COMPARISON OF ECONOMIC EFFICIENCY OF ORGANIC AND CONVENTIONAL COFFEE FARMING SYSTEMS IN MOSHI RURAL DISTRICT - TANZANIA

By

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DECLARATION

I Harold Terewaeli Lema, confirm that this thesis is my original work and has not been submitted for any degree or any other qualification in any university

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The work presented in this document is accomplished with collaborative efforts from researcher, colleagues and friends. However I say at the outset that any errors remaining in this thesis are solely mine.

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DEDICATION

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ACRONYMS AND ABBREVIATIONS

DEA	Data Envelopment Analysis
EPOPA	Export Promotion of Organic Product from Africa
FAO	World Food Organization
Ha	Hectare
IFOAM	International Federation for Organic farming Movement
ICS	Internal Control System
KNCU	Kilimanjaro Native Cooperative Union
OLS	Ordinary Least Squares
RRSS	Restricted Residual Sum of Squares
URSS	Unrestricted Residual Sum of Squares
SURE	Seemingly Unrelated Regression Estimates
TACRI	Tanzania Coffee Research Institute
UNCTAD	United Nations Conference On Trade and Development
UOP	Unit Output Price
USA	United States of America

ABSTRACT

Organic agriculture is defined as farming system that sustains the health of soils, ecosystems and people. This technology combines tradition, innovation and science in agriculture to benefit the shared environment and good quality of life for all actors involved. Compared to conventional agriculture, organic farming is viewed as appropriate and affordable farming technology for small scale coffee farmers in developing countries who cannot afford high costs of production due to continuously increasing prices of inorganic inputs and falling prices of coffee in the market. However, it is apparent that there is no consensus among researchers and policy makers on how organic farming technology affects profit and production efficiency when applied in coffee farming system in Moshi rural district. Therefore, this study compares economic efficiency of organic and conventional coffee farming system in Moshi rural district in Tanzania. The main objective of study was to examine and compare economic efficiency of organic and conventional coffee farming systems. The data related to input and output prices, production factors and socio-economic characteristics were collected from 115 coffee farmers following both farming systems in Moshi rural district in Tanzania. The profit function approach was used in this study. Analytical tools included descriptive statistics and seemingly unrelated regression (SURE).

The study results reveal that the cost of physical input of organic coffee per acre was 45% lower than that of conventional coffee while the gross profit received from organic coffee farms per acre was 65% lower than that obtained from conventional coffee farms. Based on Cobb-Douglas profit function estimation, coefficient of land, capital, extension services and education was found to be positive and statistically significant in the profit function model. Efficiency analysis

conducted by using profit function, jointly estimated with wage share equation indicates that, economic and technical efficiencies were in favour of conventional farms.

Irrespective of the disadvantages found in organic coffee farming technology, it is necessary to narrow down its technological gap when compared to conventional farming. Therefore, the research results may assist policy makers and agricultural institutions concerned with sustainable farming to take necessary measures to increase efficiency of organic farming and to enhance environmental benefits and farmer’s income

CHAPTER I

INTRODUCTION

1.1 Agriculture sector in Tanzania

The economy of Tanzania largely depends on agriculture. The country's GDP was US$ 9.9 billion in 2006, and the value added in agriculture was 43.4% of the GDP (Africa Desk Department of Agriculture, 2006). The agricultural sector continues to lead the economic growth, in spite of the recent emergence of new high-growth sectors of mining and tourism.

However, the big proportion of the farming population is constituted of small-scale subsistence farmers accounting for more than 90%, with medium and large-scale farmers accounting for only 10 % (Africa Desk Department of Agriculture, 2006). Agriculture is the main source of food supply and raw materials for the industrial sector, as well as the major market for industrial goods and services. The sector produces and exports value added products such as textiles, processed coffee and tea, sisal twine and ropes, and chemical products.

Despite the merits of agriculture for the majority of Tanzania farmers, it still faces major constraints and these include poor farm gate price and unreliable cash flow among farmers; high prices of agricultural inputs; falling labour and land productivity due to application of poor technology and dependence on irregular weather conditions (World Bank, 2007). Thus, both crops and livestock are adversely affected by periodic droughts. Irrigation played a key role in stabilizing agricultural production and improvement of food security in Tanzania; however lack of investment capital remains a major challenge in this direction.

1.2 General Situation of coffee in the world market

Coffee is one of the most important agricultural commodities in the world trade; however, the coffee industry is currently in a crisis due to the low prices offered in the world market (Lewis, 2005). Coffee prices in the world markets, which averaged around US cents 120/ lb. (132 cents/kg) in the 1980s, are now around 50 cents /lb. (55 cents/kg) (World Bank, 2007). The drastic drop in the prices in the last five years has severely affected countries that heavily depend on coffee as one of the main export commodities for revenue generation. The falling of the coffee prices in the world market has also affected livelihoods of 25 million small producers and over 125 million people in developing countries (Bacon, 2005a).

A review of the global coffee markets indicates that the coffee crisis is caused by major imbalances between supply and demand. Whereas coffee production has been increasing at an annual rate of 2%, its demand has been increasing by a mere 1.5% (Oxfam, 2005). For example, in the last decade, the production of Arabica coffee increased by 12%, while the production of Robusta coffee increased by 53% with major increases noted in Brazil and Vietnam (World Bank, 2007). This phenomenal increase has led to oversupply of coffee in the world market. The global coffee consumption on the other hand, is shown to have stagnated at around 106 million bags with the main importing countries showing signs of saturation. Coffee is mainly consumed in developed countries, which account for about 76% of the total consumption and the remaining 24% of the consumption occurring in the producer countries. Furthermore, consumption per capita is still very low in most producer countries varying between 2.6 kg in Nicaragua, 1.5 kg in Ethiopia, 0.01kg in Kenya, and 0.007kg in Tanzania (Anon, 2001). This is considerably low compared to the levels in developed countries whose consumption per capita can reach 10kg.

This is despite the fact that coffee markets in most of the producer countries including Tanzania have been liberalized, something which was expected to have promoted the local demand of the produce.

Identification of new market niches is one way of increasing market shares and prices. However, various studies have shown that in the recent past, several market niches have emerged and continue to expand in Europe, USA, Japan and Canada. The niche markets include organic and fair trade coffees. These niche markets have stirred the growing demand for organic tropical products which have galvanized organic activists, non-governmental organizations and some donors into promoting certified organic export production in a number of tropical African countries (United Nations Conference on Trade and Development (UNCTAD), 2008). Furthermore, several large global trading companies, exporters in developing countries and importers in developed countries have seen the opportunities and embarked on trading in these products.

Organic coffee is one of specialty coffees selling at a premium over the conventional coffees in the world market because of having distinct origin and flavour, being environment-friendly in its production and socio-economic concerns for the smallholder coffee growers (Van der Vossen, 2005). The growing demand for organic coffee (mainly in Western Europe, North America and Japan) exceeds the present supply, which is still less than 1% of the total annual world production (6.3 million tones of green coffee in 2003).

In Africa, organic farming is significantly more developed in South and Eastern Africa than in other regions and accounts for over three quarters of the certified organic land of the continent

(Rachel *et al.*, 2006). In 2006, at least 17 different organic products including coffee were exported from Tanzania and Uganda with 40,000 certified organic farms in Uganda which was surpassed only by Mexico and Italy in terms of the number of producers, Tanzania had 34,791 certified farms, and Kenya had 15,815 (Willer and Yussefi, 2007). Up to year 2007, only 1.5% (182,000 ha) of Uganda agricultural land was certified as organic. Tanzania had 0.1% (38,875 ha) of land and Kenya had 0.7 % (182,586 ha) (Willer and Yussefi, 2007). Organic certification may increase household income through organic price premium and by reducing the unit cost of production (IFOAM), 2000). A research conducted recently (see Onduru *et al*, 2002; Parrot *et al*, 2006) reveals that organic farmers in developing countries can increase their income by 30%-80%, after the conversion period to organic production. In Uganda, certified organic sub sector reveals a strong performance in terms of growing export volume, revenue and product diversity (Gibbon, 2006); a similar trend can be observed in the United Republic of Tanzania.

Organic agriculture combines superior ecological sustainability with lower health risks and sound economic viability basing on the following principle (IFOAM, 2000; Rice, 2001; Rice and McLean, 1999):

- Composted organic matter to improve soil quality (no inorganic fertilizers)
- Soil conservation (contour planting, terracing, cover crops, mulch, shade trees)
- Disease, pest and weed control by 'natural' methods only (no synthetic pesticides) and
- Minimum use of fossil fuels in the production system and low environmental pollution during post-harvest handling.

IFOAM has formulated basic standards for organic coffee where 41 organizations have been accredited to have certified organic coffee. The procedures of registration, certification and regular inspection of the organic farm incurred some costs which vary according to the location of producers. All these costs have to be met by the coffee producers, while the extra premium for certified organic coffee is usually not more than 20% above the conventional coffee prices. Coffee that is produced by small scale farmers without inorganic fertilizers and synthetic pesticides due to lack of financial resources is therefore organic by default, but does not qualify as organic. This is the case, for instance, with most of the Arabica coffees in Ethiopia (Kufa and Shimber, 2001).

For many small scale farmers one option for reducing the high costs of international certification is to form producer groups or co-operatives through which certification can be applied (Barret *at al*., 2001; Harris *et al.,* 2001). The groups pay one fee for the certification (Soil association, 2001) making this a viable way for small holder to afford organic certification for their produce. There are many examples of producer groups from developing countries especially in sub Saharan Africa, that have been successful in exporting organic produce to Europe, in particular coffee and cotton. However, most of these groups are associated with fair trade organization or companies that support ethical business practice and who pay for the costs of certification whilst guaranteeing the markets of crops from developing countries.

Although almost every country would now say it supports the idea of agricultural sustainability, the evidence on the implementation of the policy is scanty in most countries (Rachel, 2006). So far, there are about three countries which have given explicit national support for sustainable agriculture. Cuba has a national policy for alternative agriculture; Switzerland has three tiers of support to encourage environmental services from agriculture and rural development, and Bhutan has a national environmental policy that coordinates production across all sectors (Funes *et al.,* 2002; Pretty *et al.,* 2001; Herzog *et al.,* 2005). Neither Tanzania, Kenya nor Uganda have included organic farming in their main agricultural policies, and many of these policies still support conventional agriculture which promotes the use of inorganic agriculture inputs (Rachel, 2006).

1.3 Coffee Sub sector in Tanzania

Coffee is one of Tanzania's most significant agricultural export crops and is grown in five regions of the country (Bank of Tanzania, 2008a). Tanzania produced about 800,000bags (1bag = 60-kilogram), or 0.7 percent of the world output of 117 million bags in 2006/2007 (World Bank, 2007). About two-thirds of the coffee in the country is mild Arabica, and the rest is hard Arabica and Robusta. Arabica coffee is grown in Arusha and Kilimanjaro regions in the North and Mbeya and Ruvuma regions in the South. Robusta coffee is produced in the lake zone mainly in Kagera region. Coffee is normally intercropped with food crops such as banana, beans and maize. About 95 percent of the coffee is grown by smallholders with average holdings of 1–2 hectares, and only 5 percent is grown on estates.

Tanzanian coffee farmers have been facing numerous challenges due to fluctuating coffee prices in the world market, and which in long-term has led relative decline due to various national markets reforms. In Tanzania, the market reforms were implemented in order to ensure sustainable economic growth by providing increased incentives to agricultural producers. However, it is reported that other market reforms pushed up the prices of agriculture inputs relative to outputs (Mwakalobo, 2000, Mwakalobo and Kashuliza, 1998; 2000; Turuka, 1995; Hawassi, 1997, Hammond, 1999). These reforms have led to the reduction of coffee production due to the low or no application of agricultural inputs especially artificial inputs (inorganic) which require larger capital.

Following this rapid changing of the environment, the quality differentiation of coffee became an alternative of dealing with falling prices of coffee and increasing of the costs of production. In principle, it is suggested that the differentiation of coffee via organic cultivation could lead to considerable economic as well as environment benefits. Non-governmental and religious organizations have been mobilizing small scale farmers to transform their farming practices into organic farming. However, most of farmers have been facing constraints at some point of transformation period to organic due to lack of skills, information and technical support in organic farming principles. These challenges are reflected in the minimal percentages of farmers who are devoted to organic farming of coffee. In particular, the coffee organic farms in Tanzania reached about 8,767 in 2008 accounting for 2% percent of the total coffee farms.

Currently, organic coffee is grown in Kilimanjaro, Mbeya and Kagera regions. Organic coffee farmers in Tanzania increase their incomes through two parallel processes (EPOPA, 2004); the first is the price increase for crops, as the organically produced crops usually fetch about 10% to 20% prices higher than the prices of non-organic production. The second is that the costs of production, which also go down, as there is no use of non-organic fertilizers and pesticides. However, organic agriculture is severely more laboured intensive; therefore farmers needed to increase the amount of manual labour when transforming from non-organic to organic farming.

1. 3.1 Organic Coffee Farming System in Moshi Rural district

Organic coffee farming system has been in operation in Moshi rural district since 2001. The farming system was initiated by Kilimanjaro Coffee Cooperative Union (KNCU) in collaboration with the Export Promotion of Organic Products from Africa (EPOPA). The idea was initiated due to the fast growing of beneficial organic market of coffee in Europe, America and Japan and the rapid changing of environment (characterized by drastic reduction in coffee prices, increasing competition and liberalization of the trade flows), whereby the quality based differentiation of coffee became an appealing alternative for dealing with dropping prices and surplus production. KNCU enter into agreement with EPOPA to assist farmers to convert their conventional coffee farming to organic because had neither expertise nor experience in organic farming. Organic coffee faming system practiced in Moshi rural district is the one of which certified organic coffee is intercropped with banana, beans, and maize.

