chain can be grouped into three categories: production, commercial activities and transformation. Production credit includes credit for seeds, fertilizers, pesticides equipment and labour. More than 90% of around 4 million farming population in Mozambique is smallholder and represent more than 92% of cultivated area. Very few small farms use irrigation, fertilizers or pesticides (INE, 2010).

The irregularity of rain patterns in many areas of Mozambique presents challenges for farmers practicing rain fed agriculture and increases the risk of investing (including through lending) in crop production.

Hunguana (2012) reveals that in rural areas each branch offering financial services is for almost 85000 adult people, almost 4 times the ratio in urban areas. This shows clearly first of all the disparities between financial providers and rural producers with needs for financial services. The low level of financial literacy is another limiting issue cited by FinScope (2009). The study reveals that less than 10% of the rural population knew the meaning of terms such as interest rate, saving account, bank charges or fees, debit cards etc. Around 21% had heard about bank but did not know what meant. The demand for formal financial services in rural areas is near 0% most because only usufruct property rights exist in Mozambique, as opposed to ownership. This limits people's access to credit due to the inability to use their land as collateral.

2.3 The "Seven million[2]" program in Mozambique

In 2006 the government of Mozambique introduced the local initiative investment Budget (OIIL) later on called district development fund (FDD), also known as "7 million". The main

[1] *Xitique is an informal savings system practiced in Mozambique, also known as merry-go-round or rotating savings and credit associations (ROSCAS).*

[2] *Is called 7 million because In its first year the program allocated 7 million meticais (or about $200,000) to each of the 128 districts annually regardless to its demographic, geographical or even economic situation.*

purpose of the budget was to enhance food production, job creation and income generation for small entrepreneurs (Guebuza, 2009).

In Mozambique around 60% of the population live in rural areas with about 56% of that population living in poverty (INE, 2007). The majority of rural population like in other developing countries practice agriculture for their livelihood. Since agriculture is the economic motor of the vast majority in rural areas in the country the government developed a set of strategies to generate new jobs and increase income of smallholder farmers through improved input supply chains, production technology and practices, value-added processing, and market linkages. The OIIL was developed to in conjunction with other funds and strategies such as green revolution, Agricultural development fund (FDA), Strategic Plan for Agricultural Development 2010-2019 (PEDSA), Poverty Reduction Action Plan (PARP), Fishing Promotion Fund (FFP), Small Industry Promotion Fund (FFPI) enable small-scale entrepreneurs access credit at affordable rates (below market rate), most of the time not accessible due to the constraints discussed earlier in this document.

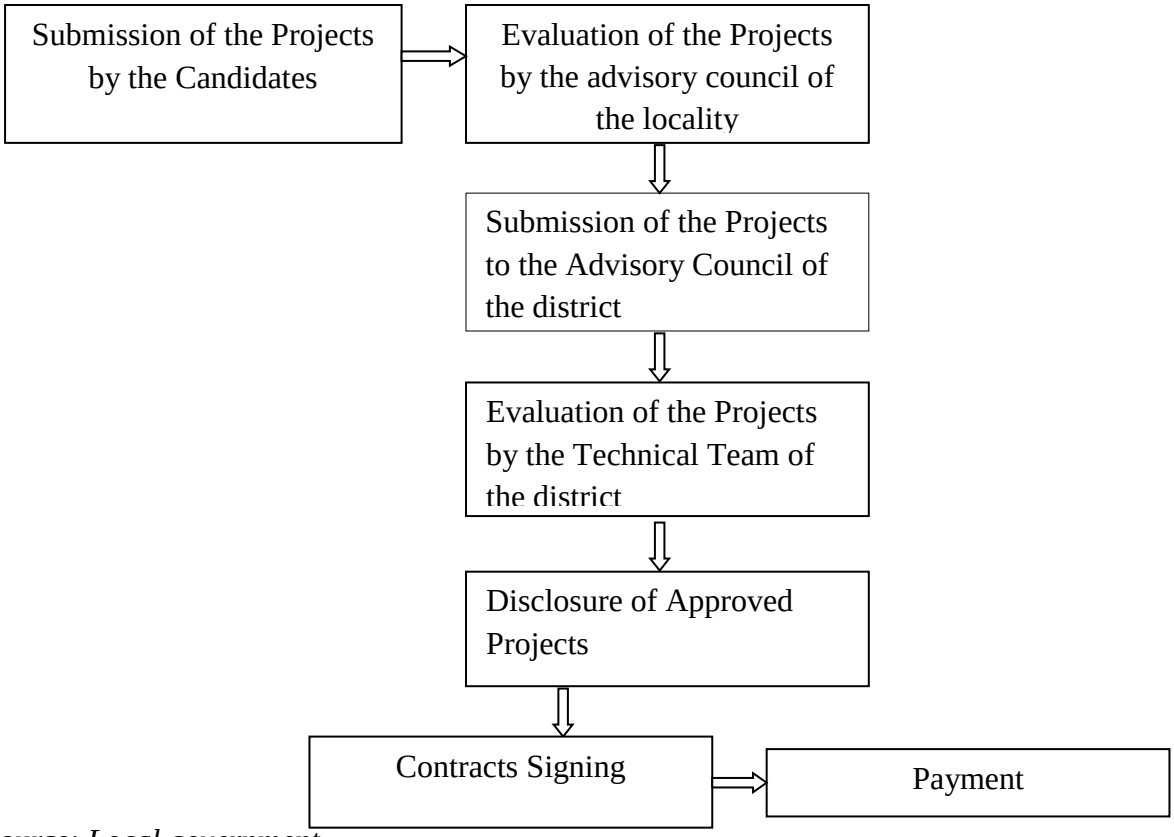
During the first year of implementation there was lack of understanding by the local authorities and borrowers. On the borrowers' side, they didn't understand that the funds were loans (at low interest rates) rather than grants and this led to diversion of funds and very low repayment rate on the other hand the local authorities used the funds for local socio-economic infrastructures (Sande, 2011)

Due to this misalignment, in 2007 the government of Mozambique introduced some changes by establishing criteria in allocating the funds for each district based on: Population density of each district (35%), poverty index (30%), geographical extent (20%) and finally the fiscal revenue of the district (15%).

From 2009 the fund is no longer called local initiative investment budget (OIIL) but District Development Fund (FDD) tutored by the provincial governor. The distribution to elective projects is left to district advisory boards. Thus the FDD is financed by repayments, government subsidies, and donatives with the aim of making credit available to excluded segments (MPD, 2009).They can apply for this fund all smallholder entrepreneurs who fulfil the following

requirements: Resident of Chókwè, proof of residence, project with impact on local development, tax proof and be considered suitable and able to implement the project.

2.4 Evaluation Stages of the Projects under the seven million program in Chokwè district



Source: *Local government*

According to the government of Chókwè, the process of evaluation starts at the locality level whereby the principal with his team evaluate each candidate based on the relevance of the project with regard to the development of the locality. The aim of this evaluation is to give the opinion on the relevance of the project and confirm the integrity and identity of the candidate. After this stage, the projects are submitted at Advisory board of the district whereby a technical team evaluates the viability of the projects and the amortization plans. This is the last stage of evaluation process. After the approval of the proposals, selected candidates are communicated to proceed the signing of the contracts. Before the signing of the contract and disbursement of the fund, the candidate must have a bank account; this makes the process takes long because most of the candidates do not have bank accounts. It is important to note that no official application form

has been published; each district is responsible of developing guidelines for application. In Chókwè the requirements are those mentioned above. More than sixty million meticais have been disbursed to Chókwè district under the Seven million program since 2009; more than 50% of financed projects are for agricultural activities.

2.5 **FDD and Gender**

At the turn of the century, the Millennium Development Goals, (currently Sustainable Development Goals) established a draft to free the world from extreme poverty through involvement of women in agriculture especially because they are constrained by market failures, including financial market (credit access).

In 2009 a decree (decreto 90/2009) was approved and states in its first clause that the FDD is a public institution with legal personality and administrative autonomy and it does not make any mention regarding to gender, this implies that both women and men have the same right with regard to the access to credit under the seven million program. The same document does not explicitly exclude people who have another source of income to apply.

Cumbe *et al.* (2010) concluded that no especially attention is given to women even if the government is aware of the socio-cultural challenges faced by women. The disequilibrium between men and women is mainly due to socio-cultural issues. Women are less involved in decision making process level such as advisory councils.

Tvedten *et al.* (2010) believe that projects led by women are more serious than those led by men in terms of implementation and repayment of loan. In 2009 40% of approved projects were proposed by women. They argue that due to socio-cultural factors women have more challenges applying individually, it is easier when they participate in a form of group however, the priority given to individuals rather than association affects the number of women benefiting from the loan under the FDD in recent years.

