

MEASUREMENT AND DETERMINANTS OF COST EFFICIENCY AMONG
CREDIT UNIONS IN THE GAMBIA

By

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DECLARATION

I hereby declare that this submission is entirely my own work towards the M.Phil. (Agricultural Economics) and that, to the best of my knowledge, it contains no materials previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This research work is dedicated to my lovely parents, late Papa Ndaparan Mendy, late Mama Nasia, Pa Paul Mendy, Ya Lisa Gomez ,Mama Ngatou, Ya Marlen, and Mama Sona without whose unflinching and continuous support I would not have been who I am today. I owe them more than strict meaning of the word dedication can carry. In other words, I cannot at this moment muster enough words with which to express how much indebted I am to them. Another stretch of dedication also goes to my brothers and sisters such as Rev.Fr. John Mendy, Emmanuel Mendy, Paulino Mendy, Francisco Ounitchapen Mendy, Mario Mendy, Rose Mendy, Sinyu Mendy, Veronica Mendy, Sosinya Mendy, Monica Mendy, Nina Mendy, Finna Mendy, Antoinet Mendy, Nenneh Correa Pierre Mendy and Penda Mendy.

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ABSTRACT

The aim of this study was to measure and examine the determinants of cost efficiency among Credit Unions (CUs) in the Gambia from 2009 to 2013. A total of 50 CUs were sampled across the sector of financial cooperative credit unions using simple random sampling technique. Both secondary and primary data were collected from the NACCUG and some individual CUs for analysis. Cobb-Douglas cost frontier and cost efficiency ratios were estimated by employing the Stochastic Frontier Approach (SFA). Results from the study showed that credit unions in the Gambia are relatively young since they had been in operations for an average of six (6) years as at 2013. A typical credit union in the Gambia had 699 active clients who save and take loans from the institution periodically. The average savings balance was found to be GMD 8.38 million compared to average loan portfolio of GMD 6.96 million. The cost of operations for a typical CU in the Gambia rose by 10% from an annual average of GMD 252,000 in 2009 to GMD 278,000 in 2013. Number of active borrowers, personnel cost and gross loan portfolio were found to have significant positive effect on annual operating costs of CUs in the Gambia. Credit unions in the Gambia were found to be cost inefficient with average cost efficiency ratio of 90%. Factors that influence cost efficiency of CUs in the Gambia were found to be borrowers per field officer (BPF), depositors per staff (DPS), average loan balance (ALB), average savings balance (ASB) and age of the credit union. Age of CU was found to have a significant positive effect on cost efficiency in the Gambia due to the presence of a positive learning curve. The study rejected the null hypothesis of tradeoff between outreach and cost efficiency since the two were found to be complementary. To reduce cost inefficiency, the study recommended that CUs in the Gambia should improve on

savings mobilization through the introduction of innovative savings products, among other things.

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LIST OF ACRONYMS

| | |
|--------|---|
| AE | Allocative Efficiency |
| AfDB | African Development Bank |
| AGRA | Alliance for Green Revolution in Africa |
| ANR | Agriculture and Natural Resources |
| CBG | Central Bank of the Gambia |
| CUs | Cooperatives Credit Unions |
| DEA | Data Envelope Approach |
| DMU | Decision Making Unit |
| DOA | Department of Agriculture |
| EE | Economic Efficiency |
| FC | Financial Companies |
| FFI | Fiduciary Financial Institutions |
| FGD | Focus Group Discussion |
| FINSSP | Financial Sector Strategic Plan |

| | |
|---------|---|
| GDP | Gross Domestic Product |
| GMD | Gambian Money in Dalasi |
| GTUCCU | The Gambia Teachers' Union Cooperative Credit Union |
| LOTG | Laws of the Gambia |
| MDGs | Millennium Development Goals |
| MFIs | Microfinance Institutions |
| MOA | Ministry of Agriculture |
| MOFEA | Ministry of Finance and Economic Affairs |
| NBFIs | Non-Bank Financial Institutions |
| NGOs | Non-Governmental Organizations |
| PAMSCAD | Programme of Action to Mitigate the Social Cost of Adjustment |
| RFP | Rural Finance Project |
| RFCIP | Rural Finance Community Initiative Project |
| SACAs | Savings and Credit Associations |
| SDF | Social Development Fund |
| SFA | Stochastic Frontier Approach |
| SFPF | Stochastic Frontier Production Function |
| TE | Technical Efficiency |
| UNDP | United Development Programme |
| WAAPP | West Africa Agricultural Productivity Programme |

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Microfinance institutions (including credit unions) provide financial services to economically active clients to enable them expand their businesses. Lending by MFIs is a challenging proposition in any setting particularly in the developing world, where legal/judicial enforcement is weak, where information about the ability and willingness to repay loans is not readily available and where many of the prospective borrowers are from a poor household/ firms; many of whom have never before borrowed and cannot pledge collateral to guarantee repayment (GonzalezVega, 2003; Conning & Udry, 2007). Efficiency in microfinance institutions (MFIs) refers to how well MFIs allocate the input resources such as asset, subsidies and personnel to produce output measured in terms of the loan portfolio and poverty outreach (Bassem, 2008). Efficiency of MFIs was not an area of focus for a long time due to a number of factors. First, most microfinance projects were entirely donor funded and only required social impact as the measure of the achievement of the project objectives (Brau & Woller, 2004). Secondly, microfinance was initially designed as credit delivery system that provide financial services to the poor by removing the need for collateral and creating banking system based on mutual trust, accountability, participation and creativity. With the primary objective of poverty alleviation, Microfinance institutions only focused on outreach to the poor and social impact through microfinance projects. Lastly, it was due to institutional characteristics of Microfinance firms which make them inefficient firms as compared to the larger financial institutions (Brandt, Park, & Sangu, 2003).

According to (Hulme & Mosley, 1996) the unit cost for small loans to the poor customers by microfinance institutions is higher as compared to unit cost of larger loans. Furthermore, making small loans to customers involves high transaction costs in terms of screening, monitoring and administration costs per loan (Conning, 1999) and (Paxton, 2002).

Recently MFIs were confronted with a number of challenges which have affected their operations and the way of doing business (Rhyne & Otero, 2006); Dooley, Folkerts-Landau, & Garber, 2007). With increased number of institutions offering microfinance services and involvement of commercial banks in microfinance services, competition has dramatically increased in which microfinance institutions not only compete for customers but also for scarce donor funds to finance their operations (Hermes, Lensink, & Meesters, 2009). This resulted in the need for efficient microfinance institutions with better allocation of input resource in the production of output. An efficient operation in microfinance institutions is a key to financial sustainability and improved performance. Efficient microfinance firm allocate better its resources and minimize wastes which in turn leads to both improved financial performance and social performance. (Bassem, 2008) argues that, the fact that microfinance institutions do not operate in the same way as commercial banks, does not mean that efficiency and profitability are not important; rather these institutions have to strike a balance between efficiency, financial sustainability and profit seeking on one hand, and social effort through improved economic and living conditions of urban and rural poor on the other hand. Due to this double bottom line of Microfinance institutions, they can only be declared efficient when they optimize their resources to satisfy both financial and social outputs (Kipsha, 2013). An efficient financially viable microfinance institution is also able to develop scale and financial leverage

which enables it not only to reach more poor people but also to multiply contributions from donors by trapping more funds from commercial sources.

1.1 Problem Statement

The evident exclusion of the poor from the banking sector in the Gambia has been cited, among others, as one of the most austere effects of financial market liberalization since 1980s. Today, Microfinance institutions (MFIs) including Credit Unions are expanding their services and outreach. An estimation of 70 million poor people in 40 countries were reported as the total number of beneficiaries of microfinance in 2005 (Daley- Harris, 2009). Today, the number of microfinance beneficiaries could even be more. In addition, evidence exists to reinforce the idea that microfinance cooperative credit institutions on the whole are making significant headways in changing the status of members of such CUs in various countries (Morduch & Graduate, 2002).

The Gambian economy has witnessed an unprecedented wave of increased financial initiatives over the past decade in the financial sector. In the light of this, both the Banks and Non-Bank Financial Institutions (NBFIs) are competing and devising various means of capturing sizeable clients through offering favorable competitive terms of credit retailing. In the face of this strong competition, some Credit Unions still employ few officers to run the administration of the union and are also unable to employ highly professional and skilled personnel to run the affairs of the unions.

The most important problem that MFIs face is high cost of operations due to small loan sizes for many individual clients; this results in high interest rates or bank charges. As at now, the benchmark interest rate in the Gambia was last registered at

23 percent for both actual and previous. It is highest and lowest interest rates are at 34 and 12 percent respectively. From 2002 until 2016 it is at an average of 19.21 percent as reported by Central Bank of the Gambia (MoFEA/CBG, 2016). Also, providing safe, reliable and flexible savings services on small scales of operations implies high transaction costs.

In summary, there may be wide variations in the inefficiencies of cooperative credit unions in the Gambia which could be due to poor product designs, poor portfolio quality, ineffectiveness of the marketing strategies, limited degree of commitment towards clients and staff, low level of experience of the cooperative credit unions, ineffectiveness of the training programmes and low productivity of the workers. The inefficient administration of loans may lead to high loan default rate; thereby, causing the CUs to be shying away from extending credit facilities to farmers and other stakeholders who need credit. In the Gambia, marked strides are being made by the central government and donor agencies to make CUs a workable intervention to reduce poverty. However, if the costs of operations of CUs in the Gambia are not examined and factors that affect cost efficiency determined, efforts aimed at improving the performance of CUs in the country may not be realized.

Therefore, this study sought to determine the level of cost efficiency among cooperative credit unions in the Gambia and the key factors that explain the level of cost efficiency.

1.2 Research Questions

To achieve the main objective of the study, the following research questions were answered:

1. What products do CUs in the Gambia offer to their members?
2. Are Credit Unions in the Gambia cost efficient?
3. What are the main determinants of cost efficiency among Cooperative Credit Unions in the Gambia?
4. Is there a trade-off between cost efficiency and outreach of Credit Unions in the Gambia?
5. What critical constraints do Cooperative Credit Unions in the Gambia face in their operations?

1.3 Objectives of the study

1.3.1 Main Objectives

The general objective of the research was to ascertain how cost efficient Credit Unions in the Gambia are in their operations and the key factors that influence the level of cost efficiency.

1.3.2 Specific Objectives

The following specific objectives were addressed in the study:

1. To identify the main products offered by CUs in the Gambia to their clients.
2. To examine the key factors which affect the annual operating expenses of CUs in the Gambia.
3. To determine the cost efficiency level of Cooperative Credit Unions and the key drivers of cost efficiency in the Gambia;
4. To identify the trade-off between cost efficiency and outreach of Credit Unions in the Gambia.

5. To identify the key constraints faced by Cooperative Credit Unions in the Gambia.

1.5 Justification/ Rationale

In the Gambia, the use of microfinance is not recent; history suggests that it has long been used as a means of organizing funds at the informal sector for the economically active but financially constrained and vulnerable in society through the concept of rotatory savings (Osusu). The activities of local money lenders and family loans had also been in place from time immemorial albeit at exploitative terms and conditions (Steel & Andah 2003).

The researcher was inspired by the current status of CUs both in social and financial sustainability in the phase of fighting poverty in the Gambia. As it is evident from previous studies that the level of vulnerable people is on the increase in most regions (as a result of Social, economic and political unrest) and the need for financial services or assistance is observed as a general outcry for the victims. This is attracting many donors and financial institutions to venture into the microfinance business, thus encouraging high competition among players. As a result, there is a need to study how efficient the cooperative credit unions are in advancing credits as most rural people are engaging in farming activities for their income and family feeding.

Furthermore, a lot of the efficiency studies were conducted on production of agricultural commodities, commercial banks and the industrial sectors. This study was aimed at identifying factors that affect cost efficiency in cooperative credit unions to mark a deviation from previous works. It will help the management and board members in decision making to be able to identify problems that affects cooperative

credit unions especially in terms of costs of operations. MFIs regulators and member body will also be informed on the factors that affect the level of inefficiency or efficiency in terms of bridging the knowledge gap through training.

Most works on efficiency have largely employed a translog function in assessing the efficiency levels of organizations, (Hartarska, Caudill & Gropper, 2006; Hermes, Lensink, & Meesters 2009; Saad & El-Moussawi 2009). This work utilizes the Cobb-Douglas function, which is also used highly in empirical research, (Masood & Ahmad 2010) and (Baten, Kamil & Haque 2009).

In The Gambia, the organization of cooperatives has scanty information with regards to its existence and performance. This is because there is no literature to provide information on its importance and existence. In 1991 the National Association of Cooperatives Credit Union (NACCUG) came up with the assistance of IRISH Cooperative Credit Union.

The motivation for undertaking this research was therefore in two ways; first, cooperative institutions have gradually become central players in the country's development agenda (Kwarteng, 2010). Their actions and inactions have therefore become sensitive variables in the discharge of the country's development agenda. The efficient administration of microfinance institutions both in the mobilization of capital resources and their delivery of credit is key to a long term improvement in the welfare and stimulation of economic growth.

Secondly, it is identified that although extensive works have been done on cost efficiency in microfinance and financial market worldwide; very little work has been conducted in the case of the Gambia. Most work on efficiency with respect to this

country's case are in the area of commercial banking units and other aspects of the manufacturing and production sector; even though the importance of microfinance cooperative industry to national growth cannot be denied. Hence, finding answers to the questions posed by the study will among others help to increase knowledge and understanding of the dynamics pertaining to the operations of CUs in the country and help decision makers to determine which policy direction to pursue.

1.6 Organization of the Study

The study was organized into five chapters as follows. Chapter one provided the general background issues to the study. It also provided the statement of problem and research questions. Again, it sets out the objectives of the study and provided justification for the study. Chapter two reviewed the relevant literature of the study including the theoretical and empirical issues.

The methodology presented in chapter 3 focused on how the various questions posed by the study were going to be answered: the method of estimation; the procedure for measuring level of inefficiency and the mode of analysis were considered in this section. A look was also taken at the source of data collected and the study period from 2009-2013 was captured by the study. The presentation of results was covered in chapter four whilst the fifth chapter entailed a summary or conclusion of the main findings and policy recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter was divided into three broad parts. The first part attempted to give a concise pictorial view of the Micro-financial Institutions that have contributed to agricultural and non-agricultural lending in the Gambia; its components, successes, constraints and frameworks utilized as outlined.

The second part attempted to bring out some of the conceptual issues pertaining to cost efficiency. A framework for measuring cost efficiency and some of the limitations that arise in the usage of any particular estimation technique have been looked at. In addition, this is followed by an appraisal of some empirical studies on efficiency and the estimation techniques that were employed in the study.