KNCU/EPOPA conducted mobilization meetings with six primary society's members in Moshi rural district namely, Mwika-mrembuo, Marangu East, Kirua Vunjo East, Uru North and Kinya Mvuo. Farmers were selected to join the project on the basis of their willingness and readiness and whose economic objective was economic return. KNCU/EPOPA has been using the approach of working with a small group of farmers and uses them as a catalyst of innovation. The idea behind the approach has been that, other farmers could join the project through the observation of the increased production, efficiency and income.

At the end of 2008, there were 3,695 farmers registered as organic growers while 1,126 farmers were delivering organic certified coffee to the market (KNCU, 2002). The programme aims at reaching 5000 – 10,000 farms in Moshi rural district. After switching from synthetic inputs to organic farming, farmers usually experience an initial decline in yields. After the agro-ecosystem is restored and organic management systems are fully implemented, yields should increase significantly. Since the majority of farmers are low income earners, they require supportive programs and policies in compensating for low production during the conversion period. The basic idea of the compensation is to help farmers cope with the lower yields and provide them with an incentive of shifting from conventional to organic farming.

EPOPA and KNCU agreed to share the costs of organic certification of the farms. A certification cost is normally paid at the beginning of the conversion period when inspection and field organization is established, but no organic certified product is sold yet. Principally, organic certification procedures require three years of conversion period but in farming systems where no chemicals have been used for at least three years, the conversion can be reduced to one year. This has been the case for few farmers in Moshi rural district who have been converting their farms to organic within one to two years.

The agreement between EPOPA and the KNCU on the payment of certification costs was that, in the first year EPOPA is to pay 100% and in the second year it is to pay 50%. From the third year onwards, KNCU is to pay 100%, as it is thought that KNCU would be selling organic certified coffee by that time (which has often been the case) and receiving a premium price for the coffee which could pay for the certification costs.

The farmers have to stop using inorganic inputs, and instead rely solely on organic inputs and environmental restoration principles. EPOPA facilitated this conversion and developed an internal control system to ensure that farmers comply with it. Internal Control System (ICS) is a documented quality assurance system that allows the external certification body to delegate the annual inspection of individual group members to an identified body/unit within the certified operator (IFOAM, 2005).

Since 2004, the cooperative have been exporting organic coffee to USA and Japan at the price of 10-20% more and above the traditional coffee prices. Other crops do qualify for organic certification, but lack proper market channels, thus it is only coffee which fetches premium prices under organic coffee farming system in Moshi rural district.

1.4 Statement of the Problem

Organic farming as compared to conventional farming is viewed as appropriate and affordable farming technology for small scale coffee farmers in developing countries, as they cannot afford high costs of production due to continuously increasing prices of inorganic inputs and falling prices of coffee in the market (EPOPA, 2006c). Organic coffee farmers in Moshi rural district in Tanzania adhere to the principles of organic coffee farming, because of its low cost of production and the motivation provided by the premium price received from certified organic coffee (KNCU, 2001). Despite the fact that farmers in Moshi rural district practice organic farming, little is known by researchers and policy makers on how organic coffee farming technology influence profit and economic efficiency. This necessitated for the need to examine the economic efficiency of organic coffee production technology and identify factors that influence profit.

Researchers like Lyngbæk, *et al.,* (2001) assessed the productivity and profitability of organic versus conventional coffee farms in Costa Rica using gross margin analysis while Vangelis *et al.*, (2001) examined economic efficiency of organic cotton farming, in Viotia Greece by using stochastic production frontier function. Mwakalobo, (2000) estimated economic efficiency of conventional coffee farming in Rungwe district in Tanzania. Similar research in organic coffee farming practices is generally lacking in Tanzania because organic coffee farming technology has been around for just decade since its introduction while conventional farming has been practiced in the country for about 100 years.

1.5 Objectives of the Study

The main objective of this study was to compare economic efficiency between organic and conventional coffee farming system in Moshi Rural district.

Specific objectives were:

- Characterize and compare conventional and organic coffee farming systems in Moshi rural district
- Compare farm-specific factors that influence profit in the two systems, that is conventional and organic coffee farming systems in Moshi rural district.
- Compare economic, technical and price efficiency of conventional and organic farms in Moshi Rural district.

1.6 Hypotheses

In view of the problem and objectives, the following hypotheses were tested:

- Organic coffee farms are more profitable compared with conventional coffee farms (H_0: $H_1 > H_2$)
- Economic efficiency, technical efficiency and price efficiency of organic and conventional coffee farms are equal (H0: $H_1 = H_2$).

1.7 Significance of the Study

The measurement of efficiency (technical, allocative and economic) is important area for research both in the developing and developed countries. This is particularly important in Tanzania where resources are limited and opportunities for developing and adopting better technologies are low. Measurement of efficiency is important because it is a factor for productivity growth in agriculture.

This kind of study has economic benefits as it determines the extent to which efficiency can be raised through improving the neglected source of growth that is efficiency using the existing resource base and available technology. The study is the first attempt in the agricultural economics in Tanzania to investigate whether organic and convectional coffee farms differ in terms of factors that affect their probabilities.

This study would provide useful information on formulation of economic policies aiming at improving productivity of organic producers of coffee. The study would also contribute to the prevailing knowledge of economic performance of coffee producers in Tanzania.

1.8 Limitation of the study

The study involved sample of the farms which were fully certified and had been in operating for about 3-8 years under organic farming principles with large quantities of coffee being under production. Farms which were under conversion period and those producing organically coffees by default were not considered because such farms were not certified and thus did not sale coffee under premium prices.

1.9 Definition of terms

Certified organic agriculture is the agricultural production that seeks to promote and enhance health of the ecosystem whilst minimizing adverse effects on natural resources. It is not just seen as a modification of the existing conventional practices, but as a restructuring of whole farm systems (Lampkin and Padel 1994, FiBL 2000, Scialabba and Hattam 2002, Caporali *et al.*, 2003, Reganold 2004).

The FAO/WHO Codex Alimentarius guidelines define **Organic agriculture** as "holistic production and management [whose] primary goal is to optimize the health and productivity of interdependent communities of soil, life, plants animals and people" (FAO/WHO 2001). Similarly, the International Federation of Organic Agricultural Movements, with over 750 member organizations in 108 countries (IFOAM 2006a), defines Organic agriculture as "a whole system approach based upon sustainable ecosystems, safe food, good nutrition, animal welfare and social justice. Organic production therefore is more than a system of production that includes or excludes certain agricultural inputs" (IFOAM 2002).

Certification is the procedure by which a third party gives written assurance that a clearly identified process has been methodically assessed, such that adequate confidence is provided that specified products conform with specified requirements(IFOAM, 2005).

Conventional farming means any material, production or processing practice that is not certified "Organic" or "organic in-conversion" (IFOAM, 2005).

Conversion period is the time between the producers start implementing organic management and the certification of the product as organic (IFOAM, 2005).

Differentiated coffees are coffee that can be clearly distinguished because of distinct origin, defined processes, or exceptional characteristics like superior taste or zero defects. In contrast, mainstream coffees are nearly always pre-ground blends that are often unidentified in terms of origin. They are often, though not always, bought and sold on the basis of price and distributed through institutional or mainstream channels, such as supermarkets. Differentiated coffees are often distinguished by a more direct relationship with a roaster or buyer rather than being traded in bulk or via the commodity markets (Lewin, *et al.*, 2004, p. 105).

CHAPTER 2

LITERATURE REVIEW

This chapter reviews the relevant literature and draws the connection between technological interventions in the face of market liberalization and price fluctuation in the world coffee markets. The review focuses on studies on agricultural efficiency among smallholder farmers. The review emphasizes those studies that investigated the disparity in productivity, efficiency and sustainability impacts among different groups of small-scale farmers, and which are attributable to technological interventions. The existing gaps in knowledge concerning economic efficiency in organic coffee farming technology are highlighted citing areas that this study contributes to the existing literature.

2.1 Importance of Coffee in Tanzania Economy

Coffee accounts for about 20% of the Tanzania's foreign exchange earnings and has been the mainstay of the country's agricultural-based economy since its introduction as a cash crop about 100 years ago (TMoA, 2007). More than 400,000 farm families (95%) and 110 estates (5%) derive their livelihoods from growing coffee with an estimated 2,000,000 additional people being employed directly or indirectly in the industry (TACRI, 2006).

Since the mid-1990s, the country's coffee industry has been in a state of stagnation or decline. The reasons for this are diverse and include, falling world coffee prices, which have eroded profit margins and income of coffee growers, thus threatening farmers' livelihoods. Another reason is low productivity resulting from lack of motivation to invest in inputs and improved crop husbandry, which in turn has affected quality and yields. High cost of production is yet another reason, which has thus reduced competitiveness in the world market. The aging of coffee trees as well as coffee growers has also taken its toll in the stagnation of coffee industry; and research, which is essential in supporting a vibrant coffee industry, had been declining for many years. However, despite all these reasons, Tanzania is very well suited to coffee production (and in particular the production of less price-sensitive Arabica coffee) because of its expansive volcanic highland areas and the Great Lakes basin which provide ideal conditions for growing coffee (TACRI, 2006).

2.2 Why Organic Coffee Farming

Organic agriculture is not to be seen as an end in itself, but rather as a means to healthier soils, plants, animals and people, or a livelihood strategy used to achieve desired livelihood outcomes such as poverty reduction, food security and environmental conservation (Scoones, 1998: 4).

There is mounting evidence showing that organic agriculture can enhance productivity and income by using locally available and appropriate low-cost technologies without causing environmental damage (Hine & Pretty, 2006; Parrott & Elzakker, 2003; Rundgren, 2002; Scialabba & Hattam, 2002). A DFID-funded assessment of farming systems of varying levels of intensity in sub- Saharan Africa reports of ‘significant potential to raise productivity through the optimized use of locally-available natural resources’ (Harris *et al.*, 2001). Studies conducted worldwide illustrate that organic agriculture can double or even triple productivity of traditional systems, particularly when one considers the total production of useful crops per area (Scialabba

& Hattam, 2002). For example, composted plots in the Tigray region of Ethiopia yielded 3-5 times more than chemically-treated plots (Edwards, 2005).

A report, “The Real Green Revolution”, found that organic and agro ecological farming in less developed countries produces dramatic yield increases, as well as greater crop diversity and greater nutritional content (Parrott & Marsden, 2002). Similarly, the finding in Indian experiments (Bhattacharya and Chakraworty, 2005) reveal that productivity of organic farming may be less in the initial years, but the yield would increase progressively under organic farming equating the yield under inorganic farming by sixth years.

2.3 Coffee Price in the World Market

The supply elasticity of coffee with respect to price is low and also the price elasticity of coffee demand is low (Ponte, 2001). Coffee demand drops only when coffee prices increase significantly. This causes the prices of coffee in the world coffee market to be highly variable. Unexpected frosts or diseases are quite common, especially in Brazil, and can destroy large amounts of coffee. Reduced supply then leads to high coffee prices without a significant reduction in consumption. The response on the supply side is usually higher than necessary, as more farmers than before would plant new coffee trees. Two years later, when the new trees have matured, there would be oversupply and low prices. This would in turn force many coffee farmers to abandon the business and or start growing something else. Consequently, the world supply of coffee would fall driving prices up again. Higher prices would again lead to oversupply, and so the cycle would continue. The changing of prices mean that coffee farmers all over the world including Tanzania live in a situation of uncertainty in which it is difficult to make plans for the future.

2.4 Market of Organic Coffee in the World Market

Among the sustainable coffee niches, organic coffee is experiencing the most rapid growth in the world, estimated at 12-20 percent per year leading to a doubling of supply every 5 to 6 years. Global exports of certified and uncertified organic coffee for 1999/2000 ranged from 15 to 21 million pounds (Giovannucci, 2001). Until recently, the estimates suggest that the demand was still outstripping the supply of certified organic coffee (Giovannucci and Koekoek, 2003). In part, this was due to the spectacular growth of organic foods in the world retail market as consumers place increasing value on the protection of health and environment (NACEC 1999; Giovannucci and Koekoek, 2003). In the last two years however, the supply and demand have become more balanced; organic coffee premiums have declined as the market experiences an increasing supply even as quality continues to rise (Ponte, 2004; Bacon, 2005b; Giovannucci, 2005). Primary markets of certified organic coffee are Germany, Holland, Switzerland, Belgium, and the United States. In the United States, certified organic coffee accounts for 3-5 percent of the specialty coffee market.

Organic coffee is indexed to global market prices and receives a premium of US$.10- .50/lb above the prevailing conventional coffee price. The variation in the premium relates primarily to quality characteristics. As will be seen, it is important to recognize that the premium for organic coffee is market-based in two different ways. First, it is a premium above the market price for conventional coffee. When prices are low the premium remains the same, so the organic price falls with the market, and rises with the market. Secondly, the premium is market-based in that the size of the premium is determined by the supply and demand for such coffee in the market.

To the extent demand for certified organic coffee outstrips the supply, the premium would rise. If the supply catches up with the demand growth, the premium will fall.