Casimiro and Souto (2010) concluded that women who benefited from the loan under the FDD were affiliated to the leading party. The number of projects proposed by women does not reflect the reality. If a man has benefited from the loan in the past years and because he cannot apply two times for the same fund as a strategy will apply on behalf of his wife (Capaina, 2015).

In this study females who used credit under the district development fund represent only 26% while non-users represent 46%; this discrepancy shows that despite the fact that women are considered good managers; the number of users is still low compared to men. Yet the government is aware of the disequilibrium between men and women and acknowledges that the Comprehensive African Agriculture Development Programme is keen to see women more involved through access to credit not much has been done to date to change their situation.

2.6 An overview of agricultural subsidy

Agricultural productivity is most of the time cited as one of the powerful means to reduce poverty and malnutrition especially in developing countries. The Food and Agriculture Organisation (FAO) reveals that in 2013 about 13% of the global population were undernourished. In order to increase productivity, an improvement in accessibility of inputs and technology is needed even in developed countries.

Zuberi (as cited in Jan and Saleem, 2011) argues that innovative agriculture is possible when farmers can access credit for purchasing modern inputs. High administration costs, lack of suitable collateral make credit inaccessible to smallholder farmers. Less expensive and easy credit is considered as the fastest way for promoting agricultural production (Abedullah, 2009). Developing countries ameliorated their agricultural production by bringing in innovative technology (Jan & Saleem, 2011); this was achieved through government intervention since the 1950's in providing subsidized or targeted credit. Governments used credit programs to boost agricultural production (Adams & Vogel, 1990).

The argument behind government intervention is that financial institutions favored the rich and powerful leaving poor farmers in disadvantage (Buttari, 1995), but in some cases this strategy did not work, most because subsidized credit often missed its target. As one of the measures to liberalise the financial market in the 1980's many governments were forced to abandon the strategies of providing subsidized credit (Meijerink & Onumah, 2011). Policy analysts believe that subsidies had been ineffective and inefficient across African countries because they have contributed to over-spending and fiscal problems (Dorward *et al*., 2008). This liberalization therefore could not generate the expected results because formal institutions found costly and more risky to make loans to scattered smallholder farmers and decided to extend credit to less risky borrowers (Buttari, 1995).

According to Kibaara and Nyoro (2007), in Kenya for example, in the late 1990's most commercial banks were forced to close their rural branches to cut cost and increase profits. In recent years there has been a revitalization of government intervention in agricultural subsidy to raise productivity and ensure food security (Chirwa & Dorward, 2014).

Though the effectiveness of investment in agricultural subsidies has been a controversial matter among policymakers and analysts (Brooks & Wiggins, 2010), agricultural subsidy is a powerful tool which enables poor farmers to acquire inputs non affordable at market prices. The literature on credit constraints (Blancard *et al*., 2006) asserts positive relationship between input subsidy and productivity. The European Union farm sector is heavily subsidised, annually it spends about € 50 billion in supporting farmer's income and productivity (Rizov *et al*., 2013). There are two competing arguments regarding the impact of input subsidies. If agricultural input subsidy increases productivity on one hand on the other will distort agricultural markets in the context of trade liberalisation.

2.7 Credit Subsidy as an instrument in agriculture finance

Limited access to production finance is the most limiting factor for the smallholderproducers in developing countries (Meijerink & Onumah, 2011). A large number of alternatives such as provision of input credit (often including subsidies on the cost of inputs as well as interest rates), supply of credit sourced from donor funds, direct government budgetary allocations and credit quotas imposed by central banks, agricultural development banks were widely used in developing countries and developed countries as well to boost agricultural productivity.

In theory farmers can finance input purchases from farm savings, off-farm income sources or by borrowing (Dorward & Poulton, 2008). However smallholder farmers are rarely able to save enough to fund significant intensification, and few have access to sufficient off-farm income for this purpose.

The absence of complementary financial services allowing farmers to access credit to finance the costs of purchasing fertiliser implies that subsidies will definitely lead to sufficiently large reductions in fertiliser prices if indeed they lead to increased access to fertilisers by poorer farmers. If subsidies lead to smaller reductions which do not make them affordable by poorer farmers then they are likely to mainly benefit credit unconstrained farmers (Dorward, 2009).

2.8 Experiences of Agricultural Credit Subsidy

The subsidization of credit for end beneficiaries is a policy that has been applied by France since 1928 up to now. This long-term continuity has been necessary to enable real in-depth change, ranging from the implementation of changes in the modes of production of existing farms to support young farmer start-up, in conditions that enable modern production (Neveu, 2001).

Neveu (2007) considers that the mechanism of loan subsidies played a key role in French agriculture modernization in the 1960's and 70s. Production increased at increasing rate and France became a net export of agricultural products. Above all work productivity became the best of European agricultural countries.

In less than a century, the United States has shifted from not very developed agriculture to one of the most productive in the world. This has been possible due to a strong support by the government for agriculture, and especially through its help in developing a financial offer for the sector. (Westercamp *et al*., 2015).

In the US the commercial credit supply to the agricultural sector was limited, thus American farmers had trouble obtaining formal credit. Limited access to agricultural finance by smallholder farmers pulled the US authorities to intervene in agricultural sector finance. The Farm Service Agency (FSA) and Farm Credit System (FCS) continue to be two of the most components of federal actions on agricultural credit. For example the FSA distributes concessional or subsidized loans to farmers excluded from commercial financing system.

The distribution of subsidized credit remains an important instrument of Brazil's agricultural support policy. Around 20th century Brazil experienced a great transformation from an economy grounded on cash crops for export to the 6th largest economic power thanks to a long term government intervention in the economy. Brazilian agriculture and agri-food sectors make up 97% of the country's trade surplus. (Westercamp *et al.,* 2015).

In each of these three cases (USA, France and Brazil), the government intervention brought about changes in agricultural sector, improving access to credit for small size farmers leading to food sovereignty and modernization of agriculture. In the context of the trade liberalisation process of the world trade organization (WTO) many governments were obliged to change the

forms of agricultural subsidies to minimise the negative effect on agricultural markets, the aim of the shift from coupled to decoupled subsidies is to fulfil the WTO agenda in agricultural markets (Ortiz *et al*., 2009).

2.9 African Experiences in Agricultural Subsidies

Since 2000 African governments have been implementing a series of agricultural subsidies which attracted international interest for example:

Fertiliser Support Program (FSP) in Zambia, Kenya National Accelerated Agricultural Input Programme (NAAIP) in Kenya, Integrated Productivity Program (PIP) in Mozambique, Malawi Agricultural Input Subsidy Programme (AISP), Targeted Input Programme (TIP) and Starter Pack Programme in Malawi. All of these programmes have as common objectives; food security, input adoption by smallholder farmers.

Carter, Laajaj, & Yang (2014) state that in the case of Mozambique the one-time provision of a voucher for fertilizer and improved seeds led to increase and persistent use of fertilizer and agricultural productivity through two subsequent agricultural seasons. Malawian experience is one of the most successful in Africa (Chirwa & Dorward, 2013). Studies on other programmes were not able to clarify the net economic impact because most of them emphasize the producer welfare and ignore the interest of the consumers and pro-poor economic growth.

2.10 Relationship between Agricultural Subsidy and Productivity

Kannan (2011) in his study in Karnataka found that credit subsidy could be a good accelerator of agricultural production, it could influence directly or indirectly the outcome of agricultural production and its measurable impact variable could be agricultural productivity, however, he believes that this impact is not straightforward given, due to the flow of credit and diversity in cropping pattern. In attempt to find relationship between productivity and agricultural credit, correlation coefficients were worked out using general linear regression. The findings show that annual rainfall were correlated with productivity and was statistically significant, the same with fertiliser and irrigation however agricultural credit was found to be statistically insignificant. He argues that an increase in agricultural credit subsidy in along with increase in investment in other support services will be crucial to find positive impact on productivity.

Using structural, semi-parametric estimation algorithm and incorporating directly the effect of subsidies into a model of unobserved productivity, (Rizov *et al*., 2013) found that CAP subsidies had negative impact on the European Union farm productivity in the time before the introduction of decoupling reform and the effect turned positive in most countries after decoupling reform, that is, subsidies have positive impact when are decoupled from production decisions.

With the help of linear Regression model in their study in Kirehe District, Eastern Rwanda Ekise *et al.,* (2013) found that AISP had a great impact in the district. The findings show that maize yields improved by a record of 529% among households. Positive relationship between agricultural credit and both productivity and income was found by Shah *et al.,* (2008) in their study assessing the impact of agricultural credit on farm productivity and income of farmers in Northern Pakistan using descriptive statistics, t-test and paired sample test.