The third part of this chapter looks at the broad concept of financial institutions, their scope, and the concept of efficiency in the area of finance and its contribution to agriculture in the struggle towards attaining food security. This is followed by a review of research works that have been conducted in the area of finance and cost efficiency. The final part sums up the main points to provide a conclusion of the main texts in this literature.

2.2 The Over view of Micro financing in Africa

An overwhelming majority of the economically active population, above all in rural areas, so far remains excluded from the formal financial system; and even those who have access to the financial system can still not get all the services they need.

Microfinance has evolved over the years to help address this gap in financial services delivery, especially in developing countries.

It is reported that microfinance has always existed in Africa, albeit informally.

Revolving credit associations, —tontines were the first form of microfinance; credit unions rapidly expanded; and today the panorama is quite diverse, with individual lenders, self-managed groups, cooperatives, NGOs, regulated MFIs, and even banks, providing a wide range of financial services (Camara, 2013).

Historically, microfinance as a financial institution in Africa has developed in different stages across the region. Financial intermediaries such as cooperatives, rural and postal savings banks pioneered the industry in the 1970s, especially in West and East Africa. In the 1980s and 90s, the sector saw a number of donorsupported credit-only NGOs develop and sometimes transform into new types of non-bank financial institutions by the end of the 90s (Camara, 2013). Today West Africa is dominated by credit cooperatives, while regulated non-bank financial institutions stand out in East Africa, and Southern Africa is mainly served by a large number of NGOs, some downscaled banks and newly established special-purpose MSME banks. Although the majority of reporting MFIs are regulated, the largest number of unregulated MFIs is located in East Africa (Kablan, 2012). However, this number is likely to decrease as many Ugandan unregulated MFIs continue to take advantage of an evolving regulatory environment, beginning in 2004, which allowed them to transform into regulated deposit taking institutions.

From a report by (Camara, 2013), it was reiterated that the Consultative Group to Assist the Poorest (CGAP) counted 467 active microfinance programs in SubSaharan Africa (SSA) in 2006 and there are handful of large institutions, including 16 MFIs

with over 50,000 loan clients each and by scores of small, young MFIs appearing in new and established markets alike. Strengthened by reforms of recent years, African microfinance attracted international attention, resulting in young start-up banks, NBFIs and NGOs setting up activities in Central, East and Southern Africa. For the same year, 190 African MFIs reported to the microfinance information exchange (MIX): they all together reached 4.8 million borrowers with 1.6 billion USD in loans, while serving 7.2 million savers and managing 1.5 billion USD in deposits. MFIs in Africa often serve a mix of poor and more middle class clients in order to achieve better cost coverage (Dalan, Gutierrez, Ramirez & Karel 2010). Financial intermediaries (i.e. institutions accepting savings) specifically cooperatives, reach a higher-end loan clientele on the lending side (usually salaried workers) while handling savings balances that are typically three to five times smaller than the credit balances they offer (Kablan, 2012).

According to (Camara, 2013) a distinctive nature of microfinance in Africa is the large deposit mobilization. Unlike in most regions around the globe, more than 70 percent of African MFIs offer savings as a core financial service for clients and use it as an important source of finance for their lending activities. African MFIs rarely resort to outside borrowing. Research conducted by CGAP in 2004 shows that African MFIs account for only 21% of recipients of foreign investment, and only 6% of total dollars invested by international financial institutions and privately managed funds. In contrast, MFIs in the Latin American and Caribbean, Eastern Europe and Central Asia regions received 7 and 10 times more foreign investment, respectively.

In terms of profitability, African MFIs do not fare well compared to their counterparts in the rest of the world. African MFIs return on assets averages (-2%). compared to

2.5% for the Latin America and Caribbean region, 3% for MENA, 1% for Asia and 1.5% Eastern Europe (Camara, 2013).

According to some estimates, only 1-2 per cent of all MFIs in the world are financially sustainable, i.e. they do not depend on outside subsidies (Deutsche Bank, 2007). Financial sustainability is determined by the extent to which MFIs are efficient in using resources and turning them into services (Hermes, Lensink, & Meesters, 2009).

Recently, research has focused on the possible determinants of financial sustainability of MFIs. In particular, researchers have looked at micro-institutional, as well as macro-institutional and macroeconomic determinants of sustainability. Microfinance-institutional factors that have been discussed among other things are, the type of borrowers, the costs of operation, the type of loans offered, etc. (Cull et al., 2014; Gutiérrez-Nieto *et al.*, 2007; Hermes, Lensink, & Meesters, 2009). Macroinstitutional factors that have been investigated are regulation and economic freedom (Hartarska, Caudill, Gropper, 2006); macroeconomic factors that have been studied are general macroeconomic performance and inflation (Ahlin & Lin, 2006).

In relation to determinants of financial sustainability, MFIs are faced with the challenges of managing their resource well with an increasing concern of poverty alleviation. The poverty alleviation/self-sufficiency paradox underscores the tradeoff between effective service leading to poverty reduction and financial selfsufficiency (Tucker & Miles, 2004). Focusing on sustainability and profitability might lead MFIs to seek to make larger loans to better-off clients in order to gain economies of scale that would both minimize expenses per loan and increase the probability of repayment. Such a strategy, while moving an MFI toward sustainability, would once again leave the poor with limited access to capital. A balance between larger, more likely to be

repaid loans and the continuance of smaller loans to the poor can serve both goals (Tucker & Miles 2004). The balance will be difficult to attain, but a financially sustainable MFI will be able to increase borrowing in private-capital markets, adding to its ability to loan money (Toward, Gibbons, & Meehan 1999). Without sustainability, MFIs are not a going concern, making the goal of poverty alleviation unreachable (Otero, 1999).

Since MFIs have only been able to reach several million of the many million poor, there is constant pressure to expand. Expanding to service more of the poor and, increasingly, the less able to repay, necessitates more capital. At the margin, added capital is more difficult to obtain, requiring higher levels of financial sustainability and all the associated reporting requirements that entails. One avenue to attain operating sustainability, although not necessarily without elimination of all subsidies, is to increase profits by raising interest rates, fees, or both. However, this method shuts out those least able to repay and increases default rates (Tucker & Miles, 2004).

The strategy of extending loan services to more people in order to achieve economies of scale can lead to increasing bad debts if not done properly (Gulli and Berger 1998). Overall, through economies of scale attained by judicious expansion and loan diversification, the larger MFIs that reach more people tend to move closer toward sustainability.

Furthermore, as the number of MFIs has dramatically increased, their main source of funds, nongovernmental organizations (NGOs) has gained leverage in demanding more transparent accounting and audits. Most of the estimated 7,000 MFIs have less than 3,000 clients with less than a 95% repayment record (Tucker & Miles, 2004). Many of these organizations have been unable to control administrative costs. For

some MFIs, high administrative costs are simply a way of doing business that enables staff members to earn a living through the generosity of NGO subsidies. Job creation in the MFI itself was not the original goal, though for some, job sustainability may have become more important than minimizing expenses. This is no longer a viable strategy (Tucker & Miles, 2004). Competitiveness in the market for funds is prompting a return to the original MFI mission motivated by a need for continuing access to capital in some cases, clear plans to attain financial sustainability and thus paving the way forward in realizing vibrant MFIs operation in most regions and assisting donors establish those MFIs that can properly manage and utilize the funds well in the process of efficient MFI service delivery in most regions.

2.3 Credit Unions and their Roles in the Supply of Microfinance in the Gambia

According to Nghiem, et, al. (2000), Microfinance is defined as the provision of a broad range of financial services such as credit, saving, insurance and money transfer for low-income individuals or households. The term *low income* used in the definition of microfinance is a relative concept; it varies from country to country or even among different areas within a country.

The Gambian economy has witnessed alternating periods of buoyancy, stagnation and decline since independence. The reasons for this are varied and complex, but notable among them are changes in the prices paid for the country's major exports, especially groundnuts, cotton and fish, poor incentives for producers, changes in monetary and fiscal policies, management practices and labor productivity.

Nonetheless, the Gambia Government continues to give due attention to the growth and development of the Microfinance sub-sector as it has been recognized as one of

the most effective tools to alleviate poverty as outlined in the PRSP II and Vision 2020 (Senghor, 2008). This is aimed at promoting and supporting access to financial services for the low income households and rural and urban poor not served by commercial banks. The nation's goal is to achieve inclusive financial independence for the entire populace to improve the livelihood of Gambians by enabling people to invest in better nutrition, housing, health and education for their children as well as coping with difficult times caused by crop failures, illness or other calamities.

The financial sector has received and continues to receive enormous support from NGOs and Donor funded projects notably the Rural Finance Project (RFP) funded by IFAD, a follow up to the Rural Finance Community Initiative Project (RFCIP) and the Social Development Fund (SDF) funded by African Development Bank (AfDB). The Central Bank of the Gambia continues to play a pivotal role in the growth and development of microfinance institutions and has recently renewed the policy guidelines and drafted a Non-Bank Financial Institution (NBFI) Bill aimed at creating an enabling environment for building more vibrant and sustainable Microfinance Institutions (MFIs) (Senghor, 2008). Among the MFIs providing financial services to farmers and non-farmers in the Gambia are Credit Unions.

Credit unions or savings and credit cooperatives are member owned financial institutions that offer savings and credit services to their members in developing, transitioning and developed countries. Credit unions serve members of all socioeconomic levels with an array of financial service products. Whether in developing, transitioning or developed countries, the purpose of a credit union remains the same: to provide members with financial and non-financial services to improve their social well-being through asset accumulation and income generation.

Voluntary savings mobilization is a critical tool to this end, equally or more important than the provision of credit services.

It is paramount to note that cooperatives are associations of people formed for the purpose of rendering services and supplying commodities to the members and surplus sharing among financial members. The goal of cooperative in the Gambia is “people helping people”.

The formation of cooperative union was due to a bill passed by Great Britain in the early 1950. It was known as cooperative societies. This bill was captioned in CAP 33 of the laws of the Gambia in 1992 and was amended to CAP 50 chapter 3 of the laws of the Gambia. People within a minimum age of eighteen years were allowed to associate themselves with a viable cooperative of any kind irrespective of any political, social or ethnical discrimination (Cooperative policy document of the Gambia in April 2008). Such cooperatives were under close supervision and monitoring by the Director of Cooperative Development (Registrar of Cooperative Societies) before they could be registered as full fledged cooperatives with limited liability status as stipulated in the Act of 1992 CAP 50, chapter 3 of the laws of The Gambia. (LOTG, 1950)

However, the Act led to the establishment of The Gambia Cooperative Union in 1962. The principal objective of The Gambia Cooperative Union is to put in place viable production and marketing mechanics for its members with emphasis on groundnut being the cash crop of the economy.

The MFIs in the Gambia are classified into three categories such as category A, B and C. The category A depicts the Fiduciary Financial Institutions whilst Category B and

C are the Savings and Credit Companies/Cooperatives, and Savings and Credit Associations (SACAs)/ Credit Unions, respectively.

The recent review of the policy guidelines catered for only three categories of MFIs in the legal and regulatory framework of Non-Bank Financial Institutions (NBFIs) in the Gambia. The hitherto 5 categories would be phased out except the Fiduciary Financial Institutions (FFI), Finance Companies (FCs) and the VISACAs. Fiduciary Financial Institutions, also referred to as Trust Institutions may manage or hold funds for the benefit of microfinance institutions or act as a link between such institutions on one part and a donor or a bank on the other.

At CUs management level, each member is entitled to three times of their savings by the Central Finance Facility (CFF) as loans. The CFF is housed at NACCUG and managed by a committee appointed by NACCUG Board of Directors. The loans from the CFF are considered as interim measure to enable the credit union to meet members' demand for loans and every effort must be made to avoid continuous dependency.

The loans provided are either development loans or quick loan facility. The development loans are granted to credit unions to enable them maintain sound liquidity at all times. These loans may be granted for funding loans to members or to enable the credit unions pursue a development project such as construction or acquisition of land or equipment.

Whiles the quick loan is designed to meet credit unions' demand for loans when liquidity falls below demand. The facility will accord the credit union the flexibility to provide more credit for their members' development projects. The facility will serve

as a standby source of liquidity for credit unions to better respond to members' urgent demand.

2.4 The Concept of Efficiency

(Annim, 2012) provided a working definition for efficiency as the optimal combination of staff time, staff number and cost of operation to respectively disburse and reach the maximum number of loans and savings clients, especially the deprived, while delivering a range of valued services.

(Balkenhoi, 2007) said efficiency in microfinance is a question of how well an MFI allocates inputs such as staff, assets and subsidies to produce the maximum output such as number of loans, financial self-sufficiency and poverty outreach.

To recap the gist of the aforesaid, an MFI pursues efficiency if management affords to concentrate on activities that yield more results at minimum cost to the units and to clients. Hence, attention will be given to the designing of correct product lines, effective market strategy, good targeting efficiency and the gradual removal of bottlenecks in supply.

(Radam et, al., 2010) noted that a production firm is efficient if it cannot improve any of its inputs or outputs without worsening some of its other inputs or output. (Belloit, 2013) also provides a technical definition that exposes how the concept should be understood empirically. According to the author, it is the ratio between actual and potential output.

From the aforesaid definitions, the concept of efficiency connotes the transformation of given inputs to yield the maximum attainable output at the minimum possible cost.

It reflects the exclusive absence of waste to extract the cost minimizing maximum-output levels. These definitions illustrate the concept of Pareto optimality which states that a unit is efficient if it is impossible to make one better off without making the other worse off. When it is possible to make somebody still better off by rearranging bundles of choice variables, a Pareto improvement is said to be made. In production and service delivery, there are different types of efficiency indices researchers may be interested in.

Economic efficiency occurs when there is a least cost procedure for producing a given amount of goods or services with the available inputs. In other words, as indicated by (Førsund et al., 1980), it reflects the capacity to produce a definite output at minimum cost. It evaluates the difference between the expected and the actual given income, quantity and price constraints. Obviously, economic efficiency is a derived concept from the principle of Pareto optimality. A gain in economics efficiency can be considered as equal to a Pareto improvement since it results from a condition of optimal resource use such that one unit was made better off without other units being made worse off.

The study of economic efficiency allows the relative comparison of efficiency among economic units sharing the same characteristics, (Guerrero & Negrín 2005). Two main components of economic efficiency are: technical and allocative efficiency.

2.4.1 Allocative Efficiency

This component shows the ability of a microfinance institution to combine available inputs in optimal proportions given factor prices and available technology. It is concerned with the choice that best compare to the budget constraint among different

possible combinations of input that yield the same amount of the desired output. In other words, it is the ability of economic agents to equate marginal cost with marginal benefit (Guerrero & Negrín, 2005). Allocative efficiency, therefore, measures how well firms combine inputs to minimize the cost of producing a given output level (Radam et al., 2010).