2.5 Market of Organic Products in Tanzania

The local market for organic products in Tanzania is not well developed. This is due to several factors, which include lack of awareness and understanding of organic agriculture principles and standards, and higher prices of organic goods compared with conventional ones. A few, who are well informed about the importance of organic products, do not find the desired range of the products in the local market due to lack of 'guaranteed sign' (Sogn and Mella, 2006). Consumers interviewed in Dar es Salaam felt they were stuck in a market situation whereby food production that is organic "by default" is mixed up with the products obtained through other farming practices and it is difficult to trace the origin of the products (Sogn and Mella, 2006). In addition, although a variety of natural, environmental, medicinal, healthy/organic products are available in Tanzania, most of them are sold at prices 50 percent to 100 percent higher than the prices of conventional products. The analysis of the supply sources for local organic markets in Tanzania has been divided into two main categories, namely the retailing outlets and the processing outlets. The retailing outlets have been further subdivided into specialized and non-specialized outlets.

2.6 Other Related Efficiency Studies

The current literature on the performance of organic farming is still small in both developed and developing countries mainly because there have not been sufficient data on organic farms (Lansink, *et al.,* 2002). Bachwenkizi, (2009) analyzed economics of small holder organic coffee farmers in Muleba district in Tanzania, the results of the study show that there was no statistically significant difference in the costs associated with the production of organic coffee and conventional coffee, especially as it was observed in labour costs and fixed costs. However there was statistically significant difference in the average variable costs of the two farming systems, and this was attributed to high marketing costs for organic coffee was 58% higher than that of conventional coffee. Farm enterprise budget indicated that the profit obtained from hulled conventional coffee exceeded that obtained from hulled organic coffee regardless of the premium prices; there were higher yields associated with organic coffee farming.

Padel and Uli (1994) reviewed several studies on the costs and returns of organic farming in various crops in Germany. Their study reveals that organic farming under German conditions was as profitable as conventional farming. Lower yields of organic crops were compensated by reduced costs of inputs and premium prices of the crops. Many farmers' reported that financial stability was the main reason for converting to organic farming. The introduction of support schemes for conversion and continuing organic farming also made a significant impact on profitability.

Anderson (1994) examined different research studies on organic farming in the USA and concludes that the lower yields in organic farms, which contrasted with yields in conventional farms, were compensated by lower production costs. The noted differences between economic performance of organic and other farms may be due to farm size rather than farming system. During the study period, the US organic producers did not receive any benefit from the environmental advantages except to the extent that consumer willing to support by paying a premium.

Dubgaard (1994) studied the economic analysis of organic farming in Denmark. His results show that the yield differences were statistically different for intensive crops such as wheat and potatoes with organic yields around half the conventional averages. The organic farms used about twice as much labour per hectare as the conventional farms. The study also concluded that the substantial price premiums on the output and public support are essential for the economic viability of organic farming in Denmark.

Shirsagar (2008) studied the impact of organic farming on economics of sugarcane cultivation in Maharashtra - India. The study was based on the primary data collected from two districts covering 142 farmers, 72 growing organic sugarcane and 70 growing inorganic sugarcane. The results indicate that organic sugar cultivation enhances human labour employment by 16.9 per cent and the cost of cultivating organic sugar is also lower by 14.2 per cent than that of inorganic sugarcane farming. Although, the yield from organic sugar was 6.79 per cent lower than the conventional crop, is the yields are more than compensated by the price premium received and yields stability observed on organic sugar farms. Overall, organic sugar farming provided 15.63 per cent higher profits than inorganic sugarcane farms.

Mbowa (1996) used DEA to examine resource use farm efficiency on small and large-scale farms in sugarcane production in Kwazulu-Natal. The study results show that small-scale farmers were technically inefficient than large-scale producers and concluded that the size of farm operation affects the level of efficiency attainable

A study by Battese *et al.*, (1998) on paddy rice farms in Aurepalle India, which used panel data for 10 years, and concludes that older farmers were less efficient than the younger ones. Farmers with more years of schooling were also found to be more efficient but declined over the time period.

A study by Mwakalobo, (2000) reveals that convectional farmers display inefficient use of available resources in coffee production in Rungwe, Tanzania. The results indicate that farmers would increase farm efficiency by the use of adequate capital-intensive input levels in order to maximize their efficiency. However, in order to achieve the use of capital intensive inputs, farmers were encouraged to form groups/associations through which these farmers can take the advantages of increasing the bargaining power in both input and output markets. Farmers' groups/associations could provide group liability in the procurement of credit from both formal and informal financial lending institutions. This in turn would improve farmers input purchasing power.

A study by Amadou, (2007) indicates that convectional Arabica coffee growers in Cameroon had educational level with a negative and significant effect on technical inefficiency. This result shows that farmers who have spent many years in formal education tend to be more efficient in coffee production. Similar results were obtained by Belbase and Grabowski (1985), Ali and Flinn (1987), Bagi (1987), Durasaimy (1990), Pinheiro (1992), Seyoum *et al.* (1998), Weir

(1999), and Weir and Knight (2000). Access to credit has also a negative influence on technical inefficiency. Actually, it reduces the financial difficulties farmers face at the beginning of the cropping year, thus enabling them to buy inputs. This result is also similar to those obtained by Bravo-Ureta and Evenson (1994), Kalirajan and Shand (1986), and Boon (2005).

A study by Wilson, *et al.,* (1998) on technical efficiency in the UK potato production used a stochastic frontier production function to explain technical efficiency through managerial and farm characteristics. The mean technical efficiency across regions ranged from 33 to 97 percent. There was high correlation between irrigation of the potato crop and technical efficiency. The number of years of experience in potato production and small-scale farming were positively correlated with technical efficiency.

A study by Liu, *et al.,* (2000) on technical efficiency in post-collective Chinese agriculture concluded that 76 and 48 percent of technical inefficiency in Sichuan and Jiangsu, respectively, could be explained by inefficiency variables. The authors used a joint estimation of the stochastic frontier model to determine this.

Awudu and Huffman (2,000) studied economic efficiency of rice farmers in Northern Ghana. Using a normalized stochastic profit function frontier, they concluded that the average measure of inefficiency was 27 percent, which suggested that about 27 percent of potential maximum profits were lost due to inefficiency. This corresponds to a mean loss of 38,555 cedis per hectare. The discrepancy between the observed profit and the 23 frontier profit was a result of both technical and allocative efficiency. Higher levels of education reduced profit inefficiency while engagement in off-farm income earning activities and lack of access to credit experience higher profit inefficiency. The study also found significant differences in inefficiencies across regions.

Awudu and Richard (2001) used a translog stochastic frontier model to examine technical efficiency in maize and beans in Nicaragua. The average efficiency levels were 69.8 and 74.2 percent for maize and beans, respectively. In addition, the level of schooling represented human capital, access to formal credit and farming experience (represented by age) contribute positively to production efficiency, while farmers' participation in off-farm employment tended to reduce production efficiency. Large families appeared to be more efficient than small families. Although a larger family size puts extra pressure on farm income for food and clothing, it does ensure availability of enough family labour for farming operations to be performed on time. Positive correlation between inefficiency and participation in non-farm employment suggests that farmers reallocate time away from farm-related activities, such as adoption of new technologies and gathering of technical information that is essential for enhancing production efficiency. The result indicated that efficiency increased with age until a maximum efficiency was reached when the household head was 38 years old. The age variable probably picks up the effect of physical strength as well as farming experience for the household head.

In a study by Wilson, *et al,* (2001) a translog stochastic frontier and joint estimate technical efficiency approach were used to assess efficiency. The estimated technical efficiency among wheat producers in Eastern England ranged between 62 and 98 percent which means that farmers who sought information, had more years of managerial experiences, and had large farm were associated with higher levels of technical efficiency.

A study by Mochebelele and Winter-Nelson (2002) on smallholder farmers in Lesotho used a stochastic production frontier to compare technical inefficiencies between farmers who sent migrant labourers to the South African mines and those who did not. They concluded that farmers who send migrant labourers to South African are closer to their production frontier than those who do not.

Belen, *et al.,* (2003) made an assessment of technical efficiency of horticultural production in Navarra, Spain. They revealed that tomato producing farms were 80 percent efficient while farms raising asparagus were 90 percent efficient. Therefore, they concluded that there exists a potential for improving farm incomes by improving efficiency.

Gautam and Jeffrey (2003) used a stochastic cost function to measure efficiency among smallholder tobacco cultivators in Malawi. Their study revealed that larger tobacco farms are less cost inefficient. The paper uncovered evidence that access to credit retards the gain in cost efficiency from an increase in tobacco acreage. This suggested that the method of credit disbursement would have been faulty.

Bravo-Ureta, *et al.,* (1994) found that Paraguay cotton had 40.1 percent average economic efficiency while cassava producers had 52.3 percent efficient. They therefore concluded that there was room for improvement in productivity for these basic crops. However they did not find any relationship between economic efficiency and socioeconomic characteristics. This observation was explained by the possibility of the existence of 25 stages of development threshold below which this type of relationship is not observed. In this case the sampled Paraguayan farmers were yet to reach the threshold.

In the light of these studies, organic agriculture shows great potential of improving domestic food production with cheap, low-cost locally-available technology and inputs. However, more research is needed in order to reveal the mechanisms through which organic agriculture increases productivity and food availability, and the extent to which it improves the security of livelihoods and access to food by vulnerable groups.

These studies show great potential of improving profitability, technical and allocative efficiency of agricultural crops in various parts of the world. However, more research in agronomic, biotechnical, economics ect, is needed in order to reveal the approach through which organic coffee farming can increases its production efficiencies in Tanzania.

CHAPTER 3

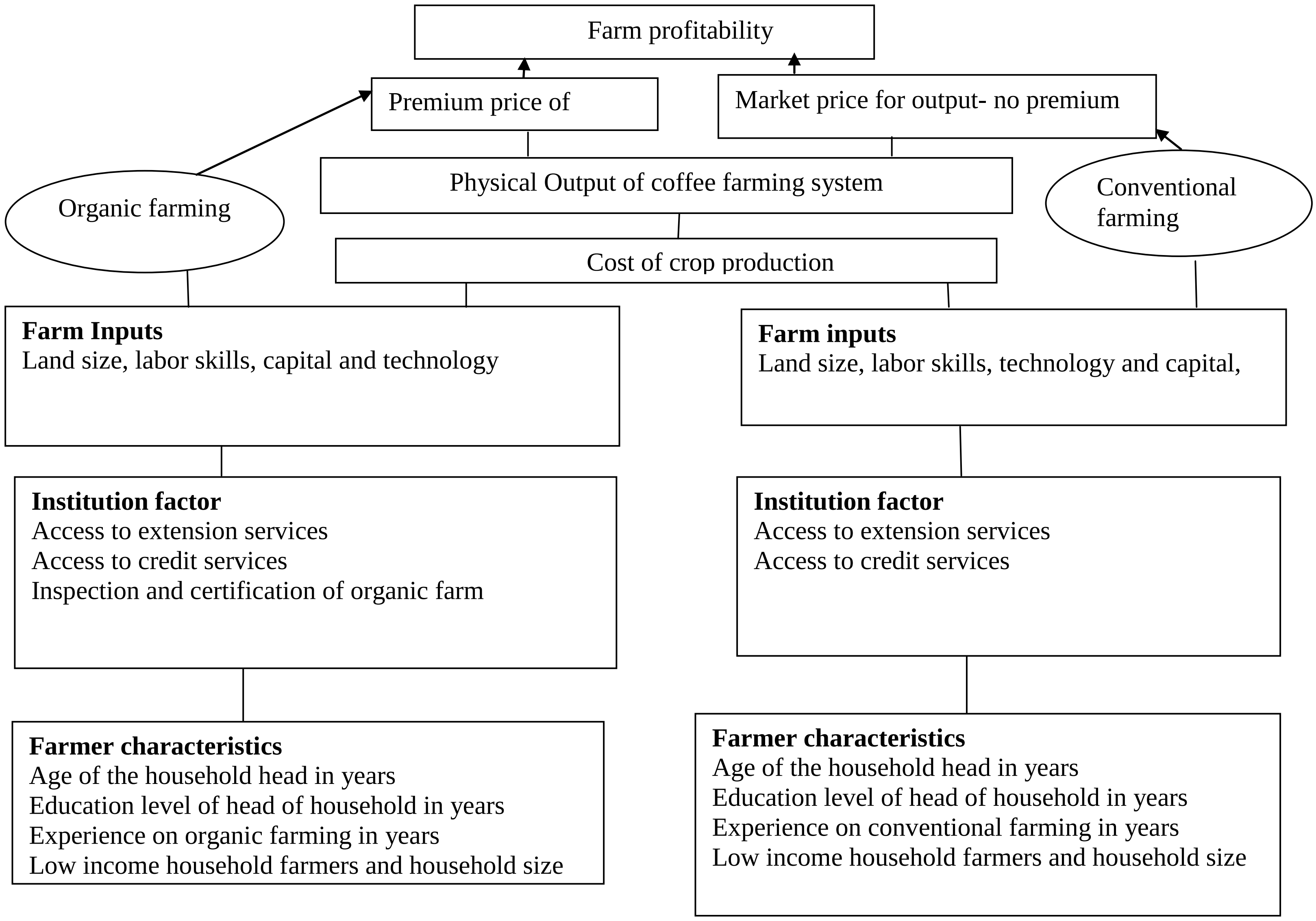
METHODOLOGY

This chapter contains theoretical background of the empirical approach chosen to achieve the study objectives. The first section presents a conceptual framework summarizing the expected relationship among key variables considered in the study. The next section discusses the economic theory on which the analytical procedures used in this study are anchored. The subsequent section presents model specification and justification. Finally, information on the study area, sampling design, sample size determination, data collection and assumption considered for estimating the model are presented in the chapter.