Rahman *et al*. (2014) analysed the impact of credit on agricultural productivity in Pakistan using logistic regression and the findings show positive impact, and they conclude that the positive relationship is due to the fact that credit enables farmers to acquire enhancing crop yield inputs. The same findings were found by (Jan & Saleem, 2011) using a linear regression model on the Cobb-Douglas type.

Ibrahim, Olaleye and Umar (2009) analyzed a sample of 100 rural youth rice farmers using descriptive statistics and T-test to examine the effect of loan utilization on the output of rice in shiroro local government area of Niger state. The results indicated that the loan had positive and significant effect on output. The mean output of beneficiaries was about five times greater than non-beneficiaries.

Awotide *et al.* (2015) analyzed the impact of access to credit on agricultural productivity in Nigeria using Endogenous Switching regression model and concluded that access to credit had a significant positive impact on cassava productivity. They also found that farm size and livestock unit were significant in determining the farmers' access to credit.

Using paired T-test and multiple regression model Mohsin *et al.* (2011) analyzed the impact of supervised agricultural credit on farm income in Barani areas of Punjab and concluded that net farm income of beneficiaries was greater than non-beneficiaries mainly due to higher input use

level. Bauer *et al*. (2012) used Heckman selection model-two stages least squares to assess the Effects of credit access on the profitability of farms in Rural Sudan. The findings show that credit had positive and significant impact on household profitability.

Matsumoto and Yamano (2010) analyzed a sample of 420 household in rural Ethiopia to study the impacts of fertilizer credit on crop production and income in Ethiopia. Findings indicated that credit increase input application for crop production as a result has positive impact on the yield of teff, however its impact on net crop income was found to be marginal.

Chirwa and Dorward (2013) analysed the impact of Agricultural Input Subsidy in Malawi using a fixed effects panel data strategy of six agricultural seasons and the findings reveal positive impact on maize production, net crop income and food consumption but the impacts on household income and physical assets were mixed.

Most studies employ a general multiple regression or a simple descriptive statistics to assess the impact of credit on productivity. The disadvantage of such approaches is that they do not take into account the problems of endogeneity and sample selection. In the case of Seven million in Chókwè no systematic research using statistical or econometric approach has been published. Available studies are not sufficiently rigorous in measuring the economic impact of the programme; their findings are theoretical and are not able to provide consistent arguments. This study therefore applies critical assessment, statistical analysis and econometric approach using Endogenous Switching Regression model to correct problems related to self-selection and endogeneity. The aim is to obtain unbiased estimates of the effect of credit under the seven million on productivity and farm incomes.

2.11 Theoretical and Conceptual Framework

Theoretical framework

The study was based on rational choice and utility maximization theories. Credit under the district development fund is decoupled in the sense that it is independent of production. Spending choice is left to the farmers' discretion, moreover this credit is not monitored; a farmer could choose either to use all of it in production, a part of it or even none at all. Farm level credit subsidy will enable smallholder farmers often excluded from formal financial services to access

credit necessary to purchase more inputs. The availability of inputs accompanied with good supportive policies will change the production patterns and productivity.

The wider (indirect) impacts of subsidies depend on productivity impact and are affected by subsidy design and implementation, institutional and policy context, output market characteristics, farmer socio-economic characteristics, infrastructures and technology (Dorward *et al*., 2013).

Green (2002) and Levin and Milgrom (2004), state that the problem of rational choice can be represented as one of utility maximizing function. Utility function consists of assigning a numerical value to each possible alternative facing the decision maker.

According to Greene (2002) if U_i denotes the utility derived with credit use and U_k that derived without using credit, the observed choice between the two reveals which one provides the greater utility. The observed indicator equals 1 if $U_i > U_k$ and 0 if $U_i < U_k$. A common formulation is given by:

$U_i = X'\beta_i + \varepsilon_i$ and $U_k = X'\beta_k + \varepsilon_k$, then if Y= 1 the decision makers' choice of alternative *i* is given by;

$$\left.\begin{aligned} prob[Y=1|x] &= prob[U_i > U_k] \\ &= prob[x'\beta_i + \varepsilon_i - x'\beta_k - \varepsilon_k > 0|x] \\ &= prob[x'(\beta_i - \beta_k) + \varepsilon_i - \varepsilon_k > 0|x] \\ &= prob[x'\beta + \varepsilon > 0|x] \end{aligned}\right\} \quad \text{..... (1)}$$

The demand for and use of credit subsidy in agricultural production will be based on the expected utility maximization, that is, the farmer will decide to take and use loan in production if $U_i > U_k$ where: U_i is the expected utility with credit use and U_k that without.

Conceptual Framework

An analysis of the effect of farm level credit requires an understanding of the relationship between credit and agricultural production. It is also important to understand how external factors can affect this relationship.

Successful government intervention in incomplete markets through provision of subsidized credit requires that the programme be well designed in terms of target group and its implementation. Good institutions and policies together with subsidy design will enable the programme to achieve its target group and objectives. Policy analysts argue that government intervention through provision of subsidized credit fail to accomplish the expected goals mainly because often misses its target (Buttari, 1995, Dorward et al., 2008).

It is assumed that credit subsidy will help financially constrained farmers to acquire more yield-enhancing inputs. The assumption is that, programme providing subsidized credit will enable farmers who cannot afford formal credit to increase their disposable income which in turn will be used to acquire more agricultural inputs and technology. In the diagram below technology refers to any other technology apart from fertilizer (eg. improved seeds, fertilizers and irrigation). Incremental use of inputs and changes in production patterns as a result of credit use are intermediate outcomes. Besides credit, household characteristics such as education, gender, age, experience will have an influence on intermediate outcomes.

Changes in productivity will occur once the intermediate outcomes are satisfied. The structure of output market, distance to both input and output markets, infrastructures and contacts with extension providers will also influence productivity and income to be obtained through sale of the produce. Indirect effects such as consumer welfare and economic growth may be affected by changes in agricultural products' prices and use of agricultural inputs. A conceptual framework below displays a graphic representation of the expected outcome on productivity and household's income. It generally expresses how subsidized credit will directly affect productivity and smallholder's income given a set of independent variables affecting this relationship.