2.4.2 Technical Efficiency

Technical efficiency on the other hand is defined as the ability to achieve a higher level of output given similar levels of inputs (Fabiya et al., 2008). According to (Guerrero & Negrín, 2005) technical efficiency is observed when a firm minimizes the use of inputs in the production of a good given input prices or maximizes the quantity of output given the amount of input. (Radam et al., 2010) also posit that the concept of technical efficiency reflect the measurement of actual input usage relative to the minimum input usage for a given set of outputs or the ratio of actual output to the maximum potential output given the set of inputs.

To measure technical efficiency the question of how much input could be proportionally reduced without changing output produced; or how much output could be enhanced without changing the combination of input; is unraveled. Hence when firms are able to employ less of at least one input and are still able to maintain the level of output or are able to increase at least one output using the same input, then an improvement in technical efficiency is said to be made, (Koopmans, 1951; Murillo-Zamorano, 2004).

2.5 Empirical Literature on Efficiency

2.5.1 Review of Empirical Literature on Efficiency

Although the measurement of cost efficiency has been extensively studied, it was the pioneering works of (Farrell, 1957) which led to serious considerations of the possibility of estimating frontier production and cost functions with a view of harmonizing and bridging a gap between theory and empirical works (Aigner, *et al.*, 1977).

The stochastic cost frontier approach was used to measure efficiency of microfinance institutions. In this approach cost efficiency is measured in terms of how close a microfinance costs lie to the efficient cost frontier for a given technology (similar outputs and working conditions). The efficient frontier is determined by two conditions: minimum use of inputs (technical efficiency) and optimal mix of inputs (allocative efficiency), (Battese & Coelli, 1995) and (Kumbhakar & Lovell, 2003).

The absence of either technical or allocative efficiency or both inevitably results in excess costs that make institutions deviate from cost minimization frontier and creates inefficiency.

Thus, cost inefficiency in our case measures the reduction in cost that could have been achieved if the microfinance were both technically and allocative efficient. In other words, it measures the magnitude of cost that could be reduced to enable the microfinance institutions achieve both technical and allocative efficiency. As cost functions are not directly observable, inefficiencies are measured relative to an efficient cost frontier that is estimated from the data. Thus, microfinance cost inefficiency is defined as the difference between observed costs and predicted minimum costs for a given output, input prices and other institution specific variables. There are non-parametric and parametric methods to measure efficiency of units (for

example, individual institutions, households and so forth). The nonparametric approach is often criticized because of its ignorance to the possible influence of measurement errors and other statistical noises in the data, it does not allow for random error caused, for instance, by luck (Coelli et al., 2005). Within the parametric approach, which accounts for random error caused by data problem and measurement errors, there are again two approaches, namely stochastic frontier approach (SFA) and data envelopment approach (DEA), which vary in their treatment of random shocks on the production process that are not in the control of, for example, a microfinance institution (Aigner et al., 1977; Kumbhakar and Lovell, 2003). We use SFA, as it allows composite error terms that control both for measurement errors and other random effects that are not within the control of microfinance. Specifically, we follow the one step SFA proposed by (Battese & Coelli, 1995), which estimates the cost frontier and inefficiency correlates simultaneously. The two steps SFA, on the other hand, involves a contradiction of assumptions and the inefficiency depends on the explanatory variables that could be partly affected by institution input choices based on knowledge of their level of inefficiency (see Schmidt, & Sickles, 1984 for detailed discussion).

An example of an empirical work on allocative efficiency is presented by (Badunenko, Fritsch, & Stephan, 2005) who proposed that allocative efficiency can be estimated using information on input and output quantities and profit. Using data from 35,000 German firms and a Cobb Douglas production function, their results showed a significant variation of allocative efficiency across the units with a mean score of 91%. In addition to the aforementioned, about 5 percent of firms obtain 20% inefficiency.

Extensive studies in the area of technical efficiency can be found in the works of

(Tahir et al., 2009) who estimated the technical efficiency of commercial banks in Malaysia. They utilized a non-parametric estimation of the efficiency frontier for each year from 2000 to 2006. They found that the domestic banks were more technically efficient with a mean score of 88.7% than the foreign banks with a mean score of 73.3%. (Mahmood, Din & Ghani, 2007) also attempted to estimate the technical efficiency of the manufacturing sector in Pakistan between two periods 1995/96 and 2000/01 using a Cobb Douglas production frontier model. Their findings showed a marginal change in mean efficiency score from 58% in 1995/96 to 65% in 2000/01; indicating a change of 11.94%. They attributed the low efficiency scores to the protective trade policy environment. Other works include: (Yu, 1998; Hasan, Lozano-Vivas, & Pastor, 2002; Nghiem, Coelli, & Rao, 2006).

As mentioned earlier SFA was utilized in the current research because it had at least two advantages over nonparametric approaches. First, nonparametric methods assumed that the variations in firm performance are all attributed to inefficiency. This assumption is problematic as it ignored the measurement errors, omitted variables and exogenous shocks in the measurement. Second, hypotheses testing was carried out for the parameters estimated by parametric methods (SFA). Main disadvantage of using parametric methods was its restrictions on the observed datasets through the imposition of functional form; meanwhile, efficiency measurement was also highly dependent on whether the functional form reflects the reality or not (Masood & Ahmad, 2010).

SFA models a cost, or a production frontier with an error component that is decomposed into two. One component represents statistical noise; and the other component captures for inefficiency. The inefficiency error component was assumed

to be either a half normal, exponential, truncated normal or gamma distributed. (Berger & Humphrey 1997; Murillo-Zamorano, 2004).

The purpose of the selection of this was because of its ability to control for statistical noise whilst at the same time capturing for pure wastes effects being generated as a result of misapplication in resource utilization. Also, as it was expected, there was a significant heterogeneity between units in the financial cooperative credit unions industry in the Gambia, and therefore SFA was better estimation technique for such a study unlike other techniques especially DEA which did not show true representation of inefficiency scores under such a case, (Mester, 1996).

2.5 Cost Efficiency in CUs

According to the comprehensive review of financial sector efficiency analyses by (Berger & Humphrey, 1997), efficiency studies can be broadly classified into two approaches, namely parametric and non-parametric. The former takes into account random disturbances in the measurement of efficiency whilst the latter assumes no random error.

However, the parametric approach needs to assign a functional form for the estimated frontier whilst the non-parametric approach does not need any assumption on functional form. Different assumptions about the probability distribution of efficiencies further distinguished the parametric approach into various techniques. Likewise, the nonparametric approach may be classified into several techniques with differing assumptions on input and output combinations, and the convexity of the frontier.

(Quayyum & Ahmad, 2006) used DEA to estimate the efficiency and sustainability of microfinance institution working in the South Asian countries of Bangladesh, Pakistan and India. They considered both inputs oriented and output oriented methods by assuming both constant returns and variable returns to scale technologies. The variables selected were divided into different groups based on location, basic characteristics – age and size, financial management and performance to estimate variants of efficiency – technical efficiency, pure technical efficiency and scale efficiency. They assumed that the large and more experienced firms may perform better than those having less experience and with smaller size whilst higher debt-equity ratio (as a proxy for financial management) represented a reduction in firm's efficiency.

(Tariq & Ahmed, 2008) also present empirical findings on the case of 40 MFIs in India by applying a stochastic frontier approach for unbalanced data. The objective was to attempt to estimate the technical efficiency level and efficiency drivers of the microfinance institutions. Maximum likelihood estimates of the parameters of the Cobb Douglas stochastic frontier production function and the technical inefficiency effects models were estimated. The findings showed that the mean efficiency scores was low about one-third even though it was increasing over the sampling period, 2005 – 2008. This indicated that the observed units could increase output levels by as many as three times the same amount of input and technology. There were also evidences of strong efficiency variations across regions. The southern microfinance units were found to be more efficient than the others; also of the total observed units, about 14 microfinance institutions had their efficiency level below one-half whilst a total of only 5 institutions had their efficiency score above 50%. Their findings also showed no trade-off between efficiency and outreach. The age of the institution representing

the level of experience gained; location and regulation were estimated as the significant determinants of the efficiency level.

(Chen, 2009) uses bank level data to study the efficiency of the banking sectors of 10 sub-Saharan African middle-income countries. The major purpose of the study was to find common factors that could help explain the differences in efficiency among banks in the region. The author focused on the cost efficiency of the banks utilizing aggregate influence rather than bank or country specific levels. Stochastic frontier approach was used to compute the efficiency scores. The total cost (C_{it}) included both interest and operating expenses. Outputs (y_{it}) were measured by all the products the bank offered. Inputs included deposits and other borrowed funds, labour, and fixed capital. The price of deposits and other borrowed funds was calculated by total interest expense divided by total deposit and other borrowed funds. The price of labour was measured by personnel expenses divided by total assets. The price of fixed capital was calculated as total expenditures on these assets divided by total fixed assets. To control for scale biases in the estimation, the study used fixed equity capital (z) to normalize cost and output quantities. The input prices were also normalized by the price of fixed capital to control for homogeneity of the model.

The result of the study indicated a possible 20-30% reduction of total cost by the banks if they operated on the efficient frontier. It was also found that the foreignowned and private banks were more efficient than the public banks. Among the factors that affected efficiency levels, the authors found that macroeconomic stability, depth of financial development; competition and strong legal framework were important drivers of efficiency. The policy implication was therefore to encourage programs that facilitated strong competition, improvement in governance and stronger institutions.

(Hermes et, al., 2009) also conducted a study to find out whether the extent to which domestic financial market are developed has an impact on the efficiency of microfinance institutions. Using of data of 435 MFIs over the period 1997-2007 with the application of SFA estimation procedure, the researchers investigated whether the country level financial systems could influence how microfinance institutions have to operate. Their argument was that, on one hand was the possibility that MFI could do well and expand their operations due to competition as a result of commercialization, stringent regulatory and supervisory roles of apex institutions, learning curve effects and external economies of scale; whilst on the other hand lies the possibility of substitutability effects as formal banks expand and take advantage of new viable, less risky investment opportunities that exist in the microfinance sector. This phenomenon, they postulates will crowd out MFIs, thereby contracting their operations since they may not have the requisite resources and the tenacity to compete with the formal banks.

To analyze the relationship between efficiency and domestic financial development, the authors specified an inefficiency model with a number of proxies for financial development plus other control variables that affect the existence of wastes in the industry. The results of the findings showed that evidences exist for a case of positive relationship between financial development and the efficiency of microfinance institutions. That is the external conditions in which MFIs work strongly influences their functionality. The authors therefore argued that better developed financial systems culminate into cost reducing activities of microfinance institutions since they foresee an imminent strong competition in the market. Some empirical works on Ghana can also be found in the works of (Mohammed & Alorvor, 2004; Frimpong, 2010); which have also been reviewed below.

Mohammed & Alorvor, 2004) examined the role of foreign human and physical capital in the productive efficiency of manufacturing firms in Ghana. The objective was to compare efficiency scores of two groups of firms- firms with foreign presence and local firms- that have heterogeneous technology. Surrogate aims of the study were also to compare technological gaps of firms with and without foreign human capital; and to identify the determinants of technical efficiency of the manufacturing units. A stochastic metafrontier production function which accommodates differences in technology was used in the studies. The data was selected from a sample of 200 firms located within the four major cities of Ghana:

Accra, Kumasi, Takoradi and Cape Coast.

The authors specified a translog stochastic production function for the two groups. The study also employed the minimum sum of absolute deviations in the construction of the metafrontier which involves solving linear programming problem subject to constraints. The results of the research indicated that the manufacturing firms in Ghana are generally less efficient – the maximum efficiency score for the different firms were less than 45% and micro and small firms with foreign presence had very low maximum efficiency scores of 11.3% and 13.4% respectively; indicating that local firms were more efficient. The authors also found technical efficiency to be influenced by such factors like firm size, food producing firms, profits and location. For instance, pertaining to location, it was found out that firms located in the Accra had generally better efficiency scores than the other three cities. They also found physical capital to be more productive in the local firms, which implies that foreign physical capital to local manufacturing firms in Ghana is more important than the foreign human capital.

(Frimpong, 2010) also examined the relative efficiency of banks in Ghana during the year 2007 using input oriented intermediation-based approach of DEA estimation technique. The author employed the Charnes, Cooper & Rhodes (CCR) model to highlight average efficiencies across the surveyed Ghanaian banks; both overall and by group. The results of the survey showed that only four out of a total of 22 banks were efficient, implying 18% of the banks studied; of which three were relatively new and small domestic private banks and the other being a foreign entity. The study found the overall mean technical efficiency score to be 74% whilst domestic private banks were portrayed to be the most efficient group of banks with an average of 87% efficiency score followed by the 72% of foreign banks. The overall average technical inefficiencies, according to the author, ranged between 12.36 and 90 percent, implying that average banks consumed 12.36 - 90 percent more resources than was needed to get to the same levels of output if they had been efficient. The lowest performing banks were found to be state-owned banks which according to the author can be attributed to lower tendencies of achieving efficiency by management of state-owned banks.

2.5.2 Factors affecting the Cost Efficiency in CUs

It is useful, at this juncture, to investigate the sources of these inefficiencies across the group of microfinance institutions. This is done by regressing the firm-specific variables on the efficiency indices through what is known in literature as “secondstep” estimation, (Bravo-Ureta & Pinheiro, 1997). Analyzing the association between cost efficiency and the independent variables; seemingly unrelated regression approach (SUR) estimates showed that the coefficients for *AGE*, and Average loan balance (*ALB*) were significant. Average saving balance (*ASB*) was negative and significant;

which agrees with *a priori* expectation. The coefficient for *Region* was also positive and significant but at only 15% significance level.

(Tariq et, al., 2008) indicated that the positive coefficient of *AGE* implies that inefficiency deteriorates as the microfinance institutions grow. *Age* controls for the effect of experience and learning on cost efficiency. The presumption is that the older the microfinance institution, the more the experience to overcome excess costs and optimize mix of inputs. However, as far as age is concerned, the other way round can also hold, as more recently established microfinance institutions have the opportunity to learn from the existing knowledge accumulated by their antecedents.

However, the implication of the signs of *ALB* and *ASB* is that the microfinance institutions are dealing with both poor and relatively rich households. This may describe a good scope of outreach. It could also mean that MFIs are rewarding the small regular savings of clients with huge loans; and not that they target the relatively rich per se.

The positive coefficient of the parameters for productivity (*BPF* and *DPS*) prove that the performance of the staff has a significant impact on the efficiency of the CUs. The higher the productivity of the workers, the more efficient the institution. However, variations of productivity levels of workers across the industry can be explained by the nature of the training programmes the CUs conducts for the staff, the skills sets of the staff, the capacity of the MFI to attract skilled personnel, the degree of motivation-salary structure and other incentives to output and also may be as a result of the marketing strategy of the microfinance institution. Also, the cost per borrower (*CPB*) is used to give a good proxy for service delivery.