3. 1 Conceptual Framework

As depicted in Figure 1.0, institutional factors, farmers' characteristics, environmental factors, farm inputs and technologies are among the factors which were considered to have an influence on the profit of the conventional and organic coffee farming systems in Moshi rural district. Farm inputs such as fertilizer, organic/inorganic pesticides, land and labour), technology (organic/conventional) influence physical output of the farm and its profit. Farmer's characteristics include, sex, years of education, family size and year of experience on coffee farming. These factors are likely to affect the management of the farms and hence the technical efficiency. Institutional factors include; access to extension services, access to inspection services, access to certification services, existence of market, access to credit, access to storage and transportation networks. Well organized institutions entail increase in physical output from the farm and hence its profit. Other factors such as environment (climate), population, pest and diseases may in one way or another affect production. Market price of the product from organic or conventional farmers determines the gross revenue from the organic and conventional farm and hence their final profits. The profit is the farm incentive desired by the farmer which is the product of gross revenue minus the total variable cost for all crops under coffee farming system.

Figure 1.0 Conceptual Framework of Coffee Based Farming System



3.2 Theoretical Framework

The study of economic efficiency is based on the production theory whereby a farmer is assumed to choose a combination of variable inputs and outputs that maximize profit subject to technology constraint (Sadoulet and De Janvry, 1995). The analysis of efficiency is linked to Knight (1933), Debrew (1951) and Koopmans (1951). Koopmans (1951) provides a definition of technical efficiency while Debrew (1951) introduced its first measure of the 'coefficient or resource utilization'. Following Debrew's seminal paper, Farrell (1957), provides a definition of frontier production functions, which embody the idea of maximality. Farrell (1957) distinguishes three types of efficiency: 1) technical efficiency and 2) price or allocative efficiency and 3) economic efficiency which are the combination of the first two.

Technical efficiency is an engineering concept referring to the input-output relationship. A firm is said to be efficient if it is operating on the production frontier (Ali and Byerlee, 1991). On the other hand, a firm is said to be technically inefficient if it fails to achieve the maximum output from the given inputs, or fails to operate on the production frontier.

Price or allocative efficiency has to do with the profit maximization principle. Under competitive conditions, a firm is said to be allocatively efficient if it equates the marginal returns of factor inputs to the market price of output (Fan, 1999). Akinwumi and Djato (1996) in their study of relative efficiency of women farm managers in Cote d'Ivoire define allocative efficiency as the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to factor costs. Failure to equate revenue product of some or all factors to their marginal cost is at the very core of economic theory (Timmer, 1971).

Economic efficiency is distinct from the other two even though it is the product of technical and allocative efficiency (Farrell, 1957). A firm that is economically efficient should by definition be both technically and allocatively efficient. However, this is not always the case as Akinwumi and Djato (1997) point out. It is possible for a firm to have either technical or allocative efficiency without having economic efficiency. The reason may be that the farmer, in this case, is unable to make efficient decisions as far as the use of inputs is concerned. In some cases, a farmer might fail to equate marginal input cost to marginal value of product. Technical and allocative efficiency are both a necessary and a sufficient condition for economic efficiency. This assumes that the farmer has made the right decision to minimize costs and maximize profits implying operating on the profit frontier.

3.3 Estimating of the Profit Function

The profit function approach combines the concepts of technical and allocative efficiency in the profit relationship and any errors in the production decision are assumed to be translated into lower profits or revenue for the producer (Ali, *et al*., 1994).

So far there are two models namely, production function approach and profit function approach which have been used to analyse economic efficiency in the farm production. Many researchers have used the production function (a mathematical expression that attempts to capture the relationship between inputs combination and the resulting output) as a tool to study economic efficiency. Some researchers have used the production function to separately estimate technical efficiency and allocative efficiency. The following reasons explain advantages of profit function over the production function approach. First, the production function approach assumes that all firms have identical ratios of inputs and outputs, hence only one point on the production plane would be observable. As Ali and Flinn (1989) conclude, a production function approach may not be appropriate when estimating the economic efficiency of individual firms because they have different ratios of input and output, and they also have different factor endowments. Due to these differences the firms will have different best practice production functions and thus, different optimal operating points. Secondly, the production function methods to test for allocative and economic efficiency have been criticized as suffering simultaneity bias because input levels are endogenously determined (Ali and Flinn, 1989). Problems of endogeneity can be avoided by estimating profit function instead of production functions (Quisumbing, 1994). The profit of the farm is the function of the prices of inputs, the price of an output and the level of fixed inputs are all exogenous from the farm point of view. Third, the profit function approach facilitates the analysis of the variables to be conducted depending on the availability of data and uniqueness of the study. Khan and Maki (1979) refer the fixed inputs as capital which includes the sum of the cost of fertilizers, seeds, irrigation and power. From this study, the variable inputs include organic/inorganic fertilizers, organic/inorganic pesticides, maize and bean seeds which were collectively considered as capital.

A study by Yotopoulos and Lau (1971) applied a profit function to compare efficiency of small and large farms in India. They further suggested that the same reasoning could be applied to compare different groupings such as owners versus share tenants or adopters of a new technology versus non adopters. As Khan and Maki (1979) point out, differences in economic efficiency among groups of farms (say users of a given technology and non-users) may result from variations in technical efficiency (larger output with equal amounts of inputs) and price efficiency (higher profits). Profit maximization implies that the value of marginal product of each variable input is equal to its price. Thus, we test the relative efficiency of the two groups of firms by comparing their actual profit functions.

3.3.1 The Profit function Model

Lau and Yotopoulos (1971, 1972) provided theoretical basis for the profit model. A Cobb-Douglas production function with decreasing returns of m variable inputs and with n fixed inputs is given by;

$$V = A\prod_{i=1}^{m} X_i^{\alpha_i} \prod_{i=1}^{n} Z_J^{\beta_j} \text{---(1)}$$

Where V= Output

$X_i =$ Variable input quantities

Z_J = Fixed input quantities

α_i >0 (Output elasticity with respect to variation input X)

Where $\mu = \sum_{i=1}^{m} \alpha_j < 1$---(2)

The production function with usual classical function can be considered in equation below

$$V = f(X_1 \ldots X_m; Z_1 \ldots Z_n) \text{---(3)}$$

Where

V = Output of the farm,

Xi = Variables inputs of the farm,

Zi = Fixed inputs of production.

The restricted profit of the farm is defined as the total revenues - current total variable costs. It is equivalent to the net return of the fixed factors of production. The term “restricted” serves to emphasize that the profit is return to fixed inputs obtained after deduction only those costs of the inputs defined as variable for that particular study. All other costs are considered as fixed costs. The restricted profit function can be written in the general form as:

$$P' = pF(X_1,\ldots,X_m; Z_1,\ldots,Z_n) - \sum_{i=1}^{m} c_i' X_i \text{ --(4)}$$

Where P' is profit, p is the unit price of output, and ci' is the unit price of the ith variable input.

The marginal productivity conditions for a profit-maximizing firm are

$$p\frac{\partial F(X,Z)}{\partial X_i} = c_i' \qquad i = 1,\ldots,m \text{ ---(5)}$$

If $c_i = \frac{c_i'}{p}$ is the normalized price of the ith input, equation (5) is written as

$$\frac{\partial F}{\partial X_i} = c_{i,} \qquad i = 1,..,m \text{ --(6)}$$

Through deflation equation 4 can be rewritten as 7 where P is defined as the "Unit-Output-Price" profit, or normalized profit function

$$\frac{P}{p} = F(X_1, \ldots, X_m; Z_1, \ldots, Z_n) - \sum_{i=1}^{m} c_i' X_i \text{ ---(7)}$$

Equation 6, which may be solved for the optimal quantities of variable inputs, denote X_i^*'s as functions of the normalized prices of the variable inputs and of the quantities of the fixed inputs,

$$X_i^* = f_i(c, z), \quad i = 1, \ldots, m \text{ ---(8)}$$

Where c and Z without subscripts denotes vectors. Profit function is obtained by substituting (8) by (4)

$$\pi = p\left(F(X_1^*, \ldots, X_m^*; Z_1, \ldots, Z_n) - \sum_{i=1}^{m} c_i' X_i^*\right) \text{ --(9)}$$

The profit function gives the maximized value of the profit for each set of values {p, c', Z}. It can be observed that the term within the large paren- theses on the right-hand side of (7) is a function only of c and Z. Hence,

$$\pi = p\,G(c_1', \ldots, c_m'; Z_1, \ldots, Z_n). \text{ ---(10)}$$

The normalized restricted profit function is therefore given by:

$$\pi^* = \frac{\pi}{p} = G(c_1', \ldots, c_m'; Z_1, \ldots, Z_n) \text{ ---(11)}$$

From equation (1) the normalized profit function for the given Cobb- Douglas production is

$$\pi^* = A^*(1-\mu)\left(\prod_{i=1}^{m} c_i'^{\,-\alpha_i^*}\right)\left(\prod_{i=1}^{n} Z_i^{\beta_i^*}\right) \text{ ---(12)}$$

By taking the natural logarithms of equation above we have;

$$\ln \pi^* = \ln A^* + \sum_{i=1}^{m} \alpha_i^* \ln c_i + \sum_{i=1}^{n} \beta_i^* \ln Z_i \text{ ---(13)}$$

The use of the restricted normalized profit function requires data of the output prices to normalize the prices of variable inputs. However in this study the output prices are missing, example banana output was measured by estimating the sizes of a bunch, dry maize and beans were measured by volumes using cans. Beans pods and green maize were measured by bundles. The flexibility of the profit function approach allows rewriting of the restricted normalized profit function in terms of restricted profit and wage rate expressed in monetary terms (Lau and Yotopoulos, 1972; Kahn and Maki, 1979). Subsequently, the weighted unit price of the combined output is no longer needed for normalizing. Therefore, the factor demand function is independent of the output of the prices. Equation 11 allows rewriting of the profit function as:

$\ln(\pi^*) \ldots$ [illegible]

[illegible] ---(14)

Hence, the final estimating equations consist of

[illegible] ---(15)

Khan and Maki (1979) studied non normalized profit function to determine the effect of farm size on efficiency for two regions in Pakistan. Wage rate was defined as a variable input while land and capital were fixed inputs. A dummy variable captured differences in large and small farms. Profit was defined in rupees (physical quantity of output times price of output) minus (the number of man days, times wage rate per day), summed over all crops activities of the farms. By considering this reference, the non- normalized profit function used in this study was specified in money terms. All inputs owned by the household were valued at market prices. General specification of estimating equation was the profit function in the log linear form and the labour demand function expressed as wage share equation as follows below.

$$\ln \pi = \alpha_0 + \alpha_1 \ln W + \alpha_2 D_{A_I} + \alpha_3 \ln T + \alpha_4 \ln Z + \varepsilon$$ --(16)

$$\frac{WL}{\pi} = \alpha_5 D_{A_I} + \alpha_6 D_{B_I} + \varepsilon_2$$ ---(17)

Where:

π = is profit in Tanzanian shillings (total revenue - total variable costs) [sum of all crop activities of coffee farming system]

α_0 = Intercept of profit function

α_1 = Marginal value of labour in the profit function

W = Wage rate in Tanzania shillings per man day. It is the weighted wage rate in Tanzanian shillings per man-day.

α_2 = Economic efficiency parameter for farming technologies

D_{A_I} = Dummy variable for farming technology taking value of 1 for conventional farms and 0 for the counterpart.

D_{B_I} = Dummy variable for farming technology taking value of 1 for organic farms and 0 for the counterpart.

α_3 = Profit elasticity with respect to land

T = Area of land cultivated in acres

α_4 = Profit elasticity with respect to capital

K = Capital input in shillings which is the sum of the costs of seed, organic/inorganic fertilizer, pesticides, etc.

L = Man-days of family and hired labour used

e_1 = error term for the profit function

e_2 = error term for the wage share function

Objective two of this study was to examine and compare farm specific factors that influence profit between organic and conventional coffee farming system. Profit function (16) was modified to exclude economic efficiency parameters as shown in equation (18), and estimated without the wage share equation. Jamson and Lau 1982 used the same model to analyse effects of farmer's education on farm efficiency.

[illegible] -- (18)

H_i = variables describing social economic characteristic hypothesized to influence profit to conventional and organic farming systems

Differences in economic efficiency between coffee farmers were tested by a profit function equation (16) which was jointly estimated with the wage equation (17) Hypothesis, which was achieved by imposing restriction to parameters in equation (16) and (17).

Table 1. Hypothesis Testing for differences in economic efficiency between farming technologies employed by coffee farmers

Hypothesis	Null hypotheses of differences between organic and conventional farms	Restriction place on parameters
1.0	Economic efficiency (technical efficiency plus price efficiency) of organic and conventional farming system farms is equal	$\alpha_2 = 0$
2.0	There is equal relative technical and price efficiency jointly between organic and conventional farming systems	($\alpha_2 = 0$) ($\alpha_5 = \alpha_6$)
3.0	The Price efficiency of organic and conventional farming systems are equal	($\alpha_5 = \alpha_6$)
4.0	Conventional farming system farms have absolute price efficiency	$\alpha_1 = \alpha_5$
5.0	Organic farming system farms have absolute price efficiency	$\alpha_1 = \alpha_6$

3.4 Covariance Analysis

Covariance analysis was carried out through Chow test to compare whether the included independent variables in both farming systems were significantly different in the way they explain variation in the profit. By using Chow test, a comparison of the unrestricted residual sum of squares from the restricted residual sum of squares models was conducted. Unrestricted sum of squares models allows the parameters to vary across data subsets while restricted residual sum of squares assumes that the parameters are constant across data subsets. The test statistics was estimated by F test which is given by:

F (K, N1+N2-2K) = ((RSSR- RSSUR)/K) / (RSSR/N1+N2- 2K)

Where RSSR= Restricted residual sum of squares, RSSUR = is the unrestricted residual sum of squares term of two kinds of technology which is given by RSS_ organic + RSS_ conventional. K is the number of estimated parameters including constant. N1 +N2 = is the degree of freedom for organic and conventional farms respectively.