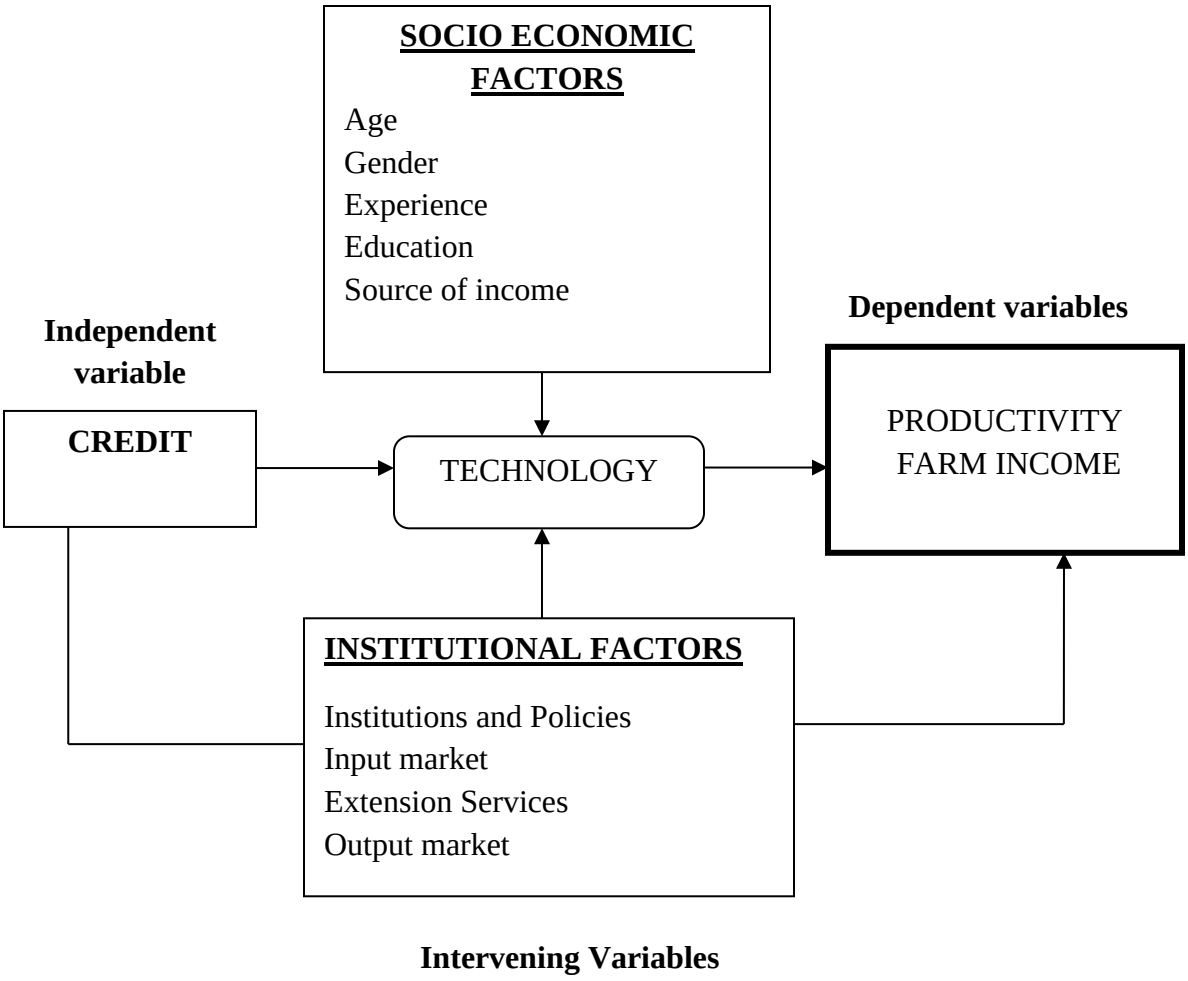


Figure 2.1: Conceptual Framework of Credit on Productivity and Farm income

Source: Own Conceptualization

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This section provides a description of the study area, sampling method and the instruments of data collection applied. It presents the specification of the empirical model and tools of data analysis and interpretation.

3.2 Study Area

The study was done in Chókwè district of Gaza Province in south western Mozambique. Chókwè district is located in south western part of Gaza province; it borders Limpopo River to the North, Bilene district to the South, Chibuto district to the East and Magude -Massingir districts to the West side. The district occupies a total area of 2466Km^2. Administratively, the district has 4 divisions (administrative posts): Macarretane, Lionde, Chókwè and Xilembene, these divisions are divided into 8 locations and 36 sub-locations (Ferro, 2005).

According to the latest district statistics, the population of Chókwè is about 196 671 people, with a population density of 80.6 inhabitants per Km^2. 55.8% are women (INE, 2012). Economic activities in Chókwè district include crop production, livestock and commercial businesses. Most agricultural activities are practiced under rain fed systems. The majority of active population in Chókwè practice agriculture and more than 80% of farming population is constituted by smallholder scale farmers with less than 5ha of land. The main crops include maize, beans, rice, potatoes and vegetables. With 80 000 ha of agricultural land, this district hosts the largest irrigated perimeter of the country with an area of 26000 ha. Due to different factors hindering the development of irrigation schemes only 300ha occupied by smallholder farmers can actually be irrigated (Amilai, 2008). The mean annual temperature varies from 22°C to 26°C and the mean annual rainfall varies from 500 to 800mm.

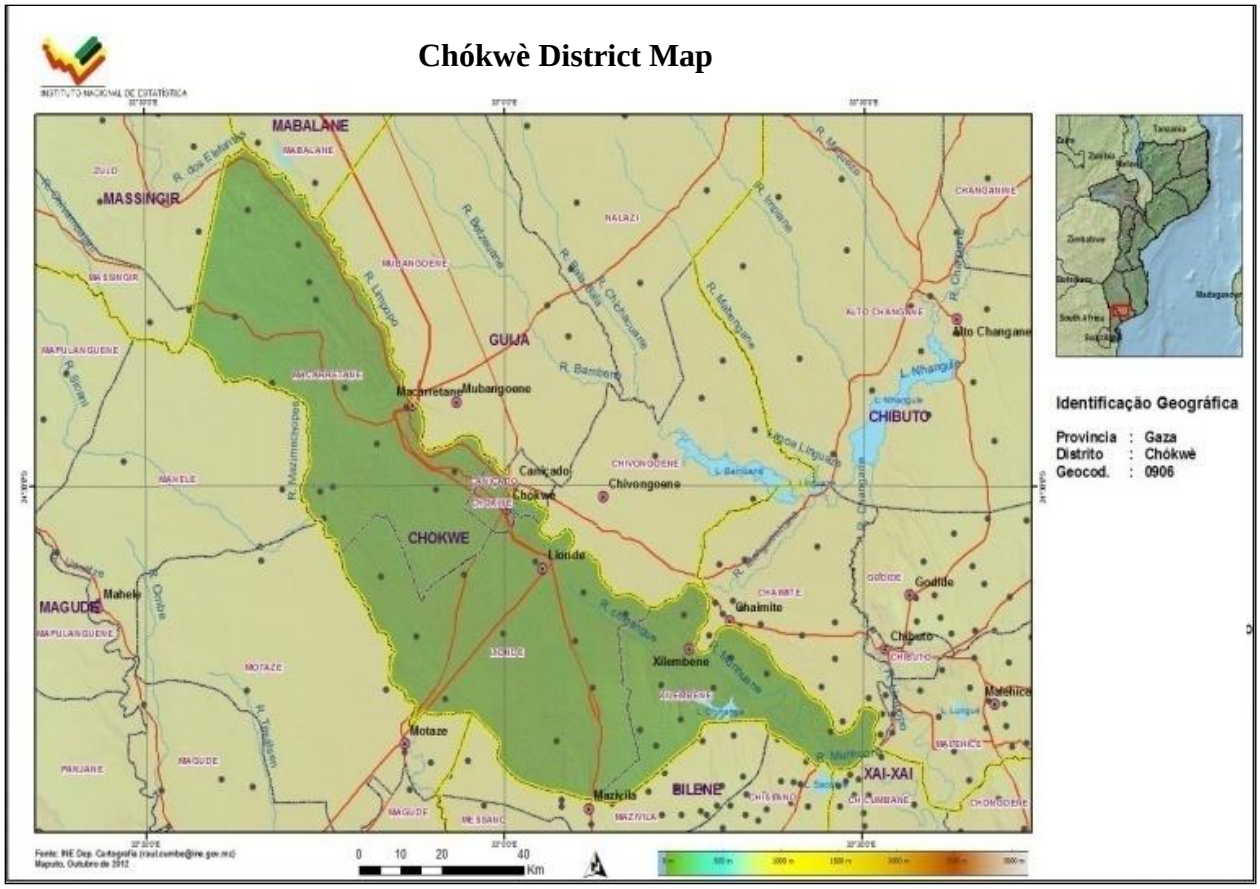


Figure 3.1: Map of Chókwè District

Source: National Statistics Institute, (2012)

3.3 Sampling Design

The study combined probability and non-probability sampling. First, purposive sampling method was applied to select Chókwè district because it is one of the largest agricultural producers in the country. Then, farmers were randomly selected and a short structured questionnaire was administered to each farmer to obtain cross-sectional data. The following data was collected; socio-economic (e.g., age, gender, education, household size, average of cultivated land etc), cultivated crops, means of transport, communication, information, source of labour and total amount borrowed.

3.4 Determination of the sample size

The required sample size was determined using the following formula (Kothari, 2004)

$$n = \frac{Z^2 pq}{e^2} \quad \text{..... (2)}$$

Where: ***n*** is the sample size, *e* margin of error, accepting *e* = 0.08 in the formula, a sample of 159 farmers were selected from the population of smallholder farmers in Chókwè district. Since the proportion of the population was unknown the most conservative estimates of 50%, with a *p*= 0.5 and *p*+*q* = 1; *q* = *1*-*p* = 0.5. Z= 1.96 at 0.05 level of significance. Due to non-response only 107 elements were used for data analysis.

3.5 Methods of data collection

The collection of primary data was through structured questions administered to both participants and non-participants of the loan under the "seven million" program in Chókwè district. Each question in the questionnaire was developed to address a specific objective of the study. The main reason behind using this method of gathering data is its cheapness, simplicity, and originality. However, the study recognizes the limitations of the method such as the difficulty to capture the in-depth, lack of accurate response from the respondents.

3.6 Data analysis

In order to provide a description of socio-economic characteristics of the sample from which data were collected, descriptive and quantitative methods were used. To provide the findings of the study data were entered and analyzed using *Excel* and STATA respectively.

3.6.1 Analytical framework

Objective 1

This objective was analyzed using Endogenous Switching Regression Model and Propensity Score matching. Descriptive statistics involving calculation of means, percentages and graphs were also applied. The specification of the model used to analyze this objective is given below.

3.6.2 Estimation of Switching Regression Model

In impact studies using non experimental or quasi-experimental designs, different approaches can be applied but there are basically three widely used, namely propensity score matching, 2 stages least squares and switching regression models. Hennessy (1998) and Ciaian and Swinnen (2009) analysing the use of two least squares to assess the impact of credit

subsidies on productivity concluded that the disadvantage of such approach is that it does not explicitly incorporate subsidies into a structural estimation algorithm and thus it cannot capture their true effect on productivity. It is also argued that this approach does not take into account self-selection problems that can provide biased estimates, therefore propensity score matching and endogenous models could be used to correct these shortcomings. Econometric problem involving both heterogeneity and sample selection, motivates the use of endogenous switching regression model (Maddala, 1983). This study applied a switching regression model to control for self-selection problems and heterogeneity. In order to compare the estimates, propensity score matching was also used to compute the average treatment effect on the treated (ATT).