By using Cobb-Douglas stochastic frontier analysis on both the cost and production functions of the microfinance institutions in Ghana, (Annim et, al., 2010) and Hag et al (2010), indicated that the increasing mean efficiency scores over the years for both cost and technical efficiency lend credence to improvements in the strategies of microfinance institutions in Ghana which also supports that an improvement in the management decisions of CUs can bring efficiency. It is also evident that the maturity of firms affects efficiency. According to (Gonzalez, 2008), CUs efficiency is strongly related to age through a positive learning curve. However, unlike the findings of (Hermes et, al., 2009) which established a significant trade-off between cost efficiency and outreach, their results indicate that efficiency and outreach are complementary. (Martinez-Gonzalez, 2008) also found a diminishing trade-off between outreach and efficiency.

Evidence is also given of a strong presence of inefficiency in the choice behaviour of the MFIs in Ghana. Computed cost efficiency scores were generally low. The mean scores of 58.40% in (Amanor, 2012) is a strong indication that the microfinance units are operating below their optimal possibility curve; hence not efficient. This conclusion is also consistent with the results of (Frimpong, 2010) who also saw evidences of strong presence of inefficiencies across the universal banking institutions in Ghana between 33-89%.

From all indication, the microfinance institutions must enhance their capacities in the area of training, logistics, market surveys and strategies in order to improve on efficiency. Indeed this view is confirmed with the result obtained for AGE in (Amanor, 2012) which is a proxy for the experience of MFIs.

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CHAPTER THREE

3.0 STUDY AREA AND RESEARCH METHODOLOGY

3.1 Study Area

The study area covers Banjul, Kanifing, North Bank Region, Bwiam, Brikama, Bansang and Basse chapters in the Gambia (Figure 3.1). The Banjul chapter exclusively consists of work-based Credit Unions whilst the remaining chapters sparsely comprise of some work-based and community-based Credit Unions.

Figure 3.1: The Map of the Republic of the Gambia



3.2 Type and Sources of Data

The study made use of both primary and secondary data. The primary data was collected from the head offices of registered Credit Unions (CUs) in National Association of Cooperative Credit Unions in the Gambia (NACCUG) and secondary data was collected from the credit unions' financial statements and balance sheets of

CUs affiliated to NACCUG from 2009-2013. Central Bank of the Gambia (CBG) and NACCUG websites were used as the main source of secondary data.

3.3 Sample and Sampling Technique

The study was conducted in five chapters of NACCUG which include Banjul, Kanifing, North Bank Region, Bwiam, Brikama, Bansang and Basse chapters where a systematic random sampling technique was used in the selection of credit unions in each chapter.

As mentioned earlier a stratified random sampling technique was used to select fifty (50) credit unions. The aforesaid sampling technique was used for all the affiliated credit unions to NACCUG in the Gambia since there is availability of the sampling frame. The researcher first listed the CUs according to their locations per region, then calculated the percentage of the CUs in each agricultural region by the total CUs, and then used the percentage of each region to calculate for the total number of CUs which was represented in the sample size for each region. The selection exercise was continued by regrouping the remaining CUs until the researcher got the fifty CUs represented in this study.

3.4 Method of Data Collection

This study involved the use of both primary and secondary sources of data. The primary data was collected in a field survey by direct interview with head offices officials in the study area.

A questionnaire was employed and was divided into five different sections: information on the institutions, performance indicators and financial indicators and operations strategy. The questionnaire developed sought information on

socioeconomic characteristics of the sampled CUs. The final part of the questionnaire solicited information on CUs constraints. Prior to the actual data collection, the questionnaire was pre-tested on a few credit unions to check for the possible errors that could affect the quality and accuracy of data collected.

3.5 Methods of Analysis

The study adopted both descriptive statistics and inferential tools to analyze field data. Descriptive tools like tables, charts, mean, standard deviation, proportions and percentages were used to describe the main characteristics of the CUs surveyed as well as the main products they offered to clients. To estimate operating expenses, audited financial statements of CUs for the past five years were used. Cost components were categorized as personnel, board expenses, interest payments and stationery among others.

The stochastic frontier approach (SFA) was employed to specify the empirical relationship between cost of operation and other important factors or variables.

This work used the (Battese & Coelli, 1995) model specification for panel data generally specified as:

$$\ln C_{i,t} = C(y_{i,t}, X_{i,t}; \beta) + \varepsilon_{i,t} \quad (1)$$

Where $C_{i,t}$ is the total cost CUi faces at time t and $C(y_{i,t}, X_{i,t}; \beta)$ is the cost frontier; $y_{i,t}$ is the logarithm of output of CUi at time t; $X_{i,t}$ is the vector of logarithm of inputs of CUi at time t; $\varepsilon_{i,t}$ is the composed error term which is decomposed as $\varepsilon_{i,t} = (V_{i,t} + U_{i,t})$. The term $U_{i,t}$ captures cost inefficiency and is independent and identically

distributed with a variance of σ_u^2 whilst $V_{i,t}$ captures random effects and is distributed as a standard normal variable such that:

$$V_{i,t} \rightarrow iidN(0, \sigma_v^2)$$

$$U_{i,t} \rightarrow N(0, \sigma_u^2)$$

The stochastic inefficiency term is defined as

$$U_{i,t} = \delta_0 + \sum_n \delta_n Z_{n,i,t} \quad (2)$$

Where, Z represents the vector of n variables that determines the inefficiency of CU_i at time t and δ 's represents the coefficients to be estimated. The inefficiency term is posited generally as having either a half normal distribution truncated normal, exponential or a gamma distribution, (Murillo-Zamorano, 2004; Hermes, Lensink, & Meesters, 2009). In this study, it is assumed that the inefficiency term follows a half normal distribution as typified in most econometric works. The expected value of the U_i 's conditional on the composed error term is measured as follows:

$$E[U_i/e_i] = \sigma \frac{\sigma_\lambda}{1+\lambda^2} \left[\frac{f_s[\varepsilon_i \lambda / \sigma]}{F_c(-\varepsilon_i \lambda / \sigma)} - \frac{\varepsilon_i \lambda}{\sigma} \right] \quad (3)$$

Where $f_s(\cdot)$ is the density of the standard normal distribution and $F_c(\cdot)$ is the cumulative density function, (Murillo-Zamorano, 2004). To yield consistent parameters of the above equations, the maximum likelihood estimation procedure was used. The restrictions imposed by the model leads to various interesting results; such as the value of

$$\sigma = (\sigma_u^2 + \sigma_v^2)^{1/2}; \lambda = \sigma_u / \sigma_v \text{ and } \gamma = \frac{\sigma_u^2}{(\sigma_u^2 + \sigma_v^2)}$$

Where;

σ = Total variation

σ^2_u = Variation due to inefficiency

σ^2_v = Variation due to noise

λ = the ratio of the standard deviation of inefficiency component. How high the value of lambda is, expresses how strong the evidence of the presence of inefficiency in the data is.

γ = Specifies the ratio of the variation due to inefficiency to the total variation. With a parametric restriction between 0 and 1, a high gamma also represents the explanatory power of inefficiency in total variation (Radam, Yacob & Muslim, 2010).

In addition, a log-likelihood ratio test was conducted to ascertain whether the estimated frontier model was robust. This is a test to show the significance or otherwise of the inefficiency component.

The null hypothesis; which states that there is no inefficiency in the observed behavior of units sampled ($H_0: \mu=0$) is tested against the alternative hypothesis; $H_1: \mu>0$. If the null hypothesis is true the stochastic frontier model reduces to an OLS model with normal errors.

The business and socio-economic related constraints were analyzed by the use of

Kendall's Coefficient of Concordance (W) after identification and ranking of the constraints: Where T= sum of ranks for each constraint ranked, m= number of respondents, n= number of rankings.

The Kendall's Co-efficient of concordance test of the significance is given by the following hypotheses:

H_0 =there is no agreement among rankings of the constraint

H_1 =there is agreement among the rankings of the constraint

The test of significance of the Kendall's concordance was done by using the chi-square (χ^2) statistic which was computed using the formula;

$$\chi^2 = \frac{p(n-1)W^2}{1-W^2}$$

Where n = sample size, p = number of constraints,

W = Kendall's coefficient of concordance

The Cronbach's Alpha is a statistic and is commonly used as an estimator of the internal consistency and reliability as specified below;

$$\alpha = \frac{N-1}{N} \left(1 + \frac{\sum_{i=1}^N \sum_{j=1}^N r_{ij}^2}{N} \right)$$

□□

□□

α = Coefficient that indicates the reliability of constraints.

N = Number of components (Items)

$\sigma_{Y_i}^2$ = Variance of observed total test scores for the current sample of CUs

σ_{x^2} = Variance of component i for the current sample of CUs

3.7 Empirical Model Specification

The cost function was specified as equation (4) using the Cobb-Douglas functional form.

$$\ln(TC_{i,t}) = \beta_0 + \beta_1 \ln(salary) + \beta_2 \ln(R_{i,t}) + \beta_3 \ln(Brw_{i,t}) + \beta_4 \ln(Sav) + \beta_5 \ln(GLP_{i,t}) + V_{i,t} + U_{i,t} \quad (4)$$

Where $TC_{i,t}$ represents total costs CU_i faces at time t , $salary$ represents cost of personnel/ labour per annum, R is the interest payment on deposits held per annum, Brw is the number of borrowers, Sav is the total savings and GLP is the gross loan portfolio. Definition of all explanatory variables and their *a priori* signs are presented in Table 3.2.

Table 3.2: The Measurement of Variables

| MEASUREMENT OF VARIABLES | | |
|-----------------------------------|--|---------------------|
| DESCRIPTION | MEASUREMENT | APRIORI EXPECTATION |
| Average Savings Balance per Saver | Total Deposits (Savings)/Number of Savers in GMD | +/- |
| Average Loan Balance per Saver | Total Loan/Number of Active Borrowers in GMD | +/- |
| Savings | Total amount of Savings mobilized by CU in GMD | + |
| Cost per Borrower | Operating Expenses/Number of Borrowers in GMD | + |
| Borrower per Field Officer | Number of Borrowers/Number of Field Officers | + |
| Depositor per Staff Member | Number of Depositor/Number of Staff Members in GMD | + |
| Experience of Credit Union | Number of years since its Establishment | + |

It was from this cost function that the cost efficiency ratios for the observed units were obtained.

To follow the footsteps of most micro econometric researchers on efficiency, the ratios computed were regressed on other control and firm-specific variables to assist in determining the factors that affect cost efficiency among credit unions in the Gambia. The cost efficiency model was specified as:

$$CE = \delta_0 + \delta_1 SAVINGS + \delta_2 CPB + \delta_3 BPF + \delta_4 DPS + \delta_5 ASB + \delta_6 ALB + \delta_7 AGE + v \quad (5)$$

CE represented the cost efficiency ratio for CUI at time t . and v was the disturbance term.

ALB is the average Loan Balance per borrower (in GMD). It was calculated as total loans divided by the number of active borrowers. ASB on the other hand, was the average savings balance per saver of the CUs (in GMD) calculated as the total deposit divided by the number of savers. Again, higher values for this variable indicate that the clients of CUs are rich. A positive (negative) sign for the coefficient also indicates that collecting huge (small) savings from clients improves on the efficiency of credit unions.

ALB and ASB, as indicators of outreach measure the socioeconomic level of the clients that prioritize the services of the CUs. The inclusion of these two indicators of outreach in the model is critical to the research as it illustrates not only the operational methods of the CUs in the Gambia, but also shows whether there is an existence of trade-off between outreach and efficiency.

Age is a measure of the experience of the CUs, i.e. the number of years since establishment. The sign of the parameter assumes is critical: a positive sign shows that experience counts in the CUs; whereas, a negative sign indicate that younger cooperative firms are more efficient than the older CUs. All the exogenous variables are in natural logs.

Empirical models were estimated using FRONTIER 4.1 and STATA software.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter presents results and discussion of the study. The characteristics of the credit unions surveyed and their cost of operations were presented before the results of the estimated cost function were discussed. The final part of the chapter investigated the drivers of cost efficiency.

4.1 Characteristics of the Credit Union Surveyed

Table 4.1 provides the distribution of CUs by agricultural regions in the Gambia.

Table 4.1: Distribution of credit unions by agricultural Region

| Agricultural Regions | No. of CUs | Percentage (%) |
|-----------------------------|-------------------|-----------------------|
| West Coast | 37 | 74 |
| North Bank | 8 | 16 |
| Central River North | 1 | 2 |
| Central River South | 1 | 2 |
| Upper River | 3 | 6 |
| Total | 50 | 100 |

Source: Field Survey 2015

As shown by Table 4.1, most of the sampled CUs are found in West Coast (74%) and North Bank (16%). This distribution reflects the situation at the national level where about 61% and 24% of all credit unions affiliated to the NACCUG are located in the West Coast and North Bank Regions respectively.

At NACCUG administrative level, Credit Unions are demarcated into chapters. There are six chapters altogether, which are Banjul chapter, Kanifing chapter,

Brikama chapter, Bwiam chapter, North Bank chapter, Basse and Bansang chapter. The Banjul chapter exclusively consists of work-based credit unions whilst the remaining chapters sparsely comprise of some work-based and community-based credit unions.

Table 4.2 shows the distribution of CUs according to chapters. About 30% and 24% of the CUs came from Brikama and Kanifing Chapters respectively. About 10% each of the CUs are found in Banjul, Basse and Bansang Chapters.

Table 4.2 Distribution of CUs by Chapters in the Gambia

| Chapters | No. of CU | Percentage (%) |
|---------------|-----------|----------------|
| Banjul | 5 | 10 |
| Kanifing | 12 | 24 |
| Brikama | 15 | 30 |
| Bwiam | 5 | 10 |
| North Bank | 8 | 16 |
| Bansang/Basse | 5 | 10 |
| Total | 50 | 100 |

Source: Field Survey 2015

The number of years credit unions have been in operation and the workforce from 2009 to 2013 have been presented in Table 4.3.

Table 4.3. Age of CUs and Staff strength credit unions

| Years | Y in operat | | | | Number of staff | | | |
|-------|-------------|-------|------|----------------|-----------------|-------|------|----------------|
| | Min | Max | Mean | Std. Deviation | Min | Max | Mean | Std. Deviation |
| 2013 | 1.00 | 16.00 | 6.96 | 4.571 | 1.00 | 40.00 | 2.00 | 5.602 |
| 2012 | 1.00 | 15.00 | 5.96 | 4.571 | 1.00 | 40.00 | 2.00 | 5.602 |

| | | | | | | | | |
|------|------|-------|------|-------|------|-------|------|-------|
| 2011 | 1.00 | 14.00 | 5.02 | 4.497 | 1.00 | 40.00 | 2.00 | 5.602 |
| 2010 | 1.00 | 13.00 | 4.24 | 4.260 | 1.00 | 40.00 | 2.00 | 5.602 |
| 2009 | 0.00 | 12.00 | 3.56 | 3.949 | 1.00 | 40.00 | 2.00 | 5.602 |

Source: Field Survey 2015

It may be evident that CUs in the Gambia are relatively young since they have been in operations for only a maximum period of 16 years. The mean age of 6.96 years in 2013 shows that a typical CU in the Gambia has been in operations for only 7 years.