3.5 Area of the Study

The study was conducted in Moshi rural district in Kilimanjaro region (figure 2.0). Kilimanjaro is located in north-eastern part of mainland Tanzania. It lies between latitudes $2^0$25' and $4^0$15' south of the Equator. Longitudinally, the region is between $36^0$25'3" and $38^0$18'00" east of the Greenwich. In Moshi rural district, seven primary societies namely, Mrimbo Uuwo, Mwika Kinyamvuo, Marangu East, Marangu West, Kirua Vunjo East, Mamba North and Uru North Njari were involved in production of certified organic coffee since 2001. These societies has total of 9,315 members (2,622 Organic members) with 3,567acres and 973,038 number of coffee trees. In 2010/2011 the societies produced a total of 121,742 Kilograms of Organic coffee (KNCU, 2011). The coffee plots are mainly intercropped with bananas, beans and maize. Patches of land grown with pastures of food crop can be observed neighboring coffee plots for farmers who have relatively large plots. Many farmers keep livestock for security, milk and for farmyard manure essential to their coffee and banana trees. Vegetables are grown by few farmers especially those close to the reliable source of water for domestic use only.

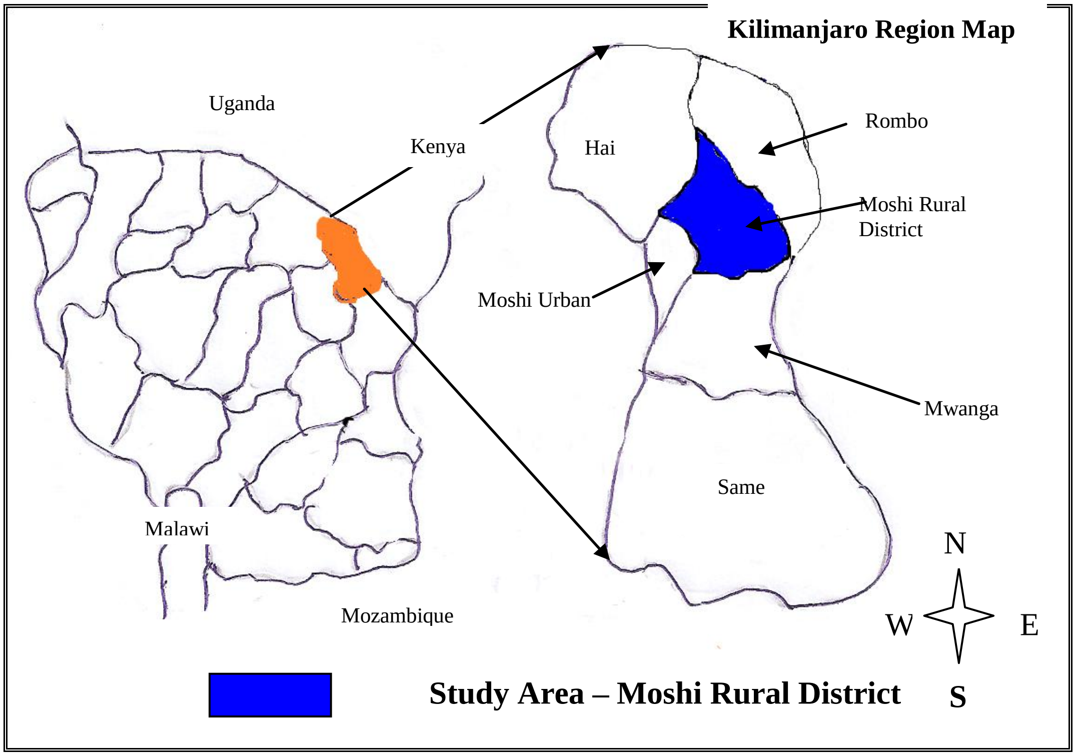


Figure 2.0: Map showing Moshi Rural District in Kilimanjaro Region

3.6 Data Source

The study was based on primary data. The respondents were selected from six Primary societies where organic coffee farming has been practised since 2001. The following are criteria used for the selection of organic farmers:

- Three years experience of practicing organic farming
- Active use of organic farming principles without defaults
- Farms with 90% of matured coffee trees.

The last criterion was also applied to conventional farms. The conventional farms were selected primarily basing on proximity of these farms to their respective organic counterparts and the similarity of altitude and area under coffee.

The combination of multi stage random sampling and purposive techniques were used in selecting 115farmers (58 organic and 57convectional). In the first stage, 4 wards out of 7 were randomly selected. The next stage, 3 villages were randomly selected from each ward. At each village, a purposive sampling was used to obtain at least a sample of 5 organic and 5 conventional farmers. Structured questionnaire prepared in English and translated into *Kiswahili* was used for data collection. Kiswahili was used because it is the common language of communication in Tanzania (See Annex A). Training was conducted to all enumerators to familiarize them with the intended meaning of each question. The researcher and enumerators pre-tested the questionnaires before the actual data collection. This was done to determine the ability of farmers to answer the questions and to test the adequacy of the questions. In doing so ten randomly selected respondents were interviewed during the testing of questionnaire. After pre-testing, redundant questions were dropped and more useful ones were added.

3.7 Assumption considered for estimating the model

Heteroscedasticity was anticipated during the analysis of the data from conventional and Organic farming systems. Johnston, (1972) considered the transformation of variables into logs to be one of the solution in dealing with the problems of heteroscedasticity. In this study, Cobb- Douglas production functions led the profit function to be specified into double logarithmic form. Logs of variables was applied in this the study to reduce severe heteroscedasticity that might have existed in collected data.

CHAPTER 4

RESULTS AND DISCUSSION

The study evaluated relative economic efficiency of organic coffee farming system and identifies important factors that influence it with a view to improve profit of organic coffee farmers in Moshi rural district in Tanzania. This chapter is organized as follows: First section present brief description of characteristics of organic and convectional farming systems. The second section gives farm specific factors determining profit between organic and conventional farming system and third section compares , economic, technical and price efficiency of organic and conventional farming system in Moshi rural district.

4.1 Characteristics of Organic and Conventional Farming System in Moshi Rural District.

Summary of socio economic characteristics of organic and conventional farming system in Moshi rural district is presented in Table 2.0. Head of household in organic coffee farming and conventional farming systems had average age of 56 and 55 years old respectively. However, a t-test on the significance of the observable differences between the ages in years showed the different was not statistically significant.

About 78% of conventional farmers had formal education of seven and more years while 22% had less than seven years (Figure 3.0), while the majority of organic farmers (86%) had formal education of seven and more years and 14% had less than seven years. Formal education gave opportunity to farmers to learn better management skills of coffee farming systems. 87% of the organic farmers respondents had access to extension services and they have been receiving organic farming expertise from extension agencies through farms visits and formal trainings. However, only 39% of interviewed conventional farmers had access to extension services. About

78% of the organic coffee farmer's household was male headed with average of 6 people per family as compared with conventional farming household who had 82% male headed with average of 7 people per

household. However, a t - test on the significance of the observable differences between the numbers of household members showed the difference was not statistically significant.

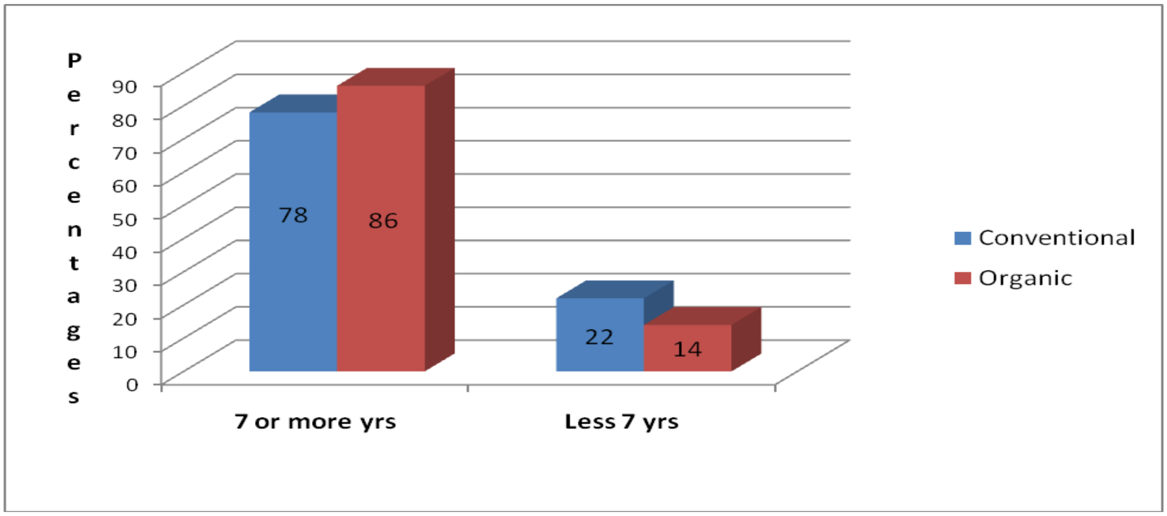


Figure 3.0: Formal education of households head for conventional and organic farms(Soucres; Authors analysis, 2012)

Organic coffee farmers had farming experience of 5 years compared to 28 years for the convectional farmers. Organic farmers had least years farming experience because organic coffee farming is considered relatively a new technology which was introduced to coffee farmers in 2001 as compared to the conventional coffee farming system introduced in the early nineteenth century.

Organic farming system farms had average of 1.4 acres with 473 coffee trees while conventional farms had average of 1.3 acres with 439 coffee trees. However, a t - test on the significance of the observable differences between the areas of farms showed the difference is not statistically significant. About 90% of the respondent from both organic and conventional farming system depends on their farms as the main source of food and income. Income from the farms contributes 87% of total household incomes for the both farming systems.

Table 2.0 Descriptive Statistics of conventional and Organic coffee farmers in Moshi rural District - 1USD = TSHS 1,250

	Organic farming		Conventional farming	
Variable	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Age of household head (years)	56	18	55	13
Number of people per household	6	6	7	7
Education level of household head (years)	10	4	7	3
Number of cows per household	4	1	4	3
Size of farm (acrages)	1.4	0.61	1.3	0.44
Conversion period (years)	1.7	0.53	-	-
Number of coffee tree per household	473	446	439	403
Experience of farming for household head (year)	5	1	28	14
Total man days for working in the farm per year	80	16	67	28
Wage rate per day for working in the farm (Tshs)	2,810	485	2,942	599
Total labour costs for working in the coffee farm (Tshs)	228,396	63,359	199,904	97,608
Physical input cost for coffee (Tshs) per year	63,730	63,802	200,026	80,267
Physical input cost for banana (Tshs) per year	34,871	34,910	98,258	39,429
Physical input cost for maize and beans (Tshs) per year	21,644	21,668	52,638	21,123
Total physical Input costs of farm per year (Tshs)	348,643	120,096	550,827	223,307
Revenue of coffee per year (Ths)	679,423	283,199	1,058,556	399,414
Revenue of banana per year (Tshs)	855,839	357,790	1,226,962	462,957
Revenue of maize and beans (Ths) per year	106,980	44,724	120,290	45,388
Total gross revenue (Tshs) per year	1,642,243	685,478	2,405,809	907,759
Gross profit (Tshs) per year	1,293,600	657,577	1,854,981	828,746
Total physical cost (Tshs)/acre/year	270,623	203,797	452,356	178,058
Gross profit (Tshs) /acre/ year	924,000	657,577	1,525,696	424,142

Soucres; Authors analysis, 2012

Organic and conventional coffee farmers owned an average of 4 cows per household. Livestock keeping especially cow-rearing was an economic activities conducted by farmers to provide manures, milk and meat. Cow manures was regarded as the main source of organic fertilizer for both organic and conventional farmers in Moshi rural district.

In organic coffee farming system, 80 man days were required by the farmers to work in their farms per year compared with 67 man days for the case of conventional farmers. A total labor costs for organic and conventional farms were TSHS, 228,397 and TSHS 199,903 respectively. As organic coffee based farming is labour-intensive, family labour was used for farm activities as much as possible in order to minimize the need for hired labour.

All organic farmers interviewed (100%) were members of organic producers groups in their respective villages. The groups were formed in 2001 with the main objective of training organic coffee farmers in organic principles. In conventional farming, there was no common group joining farmers together for the purpose of providing trainings on coffee farming techniques because it was assumed that coffee farmers had enough experience in conventional coffee farming. According to the study results, 40% of farmers from both organic and conventional farmers were the members of informal credits groups in their respective villages. This low number of farmer with access to credit was caused by the low capacity of the existing micro finance institution which was associated with the lack of sufficient capital to meet the existing demand. Organic coffee farmers required credits to purchase farm inputs which were: fungicides (copper oxide) to control coffee diseases and rock phosphate fertilizer to improve soil fertility. Most of the organic coffee farm inputs including pesticides and fertilizers were prepared within organic farms and therefore no major costs associated with it. On the other hand conventional coffee farmers required credits to purchase farm inputs which were: fungicides to control coffee diseases, pesticides to control coffee pests and inorganic fertilizers to improve soil fertility.