3.6.3 Endogenous Switching Regression Model

Assuming that the aim of the farmer is to maximize utility, comparing utility provided by *m* alternatives, then the condition for farmer *i* to select option *j* over any other in *m* is that $Y_{ij} > Y_{im}$ $m \neq j$.

$$Y_{ij} = X_i \beta_j + \varepsilon_{ij} \quad \text{..... (3)}$$

The outcome Y_{ij} which the farmer acquires from the use of subsidized loan *j*, is a latent variable determined by observed farmers' characteristics (X_{ij}) and unobserved characteristics (ε_{ij})

Equation (3) will test whether productivity depends on whether or not the farmer used credit subsidy. If the farmer used credit subsidy (participation =1) then the farmer enters regime 1 where productivity is more likely; if the farmer did not use credit subsidy (participation = 0) then he remains in a state less conducive to productivity.

Self-Selection Models

The following model describes the behaviour of the farmer with two regression equations and a criterion function or treatment T_i which determines which regime the farmer faces (credit market participant/non participant)

$$\left.\begin{array}{l} T_i = 1 \text{ If } \gamma Z_i + u_i > 0 \\ T_i = 0 \text{ If } \gamma Z_i + u_i \leq 0 \end{array}\right\} \quad \text{..... (4)}$$

Regime 1: $y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i}$ if $T_i = 1$

Regime 0: $y_{0i} = X_{0i}\beta_0 + \varepsilon_{0i}$ if $T_i = 0$ ..... (5)

Where y_{ji} is the dependents variable (maize output); X_{0i} and X_{1i} are vectors of exogenous variables and β_0, β_1 and γ are vectors of parameters. Assuming that u_i, ε_1 and ε_0 are normally distributed with a mean vector zero and covariance matrix

$$\Omega = \begin{bmatrix} \sigma_u{}^2 \sigma_{1,u} \sigma_{2,u} \\ \sigma_{1,u} \sigma_1{}^2 \\ \sigma_{2,u} \ldots\ldots\ldots \sigma_2{}^2 \end{bmatrix}$$

$\sigma_u{}^2$ is the variance of the error term in the selection equation, and $\sigma_1{}^2$ and $\sigma_2{}^2$ are variances of the error terms in the continuous equations. $\sigma_{1,u}$ is a covariance of u_0 and and ε_0 and σ_{2u} is a covariance of u_1 and ε_1. Since y_{1i} and y_{0i} are not observed simultaneously, the joint distribution of (ε_1 and ε_0) cannot be identified. The assumption is that $\rho_{0,1}$ = 1. The estimation is done by Full Specification of Maximum Likelihood (FML) model. The log likelihood function is defined by (Lokshin & Sajaia, 2004)

$$\ln L = \sum_i (I_i w_i \left[\ln\{F(\eta_{1i})\} + \ln\{f(\varepsilon_{1i}/\sigma_1)/\sigma_1\}\right] + (1 - I_i) w_i \left[\ln\{F(\eta_{2i})\} + \ln\{f(\varepsilon_{2i}/\sigma_2)/\sigma_2\}\right]) \ldots (6)$$

F (.) is a cumulative normal distribution; *f (.)* is a normal density distribution functions, w_i is an optional weight for observation *i.*(Araar,2015)

$$\eta_{ji} = \frac{\gamma Z_i + \rho_j \varepsilon_{ji}/\sigma_j}{\sqrt{1 - \rho_j{}^2}} \quad j=1, 2 \ldots\ldots (7)$$

ρ_j is the coefficient of correlation between ε_j and u.

After estimating the parameters of the model, the following conditional and unconditional expectations could be calculated. These expectations are used to determine the treatment effect (Lokshin & Sajaia, 2004)

Unconditional expectations:

$$\begin{aligned} E(y_{0i} | x_{0i}) &= x_{0i}\beta_0 \\ E(y_{1i} | x_{1i}) &= x_{1i}\beta_1 \end{aligned} \quad \ldots\ldots (8)$$

Conditional expectations :

$$E(y_{0i} | I_i = 1, x_{0i}) = x_{0i}\beta_0 + \sigma_0\rho_0 \quad \text{..... (9)}$$

$$E(y_{0i} | I_i = 0, x_{0i}) = x_{0i}\beta_0 - \sigma_0\rho_0 \quad \text{.....(10)}$$

$$E(y_{1i} | I_i = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_1\rho_1 \quad \text{..... (11)}$$

$$E(\quad y_{1i} | I_i = 0, x_{1i}) = x_{1i}\beta_1 - \sigma_1\rho_1 \quad \text{..... (12)}$$

3.6.4 Estimation of Average Treatment Effects:

The ESR can be used to examine the Average effect of Treatment on the Treated (ATT) by comparing the expected outcomes of users using credit with those not using (counterfactual). The challenge of impact evaluation on quasi and non-experimental studies is to estimate the counterfactual outcome, which is the outcome the users could have earned had they not used the credit on production. According to Carter and Milon (2005), we compute the ATT in the actual and counterfactual scenarios as:

Users actually using:

$$\left.\begin{aligned} E(Q_{1i} | I = 1) &= Z_i\alpha_1 + \sigma_i\lambda_1 \\ E(Q_{0i} | I = 1) &= Z_i\alpha_0 + \sigma_i\lambda_0 \end{aligned}\right\} \quad \text{..... (13)}$$

Not-Using: (counterfactual)

$$\left.\begin{aligned} E(Q_{0i} | I = 0) &= Z_i\alpha_0 + \sigma_1\lambda_0 \\ E(Q_{1i} | I = 0) &= Z_i\alpha_1 + \sigma_1\lambda_1 \end{aligned}\right\} \quad \text{..... (14)}$$

The expected outcomes are used to derive unbiased ATT estimates

$$ATT = E(Q_{1i} | I = 1) - E(Q_{0i} | I = 1) = Z_i(\alpha_1 - \alpha_0) + \lambda_i(\sigma_1 - \sigma_0) \quad \text{.....(15)}$$

On the right hand side the first term represents the expected change in users' mean outcome, if their characteristics had the same return as non-users (same characteristics), (λ) is the selection term that captures all potential effects of difference in unobserved variables.

Propensity Score Matching

Rosenbaum and Rubin (1983) defined propensity score as the conditional probability of receiving treatment given a vector of observed covariates. Propensity score is a probability of treatment assignment based on observed characteristics. It allows reconstruction of counterfactuals using observational data.

$$P(x) = \Pr[D = 1|X] = E[D|X] \quad \text{..... (16)}$$

Where

D= 1, for treatment

D= 0, for control

X is the vector of observed covariates for the i^{th} subject. The propensity score ranges in value from 0 to 1.

Steps to apply propensity score matching

Estimate a model of program participation: pool the sample including both participants and non-participants and estimate a model of participation (D) as a function of all variables (vector X) that are likely to influence participation. After estimating the model, predicted probabilities corresponding propensity scores are derived using probit, logit, LPM models.

Defining the region of common support and balancing propensity score: this region needs to be defined where distributions of the propensity scores for treatment and control group overlap. Some elements from both groups may be excluded if they have a propensity score outside the range (either too low or too high).

Matching participants to non-participants and estimating causal effect: different algorithms can be used to assign participants and non-participants based on the estimated propensity scores. This study relies on nearest neighbour, radius matching and kernel matching techniques.

The following equations estimate the Average Treatment effect on the Treated using different algorithms:

Stratified Matching

This technique partitions the common support into different intervals and provides the impact within each interval. The ATT is estimated by the mean difference in outcome.

$$ATT = \sum_{q=1}^{Q}\left(\frac{\sum_{i\in I(q)} Y_i^T}{N_q^T} - \frac{\sum_{j\in I(q)} Y_j^C}{N_q^C}\right) * \frac{N_q^T}{N^T} \quad \text{..... (17)}$$

Where:

Q- is the number of blocks with balanced propensity scores, N_q^T, N_q^C - Number of cases in the Treatment and Control groups for matched block *q*, Y_i^T, Y_j^C -Observational outcomes for cases *i* and *j* matched in the treated and control group *q* respectively, N^T -Total number of cases in the treated group.