On average, a typical Credit Union in the Gambia was found to have only two paid workers (staff) including the manager. However, on average there are one volunteer member of the sample credit unions under this study who provide free services to their CUs and are motivated by an annual honorarium of GMD 18,000.00 per annum on average.

4.2 Products Offered by CUs in the Gambia

Generally, all Credit Unions have savings/deposit as the main product together with loan products in almost all cases. The savings/ deposits are usually kept for a relatively long period of time before withdrawals. In the Gambia, Credit Unions have no fixed period for savings. A member of the CU could save money at any time he/she wants to save by going to the CU with his/her passbook. For withdrawals a member of CU could withdraw after six months of membership. With respect to loans, different credit unions could have different products depending on the composition of their members and their location. Table 4.4 provides distribution of the CUs according to the type of the loan product offered.

Table 4.4 Loan Products Offered by CUs

| Loan Products | No. of CUs | Percentage (%) |
|----------------------|-------------------|-----------------------|
| | (N = 50) | |
| Agric. loan | 50 | 100 |
| Business loan | 49 | 98 |
| Education loan | 41 | 82 |
| Transport loan | 3 | 6 |

Source: Field Survey 2015

Agricultural and business loans are the most common loan products offered by CUs in the Gambia. About 100% and 98% of the CUs sampled offer agricultural and business (Trading & Commerce) loans to their members. However, only 6% of the CUs have loan for transportation business.

Table 4.5 provides the number of loan clients and the total amount of loans granted for each of the loan products in the 2013 accounting year.

Table.4.5 Loan Clients and Amount granted by loan type

| <i>Loan Product</i> | Loan Clients | | Loan amount granted (GMD) | |
|---------------------|---------------------|-----------------------|----------------------------------|-----------------------|
| | <i>Mean</i> | <i>Std. Deviation</i> | <i>Mean</i> | <i>Std. Deviation</i> |
| Agric. Loan | 360.68 | 915.881 | 2266464.50 | 8495582.30 |
| Business | 215.40 | 484.755 | 1514378..23 | 4285068.70 |
| Education | 222.88 | 566.124 | 1815679.50 | 5779549.00 |
| Transportation | 4.78 | 27.253 | 5917.73 | 28454.40 |

Source: Field Survey 2015

As noticeable in Table 4.5, there is a higher allocation of loans to the agricultural sector by CUs. Again, in terms of the number of clients benefitting from credit unions loans, agriculture has the highest number of beneficiaries compared to the other loan products of CUs. Proportionally agriculture received 44.88 percent, education had 27.73 percent and business represented 26.80 percent of loans supplied by CUs in the

Gambia in the year 2013. However, agriculture had only 44.88 percent of the total loans granted in 2013 with the remaining 55.12% going to the Non-agricultural sector.

Total number of savers and amount saved by members of CUs from 2009 to 2013 have been presented in Table 4.6.

Table 4.6 Savings of credit unions for 2009-2013 Yearly Mean

| Year | Total savers | Total agric. savers | Total nonagric. savers | Total savings (Million GMD) | Total agric. Savings (Million GMD) | Total nonagric. Savings (Million GMD) | Int. rates on savings (%) |
|-------------|--------------|---------------------|------------------------|-----------------------------|------------------------------------|---------------------------------------|---------------------------|
| 2013 | 840 | 377 | 463 | 8.38 | 3.54 | 4.84 | 1.5 |
| 2012 | 773 | 338 | 435 | 6.35 | 2.66 | 3.69 | 1.5 |
| 2011 | 677 | 300 | 377 | 5.27 | 2.17 | 3.10 | 1.5 |
| 2010 | 649 | 290 | 359 | 4.43 | 1.89 | 2.54 | 1.5 |
| 2009 | 555 | 244 | 311 | 3.49 | 1.51 | 1.99 | 1.5 |
| 5 yrs. avg. | 699 | 310 | 389 | 5.59 | 2.35 | 3.23 | 1.5 |

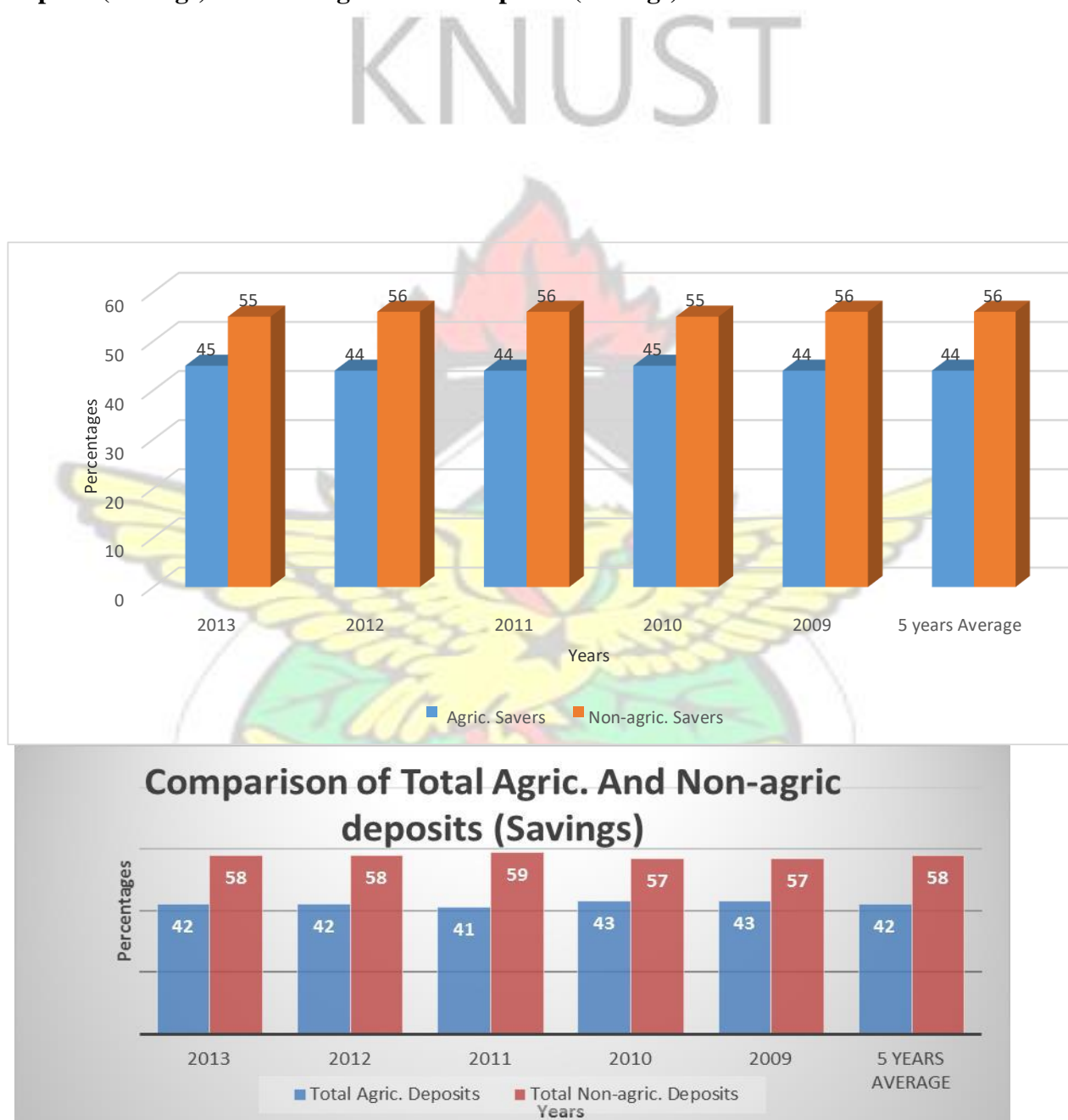
Source: Field Survey 2015

From Table 4.6, the non-agricultural savers are more than the agricultural savers from 2009 through 2013 with an average of 389 and 310 CU members per annum respectively. Figure 4.1 provides the proportion of CU members who are agricultural Savers and non-agricultural Savers from 2009 to 2013. Total Savings also manifested the same trend with a five years mean of GMD 3,232,826.39 and GMD 2,352,337.10 respectively. Figure 4.2 shows that the total deposits contributed by non-agricultural depositors was higher than that from the agricultural depositors from 2009 to 2013. The interest payment on member savings constitutes a significant share of the operating cost of CUs. The interest rate policy of CUs in the Gambia was quite similar and it did not change over the five year period used for the analysis.

Figure 4.1. A bar chart showing a comparison between Agricultural Savers and Non-agricultural Savers from 2009-2013

Source: Generated from field data, 2015

Figure 4.2. A bar chart showing a comparison between Total Agricultural Deposit (Savings) and Non-agricultural Deposits (Savings) from 2009-2013



Source: Generated from field data, 2015

Cooperative credit unions exist to better the lives of the poor by advancing them with credit hence credit must be available in meaning quantity to the poor to help them establish themselves. An analysis of loans granted by the CUs surveyed has been presented in Table 4.7. It may be seen from the table 4.7 that the number of agricultural and non-agricultural borrowers witnessed an upward trend from 2009 to 2013. However, non-agricultural borrowers from CUs were more than agricultural borrowers (Fig. 4.3). On average, about 389 non-agricultural members of CUs accessed credit per annum compared with 310 agricultural members.

Table 4.7 Loans granted by CUs from 2009-2013 Yearly Mean

| Year | Total no. borrowers | Total no. agric. borrowers | Total no. non-agric. borrowers | Total loans(Million GMD) | Total agric. Loans(Million GMD) | Total nonagric. Loans(Million GMD) | Int. rates on loans (%) |
|-------------|---------------------|----------------------------|--------------------------------|--------------------------|---------------------------------|------------------------------------|-------------------------|
| 2013 | 840 | 377 | 463 | 6.956 | 2.879 | 4.077 | 15 |
| 2012 | 770 | 337 | 433 | 4.787 | 1.942 | 2.845 | 15 |
| 2011 | 675 | 295 | 380 | 4.006 | 1.173 | 2.833 | 15 |
| 2010 | 649 | 290 | 359 | 3.375 | 1.316 | 2.059 | 15 |
| 2009 | 555 | 243 | 312 | 2.724 | 1.101 | 1.623 | 15 |
| 5 yrs. avg. | 698 | 310 | 389 | 4.370 | 1.462 | 1.003 | 15 |

Source: Field Survey 2015

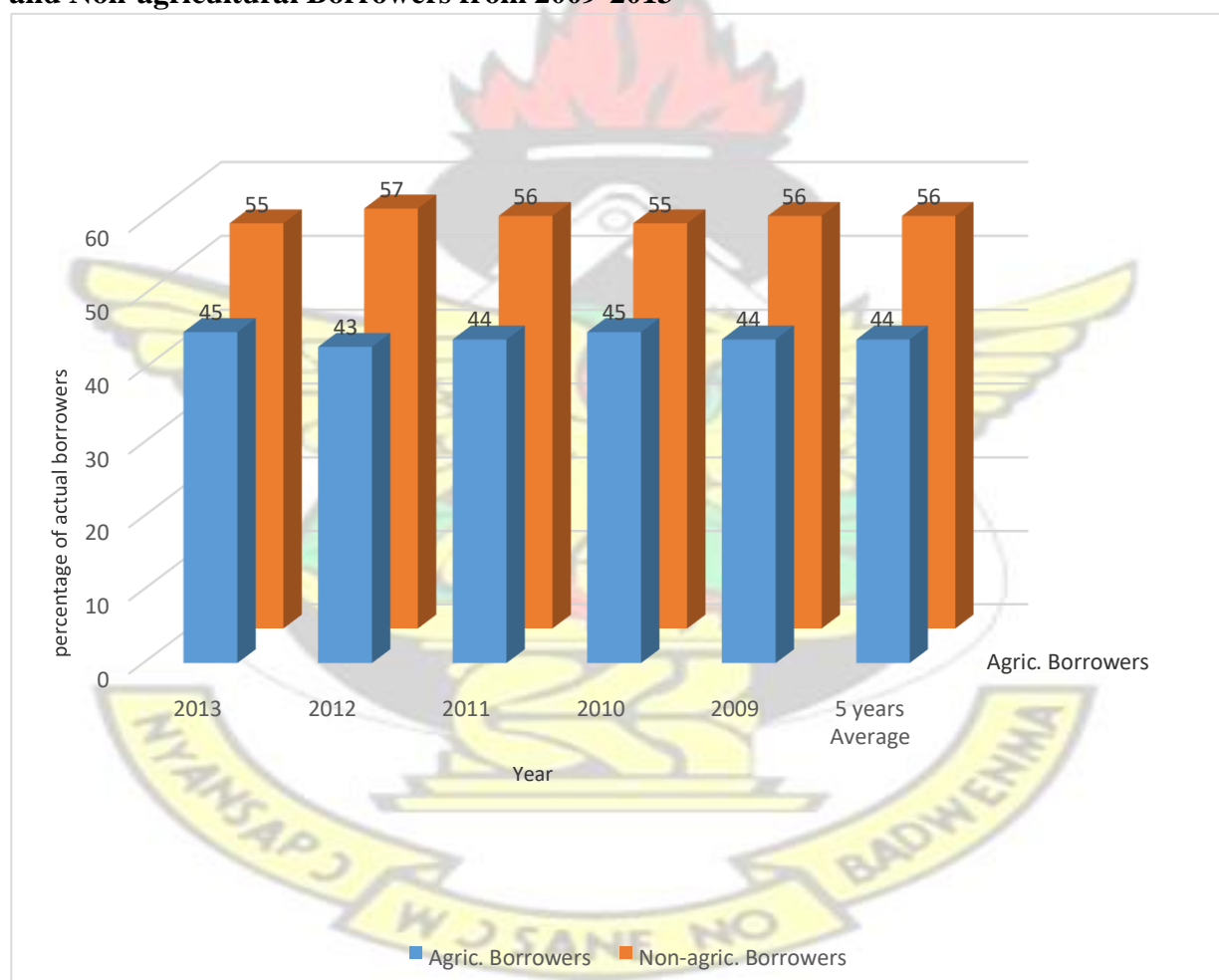
From Table 4.7 and Figure 4.3, there has been an increase in the loans proportion to the agricultural sector of about 48%, that is, from GMD 1,942,264.91 to GMD 2,878,565.04 from 2012 to 2013.