The conversion period of the organic coffee was found to be 1.68 years than the normal procedure of organic principles which requires three years. The conversion period were shortened because no agro chemical residues evidences found in their farms during farms inspection. Results indicates that 62% of organic farmers converted their farms to organic for two years compared to 35% of organic farmers who converted their farms within one year (Figure 4.0). Only 3% of organic farmers converted their farms to organic within three years.

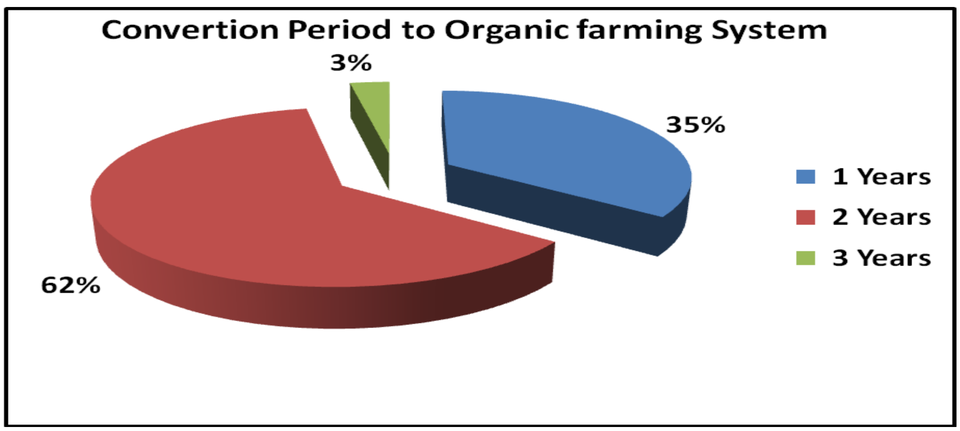


Figure 4.0 :Conversion period to Organic farming for Coffee farmers in Moshi Rural district (Soucres; Authors analysis, 2012)

About 90% of head of the household had the mandate to convert or not to convert farms from conventional to organic farming systems. Several factors for conversion to organic farming were given by the farmers. Study results shows that 90 % farmers joined organic farming system motivated by the organic coffee premium price which was 20 - 30% higher than conventional coffee price (Figure 5.0). About 9% of organic farmers were motivated by low costs of production while 1% farmers joined organic farming from their concern of health and environment.

In conventional farming system, study found that 85% of the respondents were maintaining conventional farming because they wanted to make high profit from their farms through the use of agro chemicals inputs. Also, about 15% of farmers practiced conventional farming system because they doubted drastic falls of coffee yield due to coffee berry diseases and leaf rusts. None of the conventional farmers mentioned to practice conventional farmers because of having enough money to buy agro chemicals inputs for their farms.

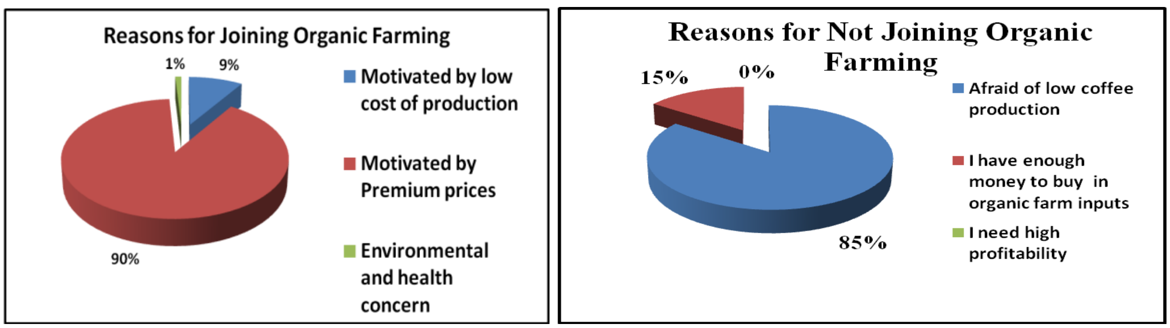


Figure 5.0: Reasons for joining or not joining to organic farming for farmers in Moshi Rural district (Soucres; Authors analysis, 2012)

Total average physical input costs of production for organic coffee farming system was TSHS 348,643 per acre compared with conventional farming system farming which was TSHS 550,827 per acre. For both farming systems, coffee had highest physical costs which were 53% for organic and 57% for conventional farms (Figure 6.0). Banana had the second highest costs of production for both farming systems which were 29% for organic and 28% for conventional farms. Conventional farming system had 57% total physical costs higher than that of organic farming system. High physical cost for conventional farms were caused by use the farms inputs which were purchased from stockiest and more expensive compared to organic inputs which prepared within their farms.

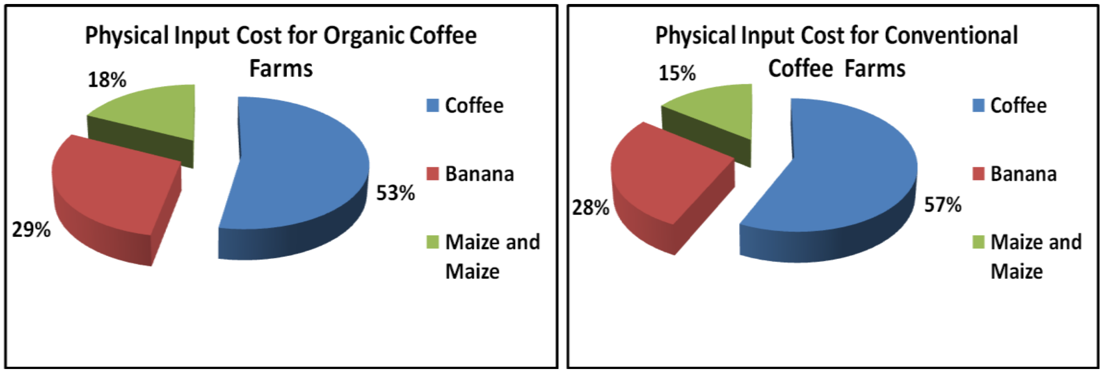


Figure 6.0: Comparison of physical Input cost between conventional and organic farms in Moshi Rural district (Soucres; Authors analysis, 2012)

Average total revenue for conventional farms was calculated at TSHS 2,405,809 compared with TSHS 1,642,243 for the organic farms. Revenues for conventional farms was 47% higher than that of their conterpart organic farms. For both farming systems, banana had highest revenue which were 56% for organic and 51% for conventional farms (Figure 7.0). Higher revenue of banana were caused by high production per unit area and higher price of banana which averaged TSHS 4,700/bunch. About 90% of banana was sold at the farm gate price to brokers who transported to Kariakoo market in Dar es Salaam. About 6% of banana used as food for families while the remaining 4% was sold to the village Market at Mwika which is located at Marangu ward in Kilimanjaro region.

Coffee had the second highest revenues from the both farming systems which were 37% for organic and 44% for conventional farms. The lower gross revenue for coffee were caused by low production per unit areas and low price of dried coffee per kilogram which were 3,505 Ths/Kgs and 2,608 Tshs/Kgs for organic and conventional farms respectivelly. Market price of organic coffee was found to be 34% higher than the conventional coffee price due to premium price offered by buyer to compensate the decrease of yield by the application of the organic principles. Coffee were delivered to KNCU through Mwika primary society and thereafter sold to the auction market which is conducted by coffee Marketing Board in Moshi town.

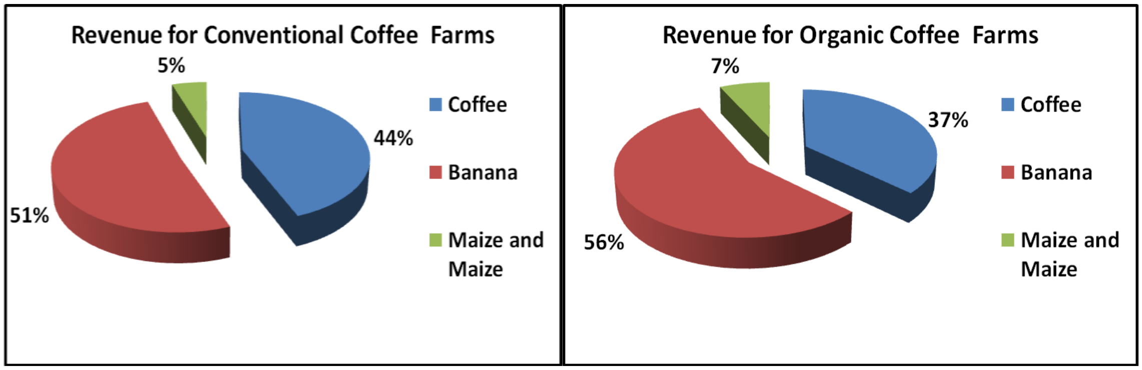


Figure 7.0: Comparison of gross revenue between conventional and organic farms in Moshi Rural district (Soucres; Authors analysis, 2012)

Study results also indicates that organic coffee farmers earned an average gross profit of TSHS 924,000 per acres as compared to conventional farms which were TSHS 1,525,696 per acre. Conventional farmer earned 65% of profit higher than that of organic farms. The t- test was conducted to assess whether the average gross profit per acre for organic coffee farms were statistically higher than that of conventional coffee farms. The following formulas were used for the t – test.

$$t = \frac{\text{Different between means of organic and Conventional farming systems}}{\text{Variability of means of organic and Conventional farming systems}}$$

$$\mathbf{t} = \frac{\bar{X}_C - \bar{X}o}{\mathrm{SE}(\bar{X}_C - \bar{X}o)}$$

Where $SE(\bar{X}_C - \bar{X}o) = \sqrt{\frac{Var_{CONV}}{n_{CONV}} + \frac{Var_{ORG}}{n_{ORG}}}$

The t - value can be positive if the average gross profit of organic farms is large than conventional farms and negative if it is smaller. Once the t value is computed is compared with the critical values from the table to find out whether there is significance difference between the two farming technologies. Significance level was set at 5% and degree of freedom was calculated by taking the sum of farmers sampled from two farming technologies minus two.

4.2: Definition of the variables used in T- tests

$\bar{X}_C$	Average gross profit of conventional farms
$\bar{X}o$	Average gross profit of organic farms
SE($\bar{X}_C - \bar{X}o$)	Standard error of the difference for two technologies
var_{conv}	Variance of average gross profit of conventional farms
var_{org}	Variance of average gross profit of organic farms
n_{Conv}	Sample size of conventional farms
n_{org}	Sample size of organic farms

The top part of the formula is difference of average profits from the conventional and organic farms were: $\bar{X}_C - \bar{X}o$ = 1,525,696 – 924, 000 = 601,696

The bottom part is called the standard error of the difference. Which were computed by taking the variance of two farming technologies and divide it by the number of sampled farmers per technology. Two values were added and took their square root. Standard error of the different was:

$$SE(\bar{X}_C - \bar{X}o) = \sqrt{\frac{4324075109}{57} + \frac{1798964361}{58}} = 103,381$$

Therefore the calculated t was:

$$\mathbf{t} = \frac{60,1696}{103,381} = 5.82017$$

The t- critical at 5% and 113 (115-2) degree of freedom were obtained to be 1.67. Since the calculated t is greater than the critical "t" value, we conclude that, the gross profit generated by organic coffee farms per acre was significantly lower compared to conventional coffee farms. Therefore we reject hypothesis that, organic coffee farms were more profitable compared to conventional coffee farms (H0: H1 > H2). Similar finding was reported by A. E. Lyngbæk etal., 2001 in Costa Rica where the gross profit for conventional coffee farms was 22% higher than that of their counterpart organic coffee farms. However, excluding organic certification costs, mean variable costs and net income were similar for both groups, mainly because organic price premiums received by the farmers compensated for lower yields.

4.3:Factors determining Profit between Organic and Conventional Farming Systems

The Chow tests were conducted to find out whether the linear regression coefficients across two kinds farming systems were equal. The results of the two unrestricted regression used for the

(Chow test) were summarized in Table 4.6. The main hypothesis in the Chow test is that coefficients from two farming systems are equal.

$H_0 = \beta_{conv} - \beta_{or} = 0$

The three linear regression were fitted to carry out Chow test; One equation for the restricted model (Pooled data) and separate regressions for the unrestricted models (Organic and Conventional farms). The test statistic was formally stated as follows:

[illegible]

Table 3.0 Definition of the variables used in Chow Tests

RSS_1	Sum of square residual from organic farms
RSS_2	Sum of square residual from conventional farms
RSS_U	Sum of square residual from the Unrestricted Models
RSS_R	Sum of square residual from the restricted model (pooled data)
N_1	Number of total observations from organic farms
N_2	Number of total observations from conventional farms
K	Number of regressor including intercept

The numerator degree of freedom is equal to the number of parameters estimated. The denominators degree of freedom is given by the degree of freedom associated with the unrestricted model (Sample size minus total number of coefficients estimated in the unrestricted models).