Nearest neighbour and Radius matching

In this matching technique each treatment unit is matched to the comparison unit with the closest propensity score. In the Radius matching the outcome of the control group is matched with that of treated group only when the propensity score falls in the predefined radius of the treated unit.

$$ATT = \frac{1}{N^T}\left(\sum_{i\in T} Y_i^T - \frac{1}{N_i^C}\sum_{j\in C} Y_j^C\right) \quad \text{..... (18)}$$

Where: N^T -Total number of cases in the treated group and N^C is a weighting scheme that equals the number of cases in the control group using a specific algorithm.

Kernel matching

Uses the weighted average of all non-participants to build the counterfactual for each participant

$$ATT = \frac{1}{N^T}\sum_{i\in T}\left\{Y_i^T - \sum_{j\in C} Y_j^C K\left(\frac{e_j(x) - e_i(x)}{h_n}\right) / \sum_{k\in C} K\left(\frac{e_k(x) - e_i(x)}{h_n}\right)\right\} \quad \text{..... (19)}$$

Where: e_j, e_i denote the propensity score of case *j* and case *i* in the control and treatment group respectively. Their difference represents the distance of the propensity scores. *K (.)* is the weight function

3.7 Variable Measurement

Table 3.1 Description of the variables in the Model

Variable	Description	Measure
Hhage	Household head age	Years
Hhagesq	Household head age squared	Years
Fmsize	Farm size	Hectares
Exp	Experience	Years
Exten	Contacts with extension providers	Number
Qfrtl	Quantity of fertilizer	Kilograms
Dstinpm	Distance to inputs market	Kilometers
Hheducys	Household head education	Years
Cred	Credit Status	1 if used credit; 0 otherwise
Tech	Technology	1 if used any other technology than fertilizer; 0 otherwise
Srinc	Source of income	0 if agriculture1st source; 1 otherwise
Hhgen	Household gender	1 if male; 0 otherwise
Out	Output produced	Tonnes
Lout	natural log of output	Tonnes
Finc	Farm income	Meticais

Objective 2

The second Objective used the Analysis of Variance to assess whether difference of mean income between users and non-users is statistically significant.

Analysis of Variance

To find out whether there is significant difference in income between users and those not using credit the one-way analysis of variance (one way ANOVA) was used. Analysis of variances is a statistical model used to analyse the differences among group means and their variations within groups. The one way analysis of variance is used to determine whether there are significant differences between the means of two or more independent groups. In this case differences in means income of users and non-users were analysed using F-test at 95% confidence interval.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents a summary of the data obtained from the questionnaire that had been administered to both participants and non-participants of the seven million program in Chókwè district. The summary tables of the data are presented followed by a discussion of the results obtained.

4.2 Descriptive Statistics

This section provides the socio-economic characteristics of the surveyed households; the characteristics presented include age, gender, activity and years of schooling of the household head. Other characteristics include the number of years spent in agriculture and source of income. Table 4.1 presents the mean values of socio-economic characteristics of the surveyed households.

Table 4.1 Summary Statistics of the Variables in the Model

Variable		Obs	Mean	Std. Dev.
Hhage	*Household head age*	107	41.8692	8.6494
Hheducys	*Household head education*	107	5.5701	2.8521
Exp	*Experience*	107	10.5608	6.9189
Fmsize	*Farm Size*	107	1.9654	0.6251
Qfrtl	*Quantity of fertilizer*	107	43.7851	34.0701
Tech	*Technology*	107	0.4953	0.5023
Exten	*Contacts with Extension providers*	107	0.3925	0.6106
Dstinpm	*Distance to inputs market*	107	5.0449	2.5998
Srinc	*Source of income*	107	0.2617	0.4416
Out	*Output produced*	107	0.7994	0.4191
Finc	*Farm income*	107	1391.1960	2047.8700

Source: Data from Chókwè Survey, February 2016

The sample under study was composed by 107 respondents, from which sixty three percent (63%) were males while around 37% were females. In terms of age the surveyed household heads had an average around 42 years falling within the most economically active interval of 25 to 50 years, they had a mean of 10 years of experience in agriculture. The age of the household head along with experience plays an important role in credit market participation and agricultural production systems. Older farmers with more years of experience are expected to participate in the credit market and get higher productivity. Surveyed households applied in average 44 kg of fertilizer per hectare which is found to be higher than the national mean value. According to Benson *et al., (2014)* the average application in the country is around 11.4 kg per hectare of cultivated land which represent only 5% of the farming population. The cultivated land was in average around 2 hectares which concur with the country's average of cultivated land by smallholder farmers. Around 70% of the cultivated land in Mozambique is occupied by smallholder farmers with an average of 2 hectares each (FAO, 2010).

The use of relatively higher amounts of fertilizer in a smaller plot implies that farmers intensify their production systems, therefore are expected to increase productivity and farm incomes. In this study technology refers to any other type of technology apart from fertilizer such as improved seeds, irrigation and pesticides. 49% of the surveyed household declared having used either one or many kinds of technology and 51% did not use any type of technology. The number of contacts with extensions services providers was too low; the mean value is 0.39 contacts per farmer per year, further the surveyed households are located 5 km from the nearest input market which is relatively far taking into account the cost of transport, therefore the distance to the input market is expected to negatively affect productivity and income. 26% of the surveyed households had another source of income while 74% had agriculture as a first source of their livelihoods.

As far as maize output and farm incomes are concerned the respondents had almost 800kg per hectare which is low when compared to the national average of 1000kg or to 4900kg in the western countries. In terms of farm income the net gain was about 1400Mt per hectare.

Inferential statistics testing the null hypothesis of equal means between users and those not using are presented in table 4.2.

Table 4.2 Mean Differences between Users and Non-Users

	Non-Users		Users		
Variable	**Obs**	**Mean (Std. Dev.)**	**Obs**	**Mean (Std. Dev.)**	**Diff**
Hhage	57	38.7719 (6.3331)	50	45.4000 (9.5980)	-6.6281***
Hheducys	57	4.2807 (2.6101)	50	7.0400 (2.3816)	-2.7593***
Exp	57	8.1404 (4.5804)	50	13.3200 (8.0621)	-5.1796***
Fmsize	57	2.0193 (0.5690)	50	1.9040 (0.6842)	0.1153
Qfrtl	57	25.7018 (28.1964)	50	64.4000 (28.0786)	-38.6983***
Tech	57	0.2807 (0.4533)	50	0.7400 (0.4431)	-0.4593***
Finc	57	548.5965 (1554.8790)	50	2351.7600 (2131.1530)	-1803.163***
Out	57	0.5588 (0.2896)	50	1.0738 (0.3741)	-0.5150***
Dstinpm	57	5.2632 (2.9187)	50	4.7960 (2.1832)	0.4672
Srinc	57	0.3509 (0.4815)	50	0.1600 (0.3703)	0.1909*
Exten	57	0.0877 (0.3423)	50	0.7400 (0.6642)	-0.6523***

Source: Own computation using STATA V.12

*** , **, * mean significant at 1%, 5% and 10% respectively

From the differences of means between participants and non-participants in credit market it can be seen that users of credit under the seven million program are not entirely similar to those that did not use credit subsidy. Users of credit under the seven million program have an average seven years of schooling and those not using have only four years. More years of education will help smallholder farmers to acquire more knowledge on how credit use can influence productivity it is therefore expected that education level will influence participation in the credit market and productivity. In terms of age, the mean age for users is 45 years while for non-users is 38. As far as years of experience are concerned, users have an average around fourteen years of experience while non-users are below ten years. The age of the farmer along with years of experience will probably influence farmers to participate in credit market based on the past experiences. Users of credit under the seven million program cultivate less land than those not using, nevertheless they produce more and earn more farm income than their counterparts. There is support for the assumption that smaller farms are more productive due to additional care taken of a smaller plot (Pycroft, 2008). It can be observed that users do apply more fertilizer and use more technology than those not using credit subsidies. These differences are statistically significant except for farm size and source of income.

The mean differences of the dependent variables (maize output per hectare and farm income) between users and non-users are presented in table 4.6.

Table 4.3 Mean differences on dependent variables

	Users	**Non-Users**	**Mean difference**
Mean output Kg/ha	1073.8	558.8	515.02***
(Std Dev.)	(52.9026)	(38.354)	
Mean Income (Mts)	2351.76	548.59	1803.16***
(Std. Dev.)	(2131.15)	(1554.87)	

Source: Own computation using STATA V.12

*** mean significant at 1%

The results above show that users of credit under the seven million program have statistically significant higher maize output and farm income than those farmers that did not use credit under the seven million program, however these results do not necessarily reflect the effect of credit on productivity and farm incomes. These findings show that there is positive selection

into regime one and a negative selection into regime zero. Any conclusion of the effect based on the mean differences would be biased. Therefore, to empirically assess the effect of credit under the seven million on maize productivity the endogenous switching regression and propensity score matching were applied.