However, from 2010 to 2011 there was a drop in the loans administered to agriculture with a decrease of 11%. The decline in 2011 loans portfolio to the agricultural sector may be attributed to the drought experienced during the 2010 cropping season which negatively affected their loan repayment in 2010 since majority of the farmers in the country rely on rainfall for their cropping activities. This caused a shift in loans portfolio to the non-agricultural sector with an increase of 38%. Most of the funds that

the CUs use for loan come from the mobilized savings from members. If savings are not forthcoming from a particular sector due to drought, then the loan portfolio to that sector drops as well.

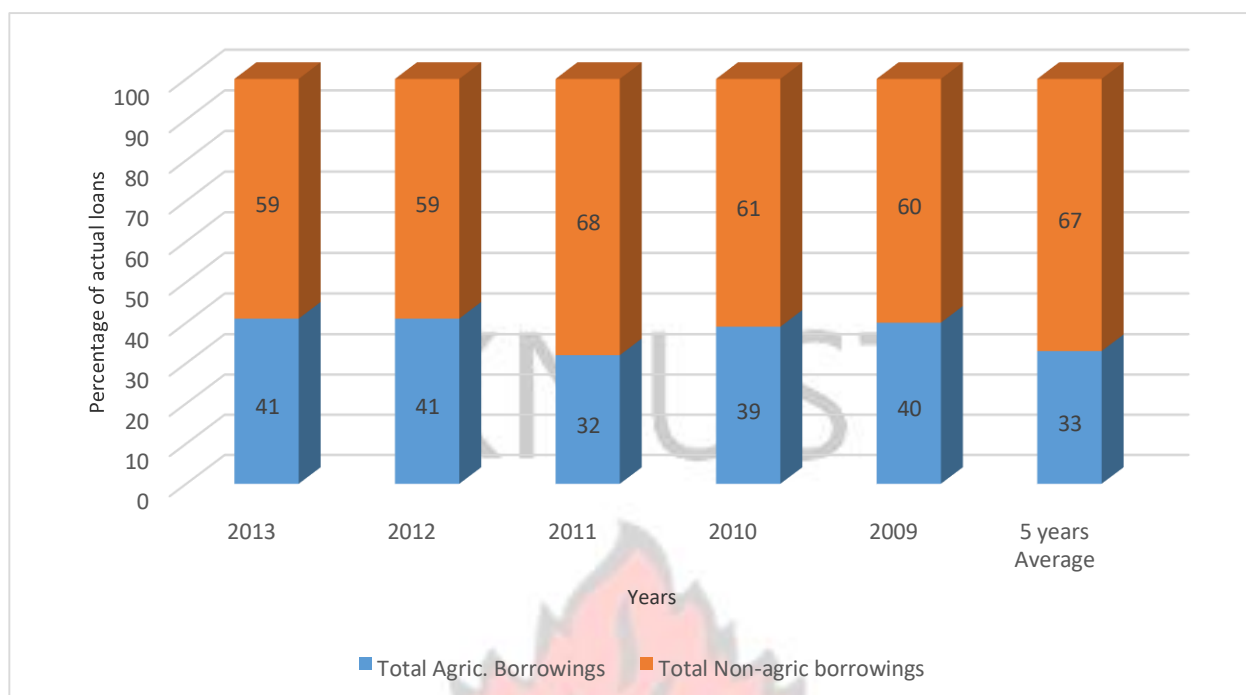
The interest rate policy with respect to lending was also the same for all the CUs surveyed and over the five year period of analysis, the lending rate (interest on loans) remained the same at 15% per annum.

Figure 4.3. A bar chart showing a comparison between Agricultural Borrowers and Non-agricultural Borrowers from 2009-2013



Source: Generated from field data, 2015

Figure 4.4: A bar chart showing a comparison between Agricultural Borrowings (Loans) and Non-agricultural Borrowings (Loans) from 2009-2013



Source: Generated from field data, 2015

4.3 Cost of Credit Unions' Operation

Credit Unions incur costs in their day to day operations and the key sources of these costs include Personnel (staff), Board of Directors, Affiliation fees, Interest payments, general transportation and stationery for office duties. Table 4.8 provides the annual operations cost decomposed according to the items listed above.

It may be apparent from Table 4.8 that total CU operations cost increased from about GMD 252,044.00 in 2009 to about GMD 278,476.00 in 2013. However, between 2009 and 2010, the operating cost reduced by 33% to GMD 167,826.00. From 2010 onwards, there was consistent increase in total cost of operation by CUs in the Gambia.

Table 4.8 Cost of Operation of Credit Unions from 2009-2013

| Year | Salary (GMD) | Board expenses (GMD) | Affiliation fees(GMD) | Int. paid on loans (GMD) | Int. paid on deposits (GMD) | Cost of transportation (GMD) | Cost of stationery(GMD) | Total Cost (GMD) |
|------|--------------|----------------------|-----------------------|--------------------------|-----------------------------|------------------------------|-------------------------|------------------|
| 2009 | 100,000.00 | 10,000.00 | 5,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 252,044.00 |
| 2010 | 60,000.00 | 10,000.00 | 5,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 167,826.00 |
| 2011 | 70,000.00 | 10,000.00 | 5,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 225,000.00 |
| 2012 | 80,000.00 | 10,000.00 | 5,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 245,000.00 |
| 2013 | 90,000.00 | 10,000.00 | 5,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 278,476.00 |

| | | | | | | | | |
|-----------------|----------|----------|----------|---------|-----------|---------|----------|-----------|
| 2013 | 68478.60 | 20607.00 | 36400.60 | 3732.00 | 125669.00 | 8978.24 | 14610.80 | 278476.00 |
| 2012 | 56849.20 | 11576.50 | 31213.50 | 1620.00 | 95271.00 | 9701.96 | 11052.40 | 217285.00 |
| 2011 | 34090.20 | 8057.60 | 28281.60 | 1005.00 | 79120.40 | 7611.06 | 12556.70 | 170722.00 |
| 2010 | 40493.70 | 16580.00 | 27552.60 | 0 | 66425.10 | 5826.72 | 10947.50 | 167826.00 |
| 2009 | 36544.80 | 12337.00 | 22998.60 | 0 | 163689.00 | 5799.98 | 10675.10 | 252044.00 |
| 5 years avg. | 47291.30 | 13831.60 | 29289.40 | 1271.40 | 106035 | 7583.59 | 11968.50 | 217271.00 |

Source: Field Survey 2015

Figure 4.5 shows that the most important cost components include interest paid on deposits, salaries and affiliation fees. On average, interest paid on deposits (savings) constitute about 65% and 44% of total operating expenses in 2009 and 2012 respectively, followed by personnel (staff) expenses which formed about 26% and 15% of the total operating costs per annum in 2012 and 2009 respectively.

(Tadesse A.G.T. et, al., 2014) presented a working paper on cost efficiency and outreach of microfinance institutions in Ethiopia: Do they contrast with financial cooperatives. This paper attempted to estimate the total cost with respect to output and input price variables from the cost frontier. The estimated elasticity for the measurement of input prices (salary and interest expenses and output (gross loan portfolio) have statistically significant relationship with total cost. Their findings showed that a percentage fall in total cost of output falls by 0.76 to 0.84 percent, labour cost falls by 0.20 to 0.32 percent, cost of capital falls by 0.22 to 0.28 percent and cost of physical capital falls by 0.01 to 0.03 percent. In all, the positive coefficients denote higher costs, reflecting that salary, interest expenses and volume of gross loan portfolio are significant shares of the total costs of microfinance institutions.

(Amanor, 2012) also attempted to assess the cost efficiency of microfinance institutions in Ghana with an application of stochastic frontier approach. The results showed that the cost on personnel and interest payment on member savings constitutes

a greater share of the operating costs of firms, although the average number of staff per MFI is small.

(Mbansor & Kalu, 2008) conducted a study which applied a translog stochastic frontier cost function to measure the level of economic efficiency and its determinants in commercial vegetables production systems in Akwa Ibom State, Nigeria. The authors used a multi-stage random sampling technique to select 150 farmers from whom input-output data and information on prices were obtained. The results of the study showed that 99% of the variations in the total production cost are due to differences in cost efficiencies.

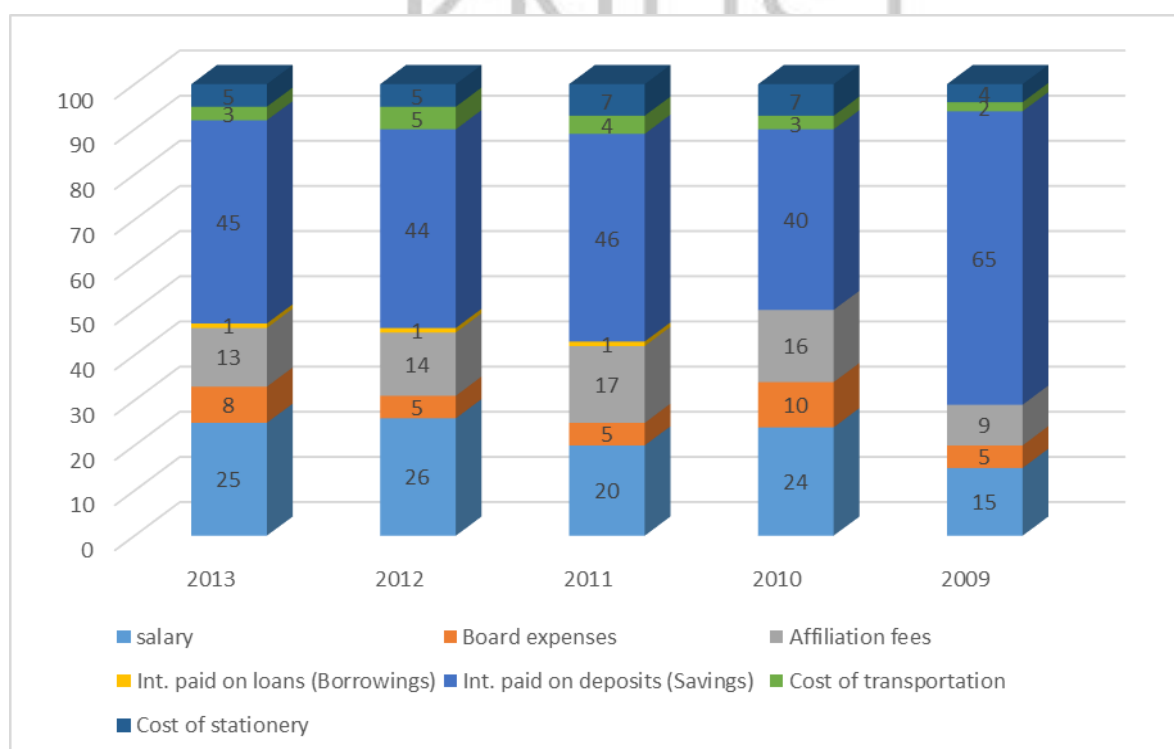
(Moktar et, al., 2006) attempted to investigate the efficiency of Islamic banks in Malaysia using stochastic frontier technique. The results of their study showed that the average technical and cost efficiencies of the conventional banks were higher than those of Islamic banking system.

(Ogundari K. et, al., 2006) also conducted a study on economies of scale and cost efficiencies in small scale maize production: Empirical evidence from Nigeria. The analysis of cost variables of the farm showed that cost of labour (personnel) accounts for about 66% of the total cost due to the fact that there is a reduction in the number of the household participation in the farm operation since most farmers send their children to the city for proper education. Hence, farmers depend heavily on hired labour to do most of the farming operations, thus, justify the high cost expenses on hired labour.

The findings from other researchers above are evidences that the cost on personnel is always high. Therefore, there is enough evidence to conclude that the sources of the

high variation of inefficiencies across the affiliated CUs to NACCUG are due to variation in cost efficiency.

Figure 4.5. A bar chart showing proportions of major components in the operating costs of credit unions per annum



Source: Field Survey 2015

4.4 The Operating Cost Frontier for Credit Unions

Factors that explain the operating expenses incurred annually by CUs in the Gambia are presented in Table 4.9 with their coefficients and Z-scores.

Table 4.9 Maximum Likelihood Estimates of Operating Cost Function from 2009 to 2013

| 2013 | 2012 | 2011 |
|------|------|------|
|------|------|------|

| Variables | Coefficient | zstatistics | Coefficient | zstatistics | Coefficient | zstatistics |
|-----------|--------------|-------------|--------------|-------------|--------------|-------------|
| LnSav | 0.3360137*** | 2.90 | 0.5229752*** | 25.06 | 0.3114809*** | 4.17 |
| LnSal | 0.2169169*** | 2.73 | 0.0676401*** | 9.13 | 0.1335839*** | 3.43 |
| LnMemb | 0.1685613*** | 2.77 | 0.1644726 | 1.11 | 0.1494939 | 1.05 |
| LnAff | 0.1493158*** | 4.96 | -0.0599474** | -2.16 | 0.1942708*** | 2.65 |
| LnGLP | 0.1336176 | 1.30 | 0.0691438 | 0.87 | 0.0006195 | 0.01 |
| Constant | 1.698281 | 1.04 | 2.431762*** | 9.70 | 2.84016*** | 2.56 |
| Sigma v | 0.4097216 | | 5.37e-08 | | 0.9934976 | |
| Sigma u | 0.0434991 | | 0.95979903 | | 0.0125481 | |
| Sigma2 | 0.169764 | | 0.9211975 | | 0.987195 | |
| Lambda | 0.1061675 | | 1.79e+07 | | 0.0126303 | |

Note; ***, ** and * are statistically significant at 1%, 5% and 10 respectively

| | 2010 | | 2009 | | 5 years avg. | |
|-----------|---------------|-------------|--------------|-------------|--------------|-------------|
| Variables | Coefficient | zstatistics | Coefficient | zstatistics | Coefficient | zstatistics |
| LnSav | 1.004036*** | 6.95 | 0.6633686*** | 9.60 | 0.3144939*** | 3.12 |
| LnSal | 0.0305308 | 1.35 | 0.0805503*** | 2.95 | 0.1030467*** | 6.74 |
| LnMemb | 0.4189846*** | 4.19 | 0.1944942 | 1.64 | 0.0804043 | 1.31 |
| LnAff | 0.0184697 | 0.48 | -0.001641 | -0.04 | 0.2150941*** | 5.21 |
| LnGLP | -0.4222022*** | -3.03 | 0.0007138 | 0.01 | 0.0463864 | 0.55 |
| Constant | 0.3070147 | 1.07 | 0.0156125 | 0.03 | 3.236661*** | 4.02 |
| Sigma v | 0.3116616 | | 0.6307349 | | 0.4063098 | |
| Sigma u | 0.6216939 | | 0.0063013 | | 0.0113054 | |
| Sigma2 | 0.4836362 | | 0.3978662 | | 0.1652155 | |
| Lambda | 1.994772 | | 0.0099905 | | 0.0278247 | |

Note; ***, ** and * are statistically significant at 1%, 5% and 10 respectively

Source: Field Survey 2015

The maximum likelihood results of the Cobb-Douglas Stochastic Operating Cost frontier shows that the variables salary (personnel expenses), number of active members and affiliation fees were significant at 1% in 2013.