Therefore, $RSS_1 + RSS_2 = RSS_U$ = 1.86436504 + 1.85522026 = 3.7195853 and RSSR = 4.74645154

The test statistic (Estimated F) becomes:

F= {(4.74645154 - 3.7195853)/8}/{3.7195853/(57+58) - (2*8)} = 3.4

The F- critical (8, 99) at 5% was obtained as 2.1 Since the calculated "F" is greater than tabulated "F" we reject the null hypothesis that the two coffee farming systems are similar in the ways they included variables to explain variation in the profit of coffee farming systems, therefore separate OLS regression was conducted to identify factors determining variation in profit between organic and conventional coffee farming Systems in Moshi Rural district.

Table 5.0 summarizes the factors determining profit between organic and conventional coffee farming system in Moshi rural district. The estimated coefficients are the elasticities of profit with respects to the factors of production meaning that they show the average percentage change in the value of output resulting from one percentage change in a given input. The coefficient for wage rate was not significantly different from zero conforming to theoretical expectation that profit is non-increasing in variable input price (Chamber, 1988). The coefficient for land and capital was significantly different from zero and had the expected positive sign

The coefficient for land was 0.62 and 0.60 for conventional farms organic farmers respectively were significant at 0.01 levels. This means that one percent increase in land input increases profit by 0.62% in conventional farms and by 0.60% in organic farms. This positive relationship between land area and profit generated does not support the findings of Mwakalobo (2002) in Rugwe Tanzania. Mwakalobo found that, land was negatively related to gross coffee profit and urged that this would be the case where increasing cultivated area translated in to even fewer inputs per unit area.

The coefficient for extension services is positive and statistically significant at 0.01 levels for both farming systems. The coefficients of extension services were 0.12 and 0.25 for conventional and organic farming systems respectively. This implied that, farmers with access to extension services increases profit by 0.12% in conventional and by 0.25% in organic coffee farms. Extension service is valuable in enabling farmers to apply farming techniques more effectively especially to organic farming principle which are newly introduced to farmers in Moshi rural district. This result agrees with those of Bravo and Ureta and Pinheiro (1997) were interactions through extension services give farmers opportunity to learn improve technologies and to acquires and apply needed inputs and services

The coefficients of capital variable are positive and statistically significant at 0.01 levels for conventional and organic farming systems. The coefficient of capital is 0.19 for conventional and 0.25 for organic farming systems respectively. This means that one percent increase of capital will increase profit by 0.19% in conventional coffee farms and by 0.25% in organic coffee farms. The finding is similar with a study by Mwakalobo (2002) among coffee small-scale farmers in Rugwe district in Tanzania who found capital increase had positive relationship with the profitability in coffee farms.

Table 4.0 Definition of the variables used in Profit function

Name of the Variable (Acronym)		Definition of variable
DEPENDENT VARIABLE		
Restricted profit(Ln π)	=	Ln of restricted profit = total revenue minus weighted wage rate x total labor in man days (family and hired)
BASIC EXPLANATORY VARIABLES		
Costs of physical inputs (lnK)	=	Ln of total costs of organic/inorganic fertilizer, organic/inorganic pesticides and fungicides
Land (LnT)	=	Ln of total land area in acres
Wage rate (LnW)	=	Ln of wage rate of labor per day
Continuous explanatory Variable		
Education of head of household (Edtn)	=	Years of education of the head of the household
Explanatory dummy variables		
Sex (Sex)	=	Sex of the head of the household (1= male; 0= female)
Access to extension services (Ext_Serv)	=	Access to the extension services by the head of the household (Access = 1; no access = 0)
Access to credit (Cred)	=	Access to the credit services by the head of the household (Access = 1; no access = 0)

Access to credit has a coefficient of 0.01 for conventional and -0.11 for organic farming which shows that credit had positive influence of profit in conventional farming system as compared to organic farming system. Credit was statistically significant at 0.05% for organic farming systems and 0.1% for conventional farming systems. Abdulai and Huffman (2000) reported similar results on rice farmers in Northern Ghana who found credit access to be negatively related to profit inefficiency. For the case of organic farmers one would expect that access in credit services by farmer would increase gross profit in coffee farming system. This was not so in the models rather access in credit for organic farming systems led to the decrease in profit of farmers. This shows that organic farmers did not spend credit obtained to purchase farm inputs rather they used for other purposes different from purchases of farm inputs.

The coefficient of wage rate is negative and not statistically significant for both organic and conventional farms. Wage rate has coefficient of -0.19 for conventional and – 0.44 for organic which shows that credit had negative influence of profit for conventional and to organic farming system. Tijan et al., (2006) reported similar results among Nigerian poultry egg farmers at Aiyedoto farm settlement where wages rate were negatively related to normalized profit.

Table 5.0 OLS Regression results of factors determining variation in Profit between Organic and Conventional coffee Farming Systems in Moshi Rural district in, Tanzania (2012)

Dependent variable = Restricted profit (Lnπ)

Variable	Coefficients and standard errors (in bracket) Conventional	Organic
Constant	13.36*** (1.249)	14.34*** (1.453)
Land (LnT)	0.62*** (0.084)	0.60***(0.061)
Wage rate (Ln W)	-0.19 (0.138)	-0.44(0.153)
Physical inputs (Ln K)	0.19*** (0.057)	0.25*** (0.060)
Gender	0.086 (0.055)	0.001(0.054)
Education	0.025*** (0.011)	0.017* (0.009)
Extension Services	0.12***(0.056)	0.25*** (0.086)
Credit	0.011* (0.053)	- 0.11** (0.105)
n	57	58
F	41.37	61.95
R^2	0.85	0.896
R^2(Adjusted)	0.8346	0.8821

*****Significant at 1% **Significant at 5% *Significant at 10%**

Soucres: Authors analysis 2012

The coefficient of education variable is positive and statistically significant at 0.01 and 0.1 levels for conventional and organic farms respectively. Education level in years had a coefficient of 0. 025 for conventional and 0.017 for organic farms which imply that, one year of formal education increases profit by 0.025% in conventional coffee farms and by 0.017% for organic coffee farms. Importance of education to farmer comes on decision making and implementing informed and timely farming decisions. Among of the important decision includes right time to apply organic/inorganic fertilizer and effective controls of pests and diseases. Therefore most educated farmers have ability to learn and practices best coffee farming techniques which determines high gross profits compared to the farmers with less

4.4 :Comparison of Economic, Technical and Price Efficiency of Organic and Conventional Farms in Moshi Rural District

Table 6.0 shows the estimation of ordinary least square (OLS) and the non normalized profit function estimated with wage share equations by using Zellner's seemingly unrelated regression method (SURE). The coefficients of the wage for labour was negative signed as expected. Capital and land was significant at 1% in the profit function through estimation of model by using OLS and SURE methods. For example, under OLS estimation, 1 percent increase in land area and capital, will increase profit by 0.62 percent and by 0.25 percent respectively.

Five hypotheses were tested in this section as shown in table 8.0. Hypothesis one states that economic efficiency (technical and price or allocative) of organic and conventional farms are equal. This hypothesis was rejected at 5% implying that, conventional farms are relatively more economically efficient than organic farms. Similar finding were reported by Vangelis, et al.,

(2001) of cotton farmers in Viotia Greece who found the economic efficiency of conventional farms was significantly higher compared to organic farms in using their respective inputs.

Hypothesis two states that the relative price or allocative efficiency of conventional and organic farmers is equal. This hypothesis failed to be rejected implying that conventional and organic coffee farmers maximized their profit equally (Table 7.0) . This imply that, organic and convetional coffee farms archieved similar allocation of farm inputs given their input and output prices. Similar finding were reported by Vangelis, et al., (2001) of cotton farmers in Viotia Greece where the average allocative efficiency of organic farms was found to be the same compared with conventional farms.

Table 6.0 Profit function Estimated with Wage share equation to test for difference in Efficiency between Organic and Conventional Farms

Variable Profit function	Parameter	Single equation (OLS)	Seemingly Unrelated Regression Estimation (SURE Method)					
				Restricted				
			no restriction	$\alpha_2 = 0$	$\alpha_6 = \alpha_7$	$\alpha_2 = 0$ $\alpha_6 = \alpha_7$	$\alpha_6 = \alpha_3$	$\alpha_7 = \alpha_3$
Constant	α_1	13.273***	12.919***	11.191***	12.812***	11.589**	9.371***	9.365***
		(0.9776072)	(0.9280382)	(0.946152)	(0.859475)	(0.927759)	(0.389485)	(0.5228814)
Conventional farm dummy	α_2	0.250***	0.275***	2.7E-17	0.261***	1.20E-16	0.165**	0.258***
		(0.0555003)	(0.0534936)	(6.5E-18)	(0.0223371)	(2.58E-17)	(0.0487912)	(0.0576822)
Ln _Wage	α_3	-0.279	-0.212	-0.189	-0.209	-0.19	-0.165	-0.238
		.1054607)	(0.1001109)	(0.110572)	(0.0997218)	(0.108397)	(0.0487912)	(0.0231047)
LN_Capital	α_4	0.252***	0.236***	0.377***	0.244***	0.348***	0.287***	0.235***
		(0. 041354)	(0.039257)	(0.031723)	(0.0297787)	(0.0311625	(0.0395183)	(0.0420648)
LN_Land	α_5	0.628***	0.581***	0.509***	5.76E-01**	0.522**	0.526***	0.545***
		(0. 0489142)	(0.0464329)	(0.047791)	(0.0395641)	(0.046867)	(0.0483377)	(0.0496451)
Wage Share Equation								
Conventional farmers	α_6		0.100***	0.108**	0.101***	0.12***	0.106***	0.100***
			(0.023641)	(0.023571)	(0.0234731)	(0.033656)	(0.023592)	(0.00238659)
Organic farmers	α_7		0.258***	0.250***	0.261***	-5.75E17***	0.253***	0.238***
			(0.0234363)	(0.023368)	(0.0223371)	(7.47E-18)	(0.023388)	(0.0231047)

*****Significant at 1% **Significant at 5% *Significant at 10%**

Soucres; Authors analysis 2012

Hypothesis three states that, there is equal relative technical and price efficiency jointly between organic and conventional farmers. This hypothesis was rejected at 5% level of significance (Table 7.0). Since allocative efficiency was shown not be significantly different, rejecting hypothesis three implies that technical efficiency of conventional farmer was significantly higher than that of organic farmers. Lower technical efficiency estimates for organic farmers as compared with conventional farmers is caused by low exploitation of fully potential of organic farming principles. Tzouvelekas et al., (2001) reported similar results of cotton farmers in Viotia Greece where the average technical efficiency of conventional cotton farms were higher compared with organic farms. The finding contradicted the results of Lansink et al., (2002) which reported the aggregate technical efficiency was not higher in conventional farms, despite their superior productivity as compared with organic farms.

Table 7. Test of hypothesis of economic efficiency between organic and conventional farms

Hypothesis Tested and restriction Imposed	**Computed F**	**Critical $F_{0.05}$**
$\alpha_2 = 0$	5.52	F(1, 108) = 4.00
$\alpha_6 = \alpha_7$	2.75	F(1, 108) = 4.00
$\alpha_2 = 0\ \alpha_6 = \alpha_7$	4.14	F(2 ,108) = 3.15
$\alpha_6 = \alpha_3$	1.97	F(1, 108) = 4.00
$\alpha_7 = \alpha_3$	1.78	F(1 ,108) = 4.00

Soucres: Authors analysis, 2012

Hypothesis four states that, conventional farmers are absolute price efficiency, i.e. they maximize profit by equating the marginal value product of labour to the wage rate. This hypothesis failed to be rejected for conventional farmers, suggesting that they are price efficiency in decision making and therefore they equated the value of marginal product of labour to the wage rate by using the maximum amount of labour in the profit maximization (Table 7.0). Hypothesis five, states that organic farmers are absolute price efficiency. This hypothesis failed to be rejected for organic farms implying that organic farmers are price efficient in their decision making meaning that they equated the value of marginal product of the labor to the wage rate (Table 7.0).

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The concept of organic farming cultivation has been suggested as promising alternative to coffee farmers in Moshi rural district. In this chapter attempts to draw some conclusions on gross profit, factors affecting profit, and comparison of technical, allocative and economic efficiency of organic and conventional coffee farms by using the profit function approach are made.

5.1 CONCLUSIONS

Coffee farmers in Moshi rural district have coffee farming experiences of 28 and 5 years for conventional and organic coffee respectively. Head of household for organic and conventional coffee farmers systems had average age of 56 and 55 years old respectively. About 78% of the organic farmer household was male headed with average number of 6 people per household compared with conventional coffee farmers who had 82% of male headed with average number of 7 peoples per household.

Organic farmers had ten years of formal education compared to conventional farmers who had seven years. The average land sizes per family for organic farms were 1.4 acres with 473 coffee trees while conventional farms had farm size of 1.3 acres with 439 coffee trees. Organic coffee farmers owned average number of four cows per household compared with conventional farmers who had average number of three cows per household. Average number of day spent by organic coffee farmers to perform various activities in their farms per year was 80 days compared with 67 days spent for conventional coffee farmers. Total labor cost incurred by conventional and organic coffee farming systems to perform various activities in their farms was TSHS, 228,397 and TSHS 199,903 respectively. The average conversion period of conventional farms to organic was two years instead of three years.

For both farming system, coffee had highest total physical costs compared to other crops which were 57% for organic coffee and 53% for conventional coffee. High physical cost of coffee for both farming systems were caused by use of farms inputs which were more expensive and purchased from stockiest compared to banana, beans and maize because which were prepared within farms. Conventional coffee farms had total physical costs which were 57% higher than that of their organic farms counterpart. Despite the facts that there was high demand of credits to purchase farms inputs from both farming systems, only 40% of them could access credits from the existing informal micro finance institution.