4.3 Empirical Results

The results of the selection equation are reported in the section selection (Table 4a) and the productivity regression of the users is reported in the section named users and the regression of non-users is reported in the section headed non-users (Table 4.4b)

Table 4.4a Regression results of selection equation

Selection	coeff	Std. Err	z	P>|z|
Hhage	-0.6745	0.3046	-2.2100	0.0270
Hhagesq	0.0097	0.0041	2.4000	0.0160
Fmsize	0.3135	0.4192	0.7500	0.4550
Exp	-0.0493	0.0581	-0.8500	0.3960
Exten	0.9224	0.5055	1.8200	0.0680
Qfrtl	0.0371	0.0136	2.7300	0.0060
Dstinpm	-0.2817	0.1159	-2.4300	0.0150
Hheducys	0.1070	0.1329	0.8100	0.4210
Tech	-0.7060	0.6319	-1.1200	0.2640
Srinc	-2.4819	0.6532	-3.8000	0.0000
Hhgen	0.6365	0.4131	1.5400	0.1230
_cons	9.9495	5.4916	1.8100	0.0700
/lns1	-1.9313	0.1000	-19.3100	0.0000
/lns2	-1.7829	0.1351	-13.1900	0.0000
/r1	0.0219	0.3391	0.0600	0.9480
/r2	1.0278	0.6966	1.4800	0.1400
sigma_1	0.1450	0.0145		
sigma_2	0.1682	0.0227		
rho_1	0.0219	0.3389		
rho_2	0.7730	0.2803		

LR test of indep. eqns. : chi2(1) = 1.92 Prob > chi2 = 0.1660

Source: Own Computation using STATA V.12

4.3.1 Factors affecting participation in the credit market

The “Seven million” program was designed to target poor farmers who cannot afford formal credit. Factors such as age of the household head, extension services, distance to input market and source of income have an influence on credit subsidy market participation. Farmers who have other source of income rather than agriculture are less likely to participate in credit subsidy under the seven million program. The same happens with older farmers; these findings are drawn from the negative signs of the coefficients in both household age and source of income variables. Farmers who live far from inputs’ markets are also less likely to use the loan. On the other hand farmers who receive extension services and use technology are more likely to use credit under the seven million program, probably because they acquire more knowledge from extension providers on how credit can increase productivity through intensive input use. Similar Results were obtained by Kiplimo *et al.* (2015) who found extension services having positive effect on credit access and use on production.

The study uses full-information maximum likelihood (FIML) to fit binary and continuous parts of the model at the same time to generate consistent standard errors. The switching model is designed to yield consistent coefficients on all variables corrected to remove selection bias. Since σ_1 and σ_2 are non zero, selectivity bias exists and the Ordinal least squares method would be inconsistent.

Table 4.4b: Estimation Results of Endogenous Switching Regression

Endogenous switching regression model			Number of obs =	107
			Wald chi2(10) =	336.64
Log likelihood = 21.962833			Prob > chi2 =	0.0000
	coeff	**Std. Err**	**z**	**P>|z|**
Users				
Hhage	-0.0008	0.0178	-0.0500	0.9630
Hhagesq	0.0000	0.0002	0.0100	0.9930
Fmsize	-0.0289	0.0359	-0.8000	0.4210
Exp	-0.0022	0.0051	-0.4300	0.6690
Exten	-0.0301	0.0387	-0.7800	0.4370
Qfrtl	0.0114	0.0012	9.2600	0.0000
Dstinpm	0.0164	0.0107	1.5300	0.1260
Hheducys	0.0004	0.0128	0.0300	0.9770
Tech	0.3595	0.0768	4.6800	0.0000
Srinc	0.0750	0.0674	1.1100	0.2660
_cons	5.9360	0.4174	14.2200	0.0000
Non-users				
Hhage	-0.0257	0.0340	-0.7600	0.4490
Hhagesq	0.0005	0.0005	1.0500	0.2950
Fmsize	-0.0493	0.0424	-1.1600	0.2450
Exp	-0.0047	0.0080	-0.5900	0.5540
Exten	0.2152	0.0695	3.1000	0.0020
Qfrtl	0.0086	0.0013	6.4600	0.0000
Dstinpm	-0.0159	0.0089	-1.7900	0.0730
Hheducys	0.0300	0.0128	2.3400	0.0190
Tech	0.2123	0.0709	2.9900	0.0030
Srinc	0.0213	0.0759	0.2800	0.7790
_cons	6.3232	0.6631	9.5400	0.0000

Source: Own Computation using STATA V.12

4.3.2 Factors affecting maize Productivity

For users there is support for the well-recognized assumption that the use of fertilizer and technology such as machinery, improved seed, and irrigation will definitely increase the agricultural output per unit land. It can be seen that users of credit under the seven million programme use more fertilizers and technology because credit enables them to purchase more

yield enhancing inputs. These results concur with those of Owuor & De Groote (2001) who found a positive correlation between credit access and input use leading to higher yields.

Comparing the two groups, apart from technology and fertilizer which are seen as crucial to increase maize productivity the results show that the number of contacts with the extension providers is significant for non-users but it turns non-significant for users. The assumption is that the non-users care more about new practices learned from the extension providers to ensure higher productivity even in the absence of credit. Another variable of interest is the distance to the input market which is significant for non-users. The coefficient of this variable is negative, implying negative correlation; this may be due to the fact that non-users, financially constrained find it costly to acquire inputs from distant markets. Lastly having educated household head helps non users, probably benefitting from extra knowledge acquired from school. The likelihood ratio test of independent equations is not significant and this means that splitting the sample would have been sufficient to estimate the two equations.

4.3.3 Effect of credit on productivity

The effect of credit on productivity can be obtained inserting the values of the variables for each farmer into the corresponding equation. This will enable to evaluate the predicted productivity for each group. Table 4.5 shows the average treatment effect on the treated based on conditional expectations.

Table 4.5 Average Treatment Effects on the treated using ESR

	To Participate		**Not to Participate**		**Treatment Effects**
	Mean	**Std. Dev.**	**Mean**	**Std. Dev**	
Users	7.0687	0.4486	6.336	0.4486	**ATT=0.7327*** **
Non Users	6.8924	0.4402	6.2299	0.3865	**ATU=0.6625*** **

Source: Own computation using STATA V.12

The conditional credit effect measures the differences in the level of output within credit users with and without credit use (counterfactual state). The assumption is that the coefficients obtained in the switching regression for the users would apply to those not using, were they to use credit and vice-versa. Results show that the average credit effect is estimated to be positive

and statistically significant. Since σ_1 and σ_2 are non-zero and statistically significant, the model suggests that credit users enjoy differentials benefits to unobservable attributes over non users which result in positive effect on productivity. This means that even in the absence of credit, users would still do better than those not using; therefore there is positive selection into regime 1 and negative selection into regime 0. Results in (Table 4.5) imply that benefits non users of using credit are less than the benefits to those already using it.

The conditional credit effect is estimated to be positive. This effect is obtained by measuring the difference between the levels of maize output of users using and without using credit (counterfactual scenario), the result suggests that maize productivity with credit is higher under the existence of credit relative to the counterfactual scenario. The difference between the average credit effect and conditional credit effect can be interpreted as the unobservable productivity attributes of those using credit.

Propensity Score Matching

Propensity score matching was used to compute the average treatment effect on the treated (ATT). Results drawn from three different algorithms suggest that credit under the seven million program has positive impact on productivity (Table 4.6).

Table 4.6 Average Treatment Effect on the Treated using Propensity Score matching

	n.treat	n.contr	ATT	Std. Err.
Kernel Matching method	50	57	0.465	0.111
Radius Matching method	28	57	0.398	0.089
Nearest Neighbor Matching method	50	22	0.564	0.145

Source: Own computation using STATA V.12

These findings are similar to those obtained using Endogenous Switching regression although more robust in Endogenous Switching Regression. There is a strong support to the idea that current non users would not produce as much from using credit as current users. The table above displays the ATT drawn from propensity score through Kernel, Radius and NN matching methods. The lowest value of ATT was obtained through Radius Matching method and the

highest was obtained through Nearest Neighbor matching, yet lower than the ATT obtained using ESR.

4.3.4 Effect of credit on Farm income

One of the objectives of the credit under the seven million program is income generation. In order to measure the influence of credit on income, Analyses of variance were used to assess whether differentials in terms of mean income between users and those not using are statistically significant. Table 4.7 shows ANOVA results as per participation in the credit subsidy market.

Table 4.7 Analysis of Variance of farm income as per participation in the credit under the "Seven million" program

Source	SS	df	MS	F	Prob > F
Between groups	343.803	1	343.803	10.59	0.0015
Within groups	3408.64	105	32.4632		
Total	3752.44	106	35.4004		

Source: Own computation using STATA V.12

Results show that users have an average higher farm income than non-users. These results are similar to those obtained by Remenyi *et al.* (2000) and Ghimire and Kotani (2015).