As expected, higher levels of activity and output results in higher cost as, indicated by the statistically significant positive signs of savings, salary, number of active members and affiliation fees. The estimated coefficients for gross loan portfolio was not significant in 2013. From the results a 10% change in savings will cause a 3.4% increase in total operation cost per annum in a positive direction. Again, a 10% increase in salary will result in a 2.7% increase in total operation cost per annum. For every additional active member gained by a credit union, cost of operations per annum will rise by GMD 0.17 and 10% increase in affiliation fees increase operating cost per annum by 1.5% all things being equal. Therefore, from the results of 2013, salary, savings, number of actual members and affiliation fees influences the Total Operation Cost of CUs. The signs and magnitudes of the coefficients were positive and statistically significant with the exception of gross loan portfolio. This is consistent with the findings of (Quayes & Khalily, 2013).

The summation of the elasticities of the inputs variables to cost (1.004) indicate a constant cost to size. This is an indication that there is possibility of growth in cooperatives credit unions affiliated to the National Association of Cooperative Credit Union of the Gambia (NACCUG) indicated by the results in 2013.

The results of the likelihood ratio shows that the alternatives hypothesis is to be rejected for the null hypothesis that there is inefficiency in the sampled units.

The value of the σ^2 (0.17) shows that a significant variation in cost is due to differences in cost efficiencies. This shows the correctness of the distributional assumption about the error term and the goodness of fit.

For the year 2012, the results of the variables of the Cobb-Douglas Stochastic Operating Cost frontier function shows that salary, and savings are positive and significant. However, affiliation fees was negative but significant in 2012.

2011 results showed that the input variables such as savings, salary and affiliation fees were all both positive and significant. A unit change in savings, salary and affiliation fees will lead to 0.31, 0.13 and 0.19 change in total operation cost respectively. The results obtained for savings and number of active members support the assumption that there is possibility of enjoying economies of scale. The scope can be achieved if CUs will improve on strategies to mobilize more savings whilst providing good customer care to the members. This is consistent with the findings of (Oteng-Abayie et. al., 2011).

The 2010 coefficients with the exception of that for gross loan portfolio were also statistically significant with positive signs. However, the magnitudes of their coefficients were different. For savings, it has a statistically positive sign value of 1.004, indicating that a unit increase in savings will cause a unit increase in total operation cost. While a unit increase in the number of actual members will cause a 0.42 increase in total operation cost.

Gross loan portfolio was significant but negative in signs. From the results obtained, a 10% increase in gross loan portfolio will cause a 4.2% decrease in total operation costs. Therefore, for the CUs to increase their profit they should cut down on operating

cost by increasing gross loan portfolio. However, this should be done carefully in order not to overburden the credit officers as that would be counterproductive. In 2009, the results indicated that a unit increase in saving and salary will cause a 0.66 and 0.08 increase in operation costs respectively. The aforesaid input variables were statistically significant with positive signs.

The results obtained in the five year period depicted that a unit increase in the savings, salary and affiliation fees will bring an increase in total operation costs by 0.31, 0.10 and 0.22 respectively. The signs and magnitudes of the aforesaid variables were positive and statistically significant.

4.5. Cost Efficiency Estimates

The distribution of cost efficiency estimates among the 50 CUs surveyed is presented in Table 4.10

Table 4.10 Frequency Distribution of Cost Efficiency of Credit Unions for 2009-2013

| <i>Efficiency level</i> | <i>2013</i> | | <i>2012</i> | | <i>2011</i> | | <i>2010</i> | | <i>2009</i> | | <i>5 years</i> | |
|-------------------------|--------------|------------|--------------|------------|--------------|------------|--------------|------------|--------------|------------|----------------|------------|
| | <i>Freq.</i> | <i>(%)</i> | <i>Freq.</i> | <i>(%)</i> | <i>Freq.</i> | <i>(%)</i> | <i>Freq.</i> | <i>(%)</i> | <i>Freq.</i> | <i>(%)</i> | <i>Freq.</i> | <i>(%)</i> |
| 1.0-1.1 | 19 | 38 | 43 | 86 | 22 | 44 | 48 | 96 | 30 | 60 | 32 | 64 |
| 1.2-1.3 | 27 | 54 | 7 | 14 | 25 | 50 | 2 | 4 | 17 | 34 | 15 | 30 |
| 1.4-1.5 | 2 | 4 | 0 | 0 | 3 | 6 | 0 | 0 | 3 | 6 | 2 | 4 |
| 1.6-1.7 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Total | 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 |
| Minimum | 1.100 | | 1.100 | | 1.100 | | 1.100 | | 1.100 | | 1.100 | |
| Maximum | 1.577 | | 1.218 | | 1.474 | | 1.218 | | 1.463 | | 1.390 | |
| Mean | 1.216 | | 1.130 | | 1.191 | | 1.148 | | 1.172 | | 1.171 | |
| Standard Deviation | 1.107 | | 1.029 | | 1.088 | | 1.033 | | 1.088 | | 1.069 | |

Source: Field Survey 2015 Table 10 shows summary of cost efficiency scores for the CUs in the sampled area. The mean cost efficiency of the CUs was estimated at 1.216 in 2013 meaning that a typical CU in the study area has costs that are about 22% above the optimum defined by the frontier in 2013. In other words, 22% of their costs are wasted relative to the best practicing CUs producing the same output (GLP) and facing the same technology.

From the efficiency estimates based on the five year average, majority (64%) of the CUs in the Gambia were found to fall within the efficiency brackets of 1.0 and 1.1. This means that cost inefficiency level is quite low (between 0 and 10%) among the majority of CUs in the Gambia. In 2010 and 2012, CUs minimum cost efficiency was observed where they recorded a ratio of 1.130. However, the highest cost inefficiency was observed in 2013 with an inefficiency score of 1.577. Thus, from the results of the efficiency distribution, the majority of the CUs are fairly cost efficient in producing at a given level of output using cost minimizing input ratios which reflects the CUs' tendency to minimize resource wastage. This is consistent with the findings of (Ogundari, Ojo, & Ajibefun 2006).

4.6 Determinants of Cost Efficiency

The descriptive statistics of the main variables used in the cost efficiency model have been presented in Table 4.11

Table 4.11: Summary statistics of possible determinants of cost efficiency among CUs

| Years | Total Cost (GMD '000) | Savings (GMD '000) | ASB (GMD '000) | DPS (GMD '00) | CPB (GMD '00) | ALB (GMD '000) | BPF (Client '00) | AGE (years) |
|-------|--------------------------|-----------------------|-------------------|------------------|------------------|-------------------|---------------------|----------------|
|-------|--------------------------|-----------------------|-------------------|------------------|------------------|-------------------|---------------------|----------------|

| | | | | | | | | | |
|--------------|----------------|---------|-----------|--------|-------|---------|-------|---------|-------|
| | Mean | 149.08 | 8377.94 | 4.7.2 | 4.46 | 4.21 | 3.65 | 6.84 | 6.96 |
| 2013 | Std. Deviation | 462.24 | 24963.66 | 5.985 | 5.721 | 5.836 | 5.343 | 13.121 | 4.571 |
| | Mean | 120.39 | 6351.40 | 3.99 | 4.27 | 4.02 | 2.74 | 6.43 | 6.02 |
| 2012 | Std. Deviation | 352.821 | 18534.000 | 5.247 | 5.795 | 1.32735 | 4.478 | 12.618 | 4.497 |
| | Mean | 90.60 | 5274.69 | 3.70 | 3.79 | 3.12 | 2.74 | 5.70 | 5.02 |
| 2011 | Std. Deviation | 234.29 | 15066.800 | 5.658 | 4.76 | 4.65 | 5.258 | 11.10 | 4.497 |
| | Mean | 101.40 | 4428.34 | 3.53 | 3.43 | 1.89 | 2.30 | 5.31 | 4.76 |
| 2010 | Std. Deviation | 358.750 | 12680.531 | 4.717 | 4.66 | 2.089 | 4.313 | 10.64 | 3.783 |
| | Mean | 88.36 | 10751.30 | 2.54 | 2.79 | 2.33 | 1.79 | 4.49 | 3.64 |
| 2009 | Std. Deviation | 315.111 | 66010.329 | 4.229 | 4.075 | 5.54 | 3.517 | 9.40 | 3.885 |
| | Mean | 1195.13 | 1306.06 | 19.03 | 18.73 | 21.32 | 4.72 | 72.92 | 6.96 |
| 5 years avg. | Std. Deviation | 3600.05 | 39453.864 | 26.183 | 24.57 | 27.41 | 6.239 | 104.615 | 4.571 |

Source: Field Survey 2015

From Table 4.11, the results indicated that the amount of savings have steadily increased from 2009 to 2013 with percentage increment in a descending order of 18%, 15%, 6% and 3% respectively.

Based the results of the aforementioned table, ASB and ALB has been fluctuating over the period of study and recorded the least in 2009. The indicators for productivity (DPS and BPF) have also demonstrated a descending order in terms of numbers from 2013 to 2009. For CPB there was a fall in 2010 and later in 2011 it continues to rise again in an ascending order. This is consistent with the findings of (Haq et, al., 2009) Similar results were also provided by Gutiérrez-Nieto et, al., 2007), in their findings in their report in Latin America and the Caribbean (LAC) CUs, that CUs are good at mobilizing high saving but have high operational costs.

The cost efficiency model for Credit Unions in the Gambia from 2009 to 2013 are presented in Table 4.12 below.

Table 4.12: The determinants of Cost Efficiency among Credit Unions from 2009-2013

| | 2013 | | 2012 | | 2011 | |
|-----------|--------------|-------------|--------------|-------------|--------------|-------------|
| Variables | Coefficient | zstatistics | Coefficient | zstatistics | Coefficient | zstatistics |
| Savings | 0.0192443*** | 26.76 | 0.0199819*** | 31.59 | 0.0149463*** | 18.55 |
| ASB | 0.4138821 | 0.41 | 20.21589*** | 4.93 | 4.36783 | 1.11 |
| DPS | 5.91545 | 0.27 | -5.72114 | -0.39 | 1.729162 | 0.10 |
| CPB | 14.18197*** | 7.11 | 9.929665 | 0.76 | 29.8987* | 1.75 |
| ALB | -13.01662*** | -4.22 | -44.53524*** | -9.67 | -18.33728*** | 14.91 |
| BPF | 1.585954 | 0.06 | 13.99675 | 1.58 | 33.03557*** | 3.30 |
| AGE | 3767.483 | 1.18 | 2510.133 | 1.64 | 1013.223 | 0.67 |
| Constant | 29131.01 | 1.26 | 9333.256 | 0.18 | 11946.64 | 0.11 |

Note; ***, ** and * are statistically significant at 1%, 5% and 10 respectively

| | 2010 | | 2009 | Five (5) years average. | | |
|-----------|--------------|-------------|--------------|-------------------------|--------------|-------------|
| Variables | Coefficient | zstatistics | Coefficient | zstatistics | Coefficient | zstatistics |
| Savings | 0.0361103*** | 33.38 | 0.000676 | 1.09 | 0.0105164*** | 6.55 |
| ASB | -4.962753 | -0.73 | 46.97656 | 1.62 | 79.01056*** | 4.84 |
| DPS | 23.06211 | 1.07 | -293.0047*** | -2.60 | -196.5802*** | -3.37 |
| CPB | 289.2539*** | 4.99 | -36.84203 | -0.52 | -110.5239 | -1.44 |
| ALB | -33.93208*** | -5.32 | -43.57779 | -1.18 | -99.01602*** | -5.19 |
| BPF | -92.86487*** | -7.46 | 246.3833*** | 6.40 | 147.532*** | 5.63 |
| AGE | 3818.077* | 1.83 | 17631.53** | 2.09 | 7713.303 | 1.40 |
| Constant | 3300.74 | 0.06 | -42099.21 | -0.35 | -410.425 | -0.00 |

Note; ***, ** and * are statistically significant at 1%, 5% and 10 respectively

Source: Field Survey 2015

The positive coefficient of borrower per field officer (BPF) in 2009 and 2011 as a parameter for productivity approves that the performance of the staff of CUs has a significant influence on the efficiency of the affiliated CUs to NACCUG. Thus, the higher the productivity of the workers the better or more cost efficient the cooperative credit union. The negative coefficient of BPF in 2010 means the case load of the credit

officer is high or huge which makes the officer to be cost inefficient. However, in 2009 and a five year average, depositor per staff (DPS) was statistically significant but with negative coefficient. This means that the case load of the credit officer was high which made the officer to be inefficient. In addition, the variation of the productivity of the workers across the sector can be explained by the skills sets of the staff; the degree of motivation –salary structure; the CUs conducts for the staff; the nature of training programmes; the capacity of the CUs to attract skilled personnel and other incentives to output. This is consistent with the findings of (Oteng-abayie, Amanor & Frimpong, 2011).

The negative sign for the coefficient of the average loan balance per borrower (ALB) from 2010-2013 and a five years average indicates that granting small loans to clients increases cost inefficiency if all things remain the same. A positive sign for the coefficient of average savings balance (ASB) also indicates that collecting huge savings from clients improves on the efficiency of CUs. The average loan balance and average savings balance (ALB and ASB) are indicators of outreach and were significant at different times of the study period. The implication of the signs of the aforementioned indicators of outreach is that CUs are dealing with both the relatively poor and the rich households which is a good scope of outreach. This could also mean that CUs are rewarding the small regular savings of clients with reasonable loans and not targeting the relatively rich per se.

However, (Quayes & Khalily, 2013) wrote a working paper on efficiency of microfinance institutions in Bangladesh. Their study presents an empirical analysis of the cost efficiency of a sample of microfinance institutions (MFIs) operating in Bangladesh. There was a negative coefficient of the average loan balance per borrower

which implies that larger loans are more cost efficient i.e. the decrease in cost efficiency tends to decrease with the average loan size.

In addition, there was higher average savers per staff member and lower borrowers per staff member in Africa registering 256 and 105 respectively as compared to Latin America and Caribbean with 199 and 112 savers per staff member and borrowers per staff member respectively. This is contrary to (Haq et, al., 2010) who reported both high average borrowers per staff member and savers per staff member in Africa compared to Latin America.

The average cost per saver in African MFIs is almost three times lower than that of Latin American and the Caribbean (LAC) MFIs, indicating a significant level of difference among the two continents. (Haq et, al., 2010) also reported that cost per saver and borrower are higher in Latin American MFIs as compared to their counterparts in Africa.