The assumption is that credit helps financially constrained farmers to acquire more productive inputs. Users are expected to produce more since credit will enable them to use more fertilizer and adopt new technologies, and that was the case in Chókwè as discussed in the previous section. An increase in maize productivity together with good market structure and infrastructures will ensure higher returns to participants in credit subsidy market. Hence is concluded that credit has positive effect on farm income.

CHAPTER FIVE

CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

The aim of this study was to assess the effect of credit under the seven million program on smallholders maize productivity and farm incomes in Chókwè district. Findings of the study on socio-economic characteristics of the surveyed households revealed that the majority of the farmers (90%) fall within the most economically active age of 20 to 50 years and only 10% are above 50 years. As far as the education level is concerned 41% of the respondents have spent less than 5 years in school and only 8% attended secondary school first degree equivalent to 10 years of schooling. With regards to gender the study showed that 63% of the surveyed household were headed by males while 37% were female headed households. Our analysis reveal that users of credit subsidy had significantly more years of schooling, more years of experience, used more fertilizer, had more maize output but cultivated less land than those not using. Farm size and distance to the input market were found to be statistically insignificant.

As regards to objective one, it was found that credit has positive and statistically significant effect on maize productivity. The Endogenous Switching Regression was carried out to find the factors influencing credit use and the average treatment effect. The results obtained indicate that extension services were statistically significant with positive effect on credit subsidy market participation. Other significant variables but with negative effect were distance to input market, household age and source of income. Analyzing the regression equations, it was found that fertilizer and technology were statistically significant and had positive effect on productivity for both users and those not using. However credit subsidy enabled users to use more inputs, therefore producing more output. Extension Services and education level were significant and had positive effect on maize productivity for non-users but insignificant for those actually using, distance to input market had negative effect for those not using but it also turned insignificant for users.

The average treatment effect suggests that apart from credit use, users enjoy differentials benefits to unobservable attributes over non users which contribute in positive effect on maize productivity.

In terms of the second objective it was found that the farm income of those who used credit under the program was higher than those not using as a result of more input use and higher level of maize output, this is because credit enables farmers to adopt new technologies which in turn will change the levels of productivity and generate more farm income.

In conclusion, this study found that credit under the seven million program had positive effect on maize productivity and farm income however, if the aim of the program is to fight hunger, poverty and generate income for the neediest in rural areas in the long run, then the implementation of the district development fund need to be improved. It is in that context that from the findings of this study the following recommendations were drawn:

5.2 **Recommendations**

From the results it was found that the credit subsidy has a positive and significant effect on smallholders maize productivity. This study therefore recommends that the authority concern in credit allocation need to continue and even increase the amount of allocation in order to enhance the production capacity of the smallholders farmers in Chókwè district. In addition the study also recommends extension advocacy on the best farming practices that can lead to increased productivity. To ensure that this is achieved this study further recommends opening up of rural areas by providing quality roads by the government to ensure accessibility of smallholders by extension officers and also for the smallholders to access both the input and output markets where they can sell their output and therefore increase their farm incomes.

5.3 Suggestions Areas for Further Research

a) Further empirical research on Gender, Seven million program and productivity should be carried out to assess whether projects led by women are more serious as proposed by some few analytical studies. This will enable policymakers to revise the guidelines of the program and include gender related issues

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APPENDICES

Dear respondent!
My name is Sérgio Ponguane, a student from Egerton University-Kenya but working at Higher Polytechnic Institute of Gaza (ISPG). I am conducting a research study on the Effects of the Seven million program on productivity and income of smallholder farmers in Chókwè as part of my thesis which leads to the award of Master of Science Degree in Agricultural Economics. The purpose of this exercise is purely academic. As a respondent you are assured that all information given will be treated with high confidentiality and none will be released to anyone else. Where additional information may be useful, feel free to provide it.

QUESTIONNAIRE FOR THE BENEFICIARIES OF CREDIT UNDER THE 7 MILLION PROGRAM IN CHÓKWÈ DISTRICT, MOZAMBIQUE.

Please tick the case which better describes your situation and give a brief and precise answer where space is provided. DATE...../...../.....Local.....

Enumerator.....

PARTE I: HOUSEHOLD COMPOSITION AND STRUCTURE

Name of the respondent: (optional).....
Gender: Male [___] Female [___]
Age [___] years

Education Level. Years of schooling [___] Primary 1st degree [___] Primary 2nd degree [___]
Secondary 1st degree [___] Secondary 2nd degree [___] University [___]

Ocupation: unemployed [___] Salaried employment [___] Agriculture (self-employment) [___]
Other (self employment) [___] Retired [___]

If beside agriculture you do have another job can you provide the interval where fall your salary (in meticais).
Less than 5000 [___] 5000-10.000 [___] 10.000-20.000 [___] 20.000-30.000 [___]
30.000-40.000 [___] 40.000-50.000 [___] Greater than 50.000 [___]

Household Size (Number of members in the household) [___]

PART II: FARM CHARACTERISTICS

Name of the
Project.....

Did you recieve credit? **YES**[___] **NON**[___] if **No** please can you tell us how do you finance your activities

.....
.....
.....

Do you own the land? Yes [____] NO [____]

If NO who is the owner of the land? [_____]

For how long have you been farming? [___] years

How big is your cultivated land? [___] Ha

Did you use fertilizer last season? **YES** [___] **NO** [___] if YES how many [___] KGs?

If you received credit how much in METICAIS? **< *50.000*** [___] / **50.000 *-100.000*** [___] / ***100.000 – 150.000*** **[**___] **> *150.000*** [___]

Did you use all of it in production [___] Part of it [___] none [___]

If part of it or none can you please tell us for what purposes did you use the money?

.....
.....
.....
.....
.....

Who assists you? Do you hire workers? [___] Family members [___] none [___]

If you hire workers can you please tell us whether: PERMANENTS [___] SEASONAL [___] BOTH [___]

How many: SEASONAL [___] PERMANENT [___]

If Family members, how many? [___]

How many contacts with extension providers did you receive? [___]

How far is the output market in Km [___] and input market? [___]

Apart from fertilizer do you use other technology? NO [___] YES [___] If YES which one?

Irrigation [___] Pesticides [___] Other [___]

Did you receive any visit from FDD providers?

YES [___] NO [___] If yes how many times? [___]

Before receiving the loan which mean were you using for farming?

Manual [___] Animal [___] Mechanic [___] If Animal/Mechanic hired [___] Own [___]

After receiving

Manual [___] Animal [___] Mechanic [___] if Animal/Mechanic: hired [___] Own [___]

If hired how much did you pay per ha [ ] MT

Which kind of seed did you use?

Improved [___] last season [___]

How many Kgs/ha [ ] Kgs. If improved which one? PAN 67 [ ] Matuba [ ] other [ ]

If other which one? [_____]

How much did you pay for each Kg of seed? [ ] MT

How much did you repay? [ ] MT. For how long will you pay [ ] years

How do you sell your produce?

Personally [ ] in group [ ] broker [ ]

From which place do you sell your produce?

Farm [ ] local market [ ] out of the district [ ]

If you sell out of the district, who pays the cost of transportation

You [ ] buyer [ ]

Which mean of transport do you use? [_____]

PART III: ASSETS OWNSHIP

Do you own livestock? **NO** [ ] **YES** [ ] if YES how many heads?

Cattle: 1 - 5 [ ] **5 – 10** [ ] **10 – 15** [ ] **> 15** [ ]

Goats: 1 – 5 [ ] **5 – 10** [ ] **10 – 15** [ ] **> 15** [ ]

Sheep: 1 – 5 [ ] **5 – 10** [ ] **10 – 15** [ ] **> 15** [ ]

Pigs: 1 – 5 [ ] **5 – 10 [**] **10 – 15** [ ] **> 15 [**]

Poultry: 1 – 5 [ ] **5 – 10 [**] **10 – 15** [ ] **> 15 [**]

Do you own one of these goods?

Own house **[**] Bicycle [ ] cell phone **[**] TV [ ] Motorbike **[**] Computer [ ]

Car-pick up **[**] Tractor [ ]

How many Kgs/Ha did you harvest last season?

Maize [ ] Rice [ ] Vegetables [ ] Others [ ]

Do you sell your produce? **YES** [ ] NO [ ] .If yes, for how much do you sell? [ ].MT/Kg.
How many kgs did you sell? Maize [ ] Rice [ ] Vegetables [ ] Others [ ]

Net gain /ha	
Revenu	
Cost	
Profit	

Do you intend to increase your production? YES [ ] NO [ ]

Do you think that credit changed/would have changed the level of production? YES [ ] NO [ ]

How?.....
.....
Comments.....
.....
.....
.....

Thank you for your Cooperation