The positive coefficient of AGE suggest that inefficiency reduces as the CUs grow. This goes to confirm the importance of experience in the operations of cooperative credit unions. From the results of the study, there is evidence that there is an existence of a learning curve effects in the industry. In the findings of (Tariq & Ahmad, 2010), their study attempted to measure the efficiency level and its determinants of a sample of microfinance institutions operating in India by applying stochastic frontier approach for unbalanced panel of 40 microfinance institutions for the 2005-08. It has been found that mean efficiency level of microfinance institutions is quite low but it increases over the period of study. Age of microfinance institutions is positive determinant of efficiency level but size does not matter much.

However, their estimated coefficient of variable AGE which shows the experience of the microfinance institution is negative as expected and significant at 5 % level of significance by both t-test and generalized likelihood test. They further reported that the negative coefficient of the variable AGE shows that efficiency of microfinance institutions increases as they gain experience in the industry.

In conclusion, there is no evidence of trade-off between outreach and efficiency; evidence suggests that the two objectives are complementary.

4.7 Constraints faced by credit unions

The main constraints faced by CUs in the Gambia are provided in the table below.

Table 4.13 Constraints faced by CUs

| Constraints | Mean Rank (N = 50) |
|--|-----------------------|
| Limited office space | 2.96 |
| Financial transaction recorded manually | 2.12 |
| Low staff strength | 1.69 |
| Difficulty in maintaining book keepers | 3.23 |
| Kendell's W = 0.461, Chi-square 69.179, df = 3, Asymp. sig = 0.000 | |

Note: 1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree

Source: Field Survey 2015

From Table 4.13, there is 46 percent level of agreement in the Kendell's W among the responses received from the various fifty (50) credit unions interviewed individually. The level of agreement is significant at 1 percent level. However, the most critical constraint faced by CUs in the Gambia is low staff strength followed by manual record keeping of financial transactions, limited office space and inability to maintain book keepers were also highlighted as key constraints in operations of CUs in the Gambia.

During the focus group discussion, it was reported that some CUs employ few officers to run the administration of their union and are also unable to employ highly professional and skilled personnel to run the affairs of the union. The level of training and education is generally lower in rural CUs affiliated to NACCUG as reported during the focus group discussion. Others find it difficult to maintain their book keepers hence their work is on voluntary bases. This occurs because some of them are just starting operations and are not financially strong to create salary for their workers. Office space remain a challenge for some CUs and financial transaction too is normally recorded manually hence the cost involved in purchasing the software is very high.

However, because providing financial services for the poor often require high transaction cost, CUs institutions need resources from donors to cover the shortfalls between revenue received from clients and the cost of service delivery. Besides, subsidy resources are limited and the interest of donors in microfinance in the future is uncertain. Thus, for the poor to continue to receive financial services they need, credit unions should factor financial sustainability reported by (Nghiem et, al., 2006) on their work on the efficiency of microfinance in Vietnam: Evidence from NGO schemes in the North and Central Regions.

In addition, (Debashis, 2013) conducted a study on pressure on loan officers in microfinance institution: An ethical perspective. In the author's findings, it was reported that loan officers play diverse and significant role in microfinance institutions. However, they encounter pressures such as meeting deadlines, powerful hierarchical pressure, reducing portfolio at risk, working more than normal functioning hours outside office and structural pressure. These types of pressure

reduce productivity and as a result will lead to inefficiency thereby leading to high cost and low profitability. Thus, hindering portfolio quality, employer-employee relationship and the image of the institution.

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CHAPTER FIVE

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the main findings conclusions drawn and recommendations based on the findings of the study.

5.1 Summary

The main objective of this study was to measure and determine the cost efficiency among credit unions in the Gambia using the stochastic frontier approach. The cost efficiency was analyzed using the Cobb Douglas cost function modeled for 50 credit unions in the study areas from the 2009 to 2013 financial year. Results have revealed that there is a significant level of inefficiency among the CUs as manifested by the coefficients.

From findings all credit unions have savings/deposits as the main product together with loan products in almost all cases. The savings/deposits are usually kept for a relatively long period before withdrawals with a minimum of six months of membership.

CUs incur costs in their day to day operations and the key sources of these cost include personnel (staff), board of directors, affiliation fees, interest payments, general transportations and stationery for office duties. From findings it was discovered that most of the important cost components include interest paid on deposits, salaries payment and affiliation fees.

CUs cost efficiency were influenced by borrower per field officer (BPF) which was as a result of staff performance in their service execution. Thus, the efficiency of the

CUs depend on their staff performance which was good. Depositor per staff (DPS) was also another variable which illustrated that the performance of the staff can influence a decrease in the CUs cost efficiency.

In the Gambia CUs are operating below their optimal scale capacity as none of the sampled CUs was identified to be cost efficient. Thus, a typical CU in the Gambia was found to be cost inefficient. The maximum number of CUs existence in the financial sector for CUs in the Gambia is 16 years and a mean of 7 years. This is an indication that CUs in the Gambia are very young in the financial system in the Gambia.

The significance of savings, the indicators of productivity (DPS and BPF) and cost per borrower (CPB) are proof to justify that CUs must look for ways and come up with strategies to mobilize more savings. Hence, there is a possibility of enjoying economies of scale in lending so long as the CUs institute savings mobilization strategies in the operations. This will only take effect if there are well-motivated and well-equipped staff that are set to offer valued financial services to clients.

From the result obtained, it is clear that CUs in the Gambia are not necessarily to target the ultra-poor per se but to serve the market with products which the formal financial system has failed. They also provide services to the rich as well.

5.2 Conclusion

The mean five years cost efficiency of 1.171 of the CUs across the study areas in the Gambia means that CUs are not operating on the cost frontier (100% efficient). The study indicated that savings, average savings balance (ASB) cost per borrower (CPB)

and borrower per field officer (BPF) positively influence cost efficiency at different years of the study period.

There is no evidence of trade-off between outreach and efficiency; evidence suggests that the two objectives are complementary.

5.3 Recommendations

From the above findings the following were recommended:

- i. Credit Unions should spread their services to attract more members as the results of ALB and ASB are small.
- ii. The CUs in the Gambia should endeavor to bring diversified savings products to improve on loan portfolio quality in order to reduce the cost inefficiency and to ensure sustainability.
- iii. For efficiency and better management small CUs should be merged together under one management where qualified officers are employed to run the affairs of the CUs, especially those CUs run by their members through voluntary services.
- iv. From the results of the findings, it is realized that the higher the savings the higher or better the portfolio quality and therefore CUs should encourage their members to save more to attract more loans in the future.
- v. The coefficients of Savings of credit unions have been positive and significant which is an indication that the more savings a credit union has, the more cost efficient it becomes. Therefore, CUs should encourage more savings by creating more savings products and increase interest on savings.

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APPENDIX

Frequency distribution of cost efficiency scores for 2009-2013

| | Ineff_2013 | Ineff_2012 | Ineff_2011 | Ineff_2010 | Ineff_2009 |
|----|----------------|----------------|----------------|----------------|----------------|
| 1 | 0.10048813E+01 | 0.13602363E+01 | 0.17803388E+01 | 0.13602363E+01 | 0.15099288E+01 |
| 2 | 0.17164123E+01 | 0.10847889E+01 | 0.11258603E+01 | 0.10847889E+01 | 0.13986718E+01 |
| 3 | 0.33703375E+01 | 0.11244858E+01 | 0.19229852E+01 | 0.11244858E+01 | 0.24913189E+01 |
| 4 | 0.14724554E+01 | 0.12383189E+01 | 0.12063916E+01 | 0.12383189E+01 | 0.11121330E+01 |
| 5 | 0.11839891E+01 | 0.12294896E+01 | 0.12294896E+01 | 0.10017645E+01 | 0.11568279E+01 |
| 6 | 0.22539401E+01 | 0.12304313E+01 | 0.26518039E+01 | 0.12304313E+01 | 0.46319321E+01 |
| 7 | 0.10004558E+01 | 0.21200975E+01 | 0.12379835E+01 | 0.21200975E+01 | 0.28546675E+01 |
| 8 | 0.26983282E+01 | 0.11783658E+01 | 0.20355122E+01 | 0.11783658E+01 | 0.19635398E+01 |
| 9 | 0.21327715E+01 | 0.11283812E+01 | 0.13791547E+01 | 0.11593318E+01 | 0.13286935E+01 |
| 10 | 0.25722728E+01 | 0.11593318E+01 | 0.10002806E+01 | 0.10017686E+01 | 0.11568279E+01 |
| 11 | 0.27772376E+01 | 0.14330115E+01 | 0.25563706E+01 | 0.14330115E+01 | 0.10052774E+01 |
| 12 | 0.23319108E+01 | 0.12776243E+01 | 0.25275683E+01 | 0.12776243E+01 | 0.11568279E+01 |
| 13 | 0.28397936E+01 | 0.18209091E+01 | 0.16929407E+01 | 0.18209091E+01 | 0.42551073E+01 |
| 14 | 0.14662789E+01 | 0.14270700E+01 | 0.15958514E+01 | 0.14270700E+01 | 0.14484292E+01 |
| 15 | 0.23085512E+01 | 0.15033905E+01 | 0.11400573E+01 | 0.15033905E+01 | 0.11568279E+01 |
| 16 | 0.10296380E+01 | 0.12894991E+01 | 0.16476121E+01 | 0.12894991E+01 | 0.12854561E+01 |
| 17 | 0.16860953E+01 | 0.10063308E+01 | 0.20671401E+01 | 0.10063308E+01 | 0.11411771E+01 |
| 18 | 0.32740232E+01 | 0.10985581E+01 | 0.14379224E+01 | 0.10985581E+01 | 0.11568279E+01 |
| 19 | 0.27073054E+01 | 0.12804161E+01 | 0.33424254E+01 | 0.12804161E+01 | 0.31239944E+01 |
| 20 | 0.57674735E+01 | 0.10006081E+01 | 0.33422551E+01 | 0.10006081E+01 | 0.11568279E+01 |
| 21 | 0.31470145E+01 | 0.11545608E+01 | 0.29720408E+01 | 0.11545608E+01 | 0.30679587E+01 |
| 22 | 0.36213645E+01 | 0.11308223E+01 | 0.26403964E+01 | 0.11308223E+01 | 0.11568279E+01 |
| 23 | 0.17947015E+01 | 0.11782462E+01 | 0.17169293E+01 | 0.11782462E+01 | 0.15226386E+01 |
| 24 | 0.37859015E+01 | 0.10103389E+02 | 0.16304133E+01 | 0.10103389E+02 | 0.11568279E+01 |
| 25 | 0.31664992E+01 | 0.10931248E+01 | 0.17756820E+01 | 0.10931248E+01 | 0.35356751E+01 |
| 26 | 0.48436526E+01 | 0.10264119E+01 | 0.39491140E+01 | 0.10264119E+01 | 0.11568279E+01 |
| 27 | 0.32712406E+01 | 0.11270794E+01 | 0.20976880E+01 | 0.11270794E+01 | 0.11568279E+01 |
| 28 | 0.24853893E+01 | 0.18238537E+01 | 0.47362447E+01 | 0.18238537E+01 | 0.25141895E+01 |
| 29 | 0.23451651E+01 | 0.10049047E+01 | 0.10309941E+01 | 0.10049047E+01 | 0.11568279E+01 |
| 30 | 0.31878402E+01 | 0.12052905E+01 | 0.36709963E+01 | 0.12052905E+01 | 0.33405230E+01 |
| 31 | 0.26622234E+01 | 0.10575920E+01 | 0.12365238E+01 | 0.10575920E+01 | 0.11568279E+01 |
| 32 | 0.10005279E+01 | 0.12609818E+01 | 0.32507043E+01 | 0.12609818E+01 | 0.11568279E+01 |
| 33 | 0.15348590E+01 | 0.14006462E+01 | 0.21175229E+01 | 0.14006462E+01 | 0.20122973E+01 |
| 34 | 0.13761276E+01 | 0.11395156E+01 | 0.10743850E+01 | 0.11395156E+01 | 0.14153187E+01 |
| 35 | 0.10849143E+01 | 0.19896715E+01 | 0.25796545E+01 | 0.19896715E+01 | 0.27032284E+01 |
| 36 | 0.10005708E+01 | 0.11712123E+01 | 0.20532965E+01 | 0.11712123E+01 | 0.17079904E+01 |
| 37 | 0.14349329E+01 | 0.10824168E+01 | 0.13192226E+01 | 0.10824168E+01 | 0.10104889E+01 |
| 38 | 0.10071172E+01 | 0.17858617E+01 | 0.11578141E+01 | 0.17858617E+01 | 0.11568279E+01 |
| 39 | 0.19487654E+01 | 0.14970472E+01 | 0.11400573E+01 | 0.14970472E+01 | 0.11568279E+01 |
| 40 | 0.23797686E+01 | 0.10474714E+01 | 0.11656688E+01 | 0.10474714E+01 | 0.18282972E+01 |
| 41 | 0.10032068E+01 | 0.11184145E+01 | 0.10001092E+01 | 0.11184145E+01 | 0.12535947E+01 |
| 42 | 0.13310814E+01 | 0.14879795E+01 | 0.10606234E+01 | 0.14879795E+01 | 0.10765840E+01 |

| | | | | | |
|----|----------------|----------------|----------------|----------------|----------------|
| 43 | 0.16061667E+01 | 0.16329080E+01 | 0.12635886E+01 | 0.16329080E+01 | 0.15823225E+01 |
| 44 | 0.10026345E+01 | 0.21791326E+01 | 0.10914992E+01 | 0.21791326E+01 | 0.10004998E+01 |
| 45 | 0.12454018E+01 | 0.14831358E+01 | 0.12994887E+01 | 0.14831358E+01 | 0.10001917E+01 |
| 46 | 0.12886979E+01 | 0.11713584E+01 | 0.11400573E+01 | 0.11713584E+01 | 0.11568279E+01 |
| 47 | 0.21409033E+01 | 0.10109729E+01 | 0.20745621E+01 | 0.10109729E+01 | 0.18687216E+01 |
| 48 | 0.14062819E+01 | 0.13510192E+01 | 0.29177397E+01 | 0.13510192E+01 | 0.17547660E+01 |
| 49 | 0.11015434E+01 | 0.14346589E+01 | 0.13447396E+01 | 0.14346589E+01 | 0.11068897E+01 |
| 50 | 0.34240152E+01 | 0.10458206E+01 | 0.14528047E+01 | 0.10458206E+01 | 0.23677172E+01 |

mean efficiency =
0.21644532E+01

mean efficiency =
0.14837369E+01

mean efficiency =
0.19087456E+01

mean efficiency =
0.14837369E+01

mean efficiency =
0.17145893E+01