The study found that, the majority of small scale coffee farmers (91%) who converted their farms to organic were operating under organic farming by defaults and thereby attracted by lower costs of organic coffee production and premiums prices offered for certified organic coffee. However, farm profit per unit area realized for organic coffee farm was low when compared with conventional farms. The gross profit per acre for conventional farms was 65% higher than that of organic farms. Low gross profit for organic farms compared to conventional farms were caused by low yields of organic crops and lack of premium prices for banana, maize and beans which were grown under certified organic farming system.

Organic certified coffee was sold under well organized organic coffee markets channels through KNCU while the organic banana maize and beans was sold to the national local markets including small markets available at village level and brokers who could purchase bunches of banana under farm gate prices and re - sell to city markets mainly in Kariakoo - Dar es salaam**.** Organic banana, beans and maize did not fetch organic premium prices due to the lack of national organized organic markets channels. The organic products would require a premium price of 46% for all crops grown under organic farming system in order to match the gross profit of their conventional counterparts.

Based on the Cobb-Douglas profit function estimation, coefficient of land, capital, extension services and education was found to be positive and statistically significant in the profit function model. These imply that, famers can improve their farm profit significantly by using these factors of production. Land had the highest profit elasticity for the coffee farms. One percent increase of land for example would have led to 62% and 60% increase of profit for conventional farms organic farmers respectively. Capital had second highest profit elasticity for coffee farms in Moshi rural district in organic and conventional coffee farming system. One percent increase of capital increased profit by 0.25% in organic and by 0.19% in conventional coffee farms. Capital to purchase farm inputs was the main problem encountered by the most of conventional coffee farmers in Moshi rural district which need supportive government intervention policy.

In comparing the results of organic and conventional coffee farms tests performed on hypothesis of efficiency, economic and technical efficiencies are higher in conventional farms. The significant lower economic efficiency in organic coffee farms is mainly due to their low technical efficiency. This imply that relatively more cost saving may be achieved by improving technical rather than allocative efficiency, although considerable saving could be realized by improving both.

5.1 RECOMMENDATIONS

The study found that, despite the facts that organic coffee farming systems is considered appropriate farming technology for small scale farmer who cannot afford to buy inorganic inputs for their farms it is neither profitable nor technically efficient when compared to the conventional farming technology. Irrespective of the weakness found under organic coffee farming system, it is necessary to narrow down technological gap between the two farming systems. The following are recommended for policy and practice:

- Policy aiming to improve extention services and researches in organic farming should be intensified to impact technical and economic knowledge of organic farmers. Use of extension services approaches towards application of organic farming principles to coffee farmers will ensure fully exploitation of potential efficiency gains. Deliberate efforts should be employed to simplify complex components of organic farming principles to quicken farmers understanding and implementation. The use of Farmers' Field Schools and other cost-effective extension approaches should be encouraged during the extension practices. Therefore, policy aiming to improve extention services and researches in organic farming should be intensified to impact technical and economic knowledge of organic farmers.

- Policies measure that strengthening the provision of education to farmers will lead to the increase of technical efficiency of farmers in long run. Importance of education comes on decision making and implementing informed and timely farming decisions.

- The study result found that, in order to improve profit levels under coffee based farming system there is need to increase area of production and capital while reducing labor costs. Currently, organic coffee farmers are operating under average farm size of 1.4 acres with constrained source capital to purchase farm inputs. The expansion of area of organic coffee farming will imply increasing labor costs and farm inputs. Since increases in labor cost will negatively affects profit per unit area, the study serves to emphasize the efficiently use of the required farm inputs. Therefore, policy aiming to encourage investment at village level will enable credit availability to organic coffee farmers to purchase the required farm inputs.

5.2 RECCOMENDATIONS FOR FURTHER RESEARCH

This study prompts the following areas for further research:
This study focused only in Kilimanjaro region which is among of five regions in Tanzania where coffee is grown. Coffee being a significant export crop, a similar study can be conducted in other regions to establish an evidence for further improvement of sustainable agriculture

Cross-sectional data was used in this study to estimate efficiency of organic coffee farming production n Moshi rural district. The analysis by using this kind of data can not to capture changes in efficiency over time as it only provides information on spatial efficiency variation.

Positive performance under organic farming technology production take place gradually over time which justifies the need for time series analysis that would offer insights into temporal variations.

REFERENCES

A. A. Tijani, T. Alimi and A.T. Adesiyan (2006). Profit Efficiency among Nigerian Poultry Egg Farmers: A Case Study of Aiyedoto Farm Settlement, Nigeria. *Research journal of Agricultural Biological Sciences, 2(6): 256-261, 2006*

A. E. Lyngbæk, R. G. Muschler, and F. L. Sinclair (2001), Productivity and profitability of Multistrata organic versus conventional coffee farms in Costa Rica: *Agroforestry Systems 53: 205–213, 2001.*

Abdulai A. and W. Huffman (2000). Structural Adjustment and Economic Efficiency of Rice farmers in Northern Ghana. *Economic Development and Cultural Change, 48: 503-520.*

Adesina, A.K. and Djato, K.K. (1997). Relative efficiency of women as farm managers: profit function analysis in Cote d' Ivore. *Agricultural Economics 16:47-53*

Africa Desk Department of Agriculture, (2006). Country Profile of the United Republic of Tanzania (Agricultural Trade).

Akinwumi, A., and Djato, K. K. (1996). Farm size, relative efficiency and agrarian policy in Cote d'Ivoire: Profit function analysis of rice farms. *Agricultural Economics, 14, 93-102.*

Akinwumi, A., and Djato, K. K. (1997). Relative efficiency of women as farm managers: Profit function analysis in Cote d'Ivoire. *Agricultural Economics, 16, 47-53.*

Akkerman A and Baar van P (1992) El Café Orgánico: la Sostenibilidad de un Grano de Oro. Study Series No. 4. The Free University of the Netherlands. Amsterdam, Netherlands, Ali, F., Parikh, A., and Sha, M.K. (1994). Measurement of profit efficiency using behavioral and stochastic frontier approaches. *Applied Economics, 26, 181-188.*

Ali, M. and Flinn, J.C. (1989). Profit efficiency among basmati rice producers in Pakistan Punjab. *American Journal of Agricultural Economics, 71: 303-310.*

Ali, M. and J.C. Flinn. (1987). "Profit efficiency among Basmati rice producers in Pakistan Punjab". *American Journal of Agricultural Economics, 71: 303–10.*

Ali, M., and Byerlee, D. (1991). Economic efficiency of small farmers in a changing world: A survey of recent evidence. *Journal of International Development, l3 (1), 1-27.*

Altieri M A. (2002). Non-certified agriculture in developing countries

Alvarado-Soto M and Gonzáles-Mora CE (1996). Estudio Comparativo de dos Sistemas de Producción de Café: Convencional y Orgánico. MA thesis. *Universidad Latinoamericana de Ciencia y Técnologia, Facultad de Ciencias Empresariales. San José, Costa Rica, 211 pp*

Amadou, N. (2007). Analysis of factors affecting the technical efficiency of arabica coffee producers in Cameroon aerc research paper 163; African economic research consortium, Nairobi January 2007

Amani, H. K. R. (1992). Agricultural Reforms in Tanzania: Evolution, Performance and future policy issues.

Amara, N.; Traore, N.; Landry, R. and Romain, R. (1999). Technical Efficiency and Farmers' Attitudes Torwards Technological Innovation: The case of the Potato Farmers in Quebec. *Canadian Journal of Agricultural Economics, 47,1, March 1999,pp 31-43.*

Anderson M.D (1994) "Economics of organic farming in USA" in The economics of organic farming – An international perspective (ed.) by Lampkin N.H and Padel S., CAB International Publishers

Anon. (1989). Agricultural Compendium for Rural Development in the Tropics and Subtropics. Amsterdam: Elsevier Science Publishers BV.

Aranda Bezaury, Josefina (2005). La experiencia organizativa de las mujeres cafetaleras de la CEPCO. Noticias: *Voz e Imagen De Oaxaca 16 de marzo 2005, no. 10135*

Asfaw, T. and Sahle, T.(2007). Organic Coffee Production and Sustainable Agriculture (A socio- ecological analysis) a case study in limmuu Kossaa District

Awudu, Abdulai and Richard Eberlin (2001). "Technical Efficiency during Economic Reform in Nicaragua: Evidence from Farm Household Survey Data." *Economic Systems, 25: 113-125.*

Bachwenkizi, Beatrice, (2009). Economic analysis of organic farming in Tanzania: A case study of smallholder coffee production in Muleba district.

Bacon, C. (2005a). ″Confronting the Coffee Crisis: *Can Fair Trade, Organic, and Specialty Coffees Reduce Small‐Scale Farmer Vulnerability in Northern Nicaragua?″ World Development* ***33****(3): 497‐511.*

Bagachwa and Mbelle (eds.) (1992). Market Reforms and Parastatal Restructuring in Tanzania. *Economics Department and Economic Research Bureau, University of Dar es Salaam, 1992 pp116-132*

Bagi, F.S. (1987). "Relationship between farm size and technical efficiency in West Tennessee agriculture". *Southern Journal of Agricultural Economics, 14: 139–44.*

Bank of Tanzania (2008a). Economic Bulletin for the Quarter Ending March 2008: Vol XL No. 1. Dar es Salaam.

Barret, C. B. (2001). “Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa”. Cornell University.

Battese, G.E. and G.S. Corra (1977). “Estimation of production frontier model: With application to pastoral zone of Eastern Australia”. *Australian Journal of Agricultural Economics, 21: 169–79.*

Battese, G.E., T.J. Coelli and T.C. Colby (1988). ‘‘Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data’’. *Journal of Econometrics, 38: 387–99.*

Battese, G.E. and H. Sarfraz (1998). “Technical efficiency of cotton farmers in Vehari District of Punjab, Pakistan”. Center for Economic Policy Analysis Working Paper No. 8/98. Department of Econometrics, University of New England, Armidale, Australia.

Battese, G.E., T.J. Coelli and T.C. Colby (1989). “Estimation of frontier production functions and the efficiencies of Indian farms using panel data from ICRISAT’s village level studies”. *Journal of Quantitative Economics, 5: 327–48.*

Belbase, K. and R. Grabowski (1985). “Technical efficiency in Nepalese agriculture”. *Journal of Development Areas, 19(4): 515–25.*

Belbase, K. and R. Grabowski (1985). “Technical efficiency in Nepalese agriculture”. *Journal of Development Areas, 19(4): 515–25.*

Belen, Iraizoz, Manuel Rapun and Idoia Zabaleta (2003). “Assessing the Technical Efficiency of Horticultural Production in Navarra, Spain.” *Agricultural Systems, 78:387-403.*

Bhattachary, P. and G. Chakraborty (2005). *Current Status of Organic Farming in India and other Countries. Indian Journal of Fertilizers. 1(9): 111-123*

BIOFACH (2000). International organic commodity trade fair. BIOFACH and IFOAM. Nürnberg, Germany

Bradley D. Parrish, Valerie A. Luzadis and William R. Bentley (2005) What Tanzania Teach the World:

Bravo – Ureta, BE, and Pinheiro, E (1997) Technical and Allocative Efficiency in Peasant Farming. Evidence from Dominican Republic. *The Development Economics, Tokyo, P. 48-67, 1997*

Bravo-Ureta, B.E., Evenson, R.E. (1994). Efficiency in agricultural production: the case of peasant farmers in Eastern Paraguay. *Agricultural Economics 10, 27–37.*

Caporali F, Mancinelli R and Campiglia E. (2003). Indicators of cropping system diversity in organic and conventional farms in Italy. *International Journal of Agricultural Sustainability 1 (1), 67*-72 *certified products for developing countries.*

Chambers R, Pacey A and Thrupp L. A. (eds) (1989). *Farmer First: Farmer Innovation and Agricultural Research*. IT Publ, London

Chambers, G. R. (1988). Applied Production Analysis. 5th Edition. Cambridge University Press, UK.

Coelli, T., Rao, D.S.P., and Battese, G.E (1998). An Introduction to efficiency and Productivity Analysis. Kluwer Academic Publishers, Boston.

Debrew, E. (1951). The coefficient of resource utilization. *Econometrica, 19, 273-292.*

Dubgaard A (1994) "Economics of organic farming in Denmark" in The economics of organic farming – An international perspective (ed) by Lampkin N.H and Padel S., CAB International Publishers

Durasaimy, P. 1990. "Technical and allocative efficiency of education in agricultural production:

A profit function approach”. *Indian Economic Review, XXV (1): 17–32.*

Edwards, S. (2005) Organic Agriculture for Food Security in Africa. Germany: *Journal of Political Economy, 79, 776-94.*

ELyngbæk (2001). Productivity and profitability of Multistrata organic versus conventional coffee farms in Costa Rica. *Agroforestry Systems 53: 205–213, 2001*.

EPOPA (2004). An evaluation of the program “Export Promotion of Organic Products from Africa”, phase II.

Fan, S. (1999). Technological change, technical and allocative efficiency in Chine Agriculture: *The case of rice production in Jiangsu. (EPTD Discussion Paper no 39, International Food Policy Research Institute IFPRI).Washington, D.C.*

FAO/WHO Codex Alimentarius Commission (2001). Guidelines for the production, processing, labeling and marketing of organically produced foods.

Farrell, M. J. (1957). The measurement of productivity efficiency. *Journal of Royal Statistical Society Series, 120, 253-290.*

FiBL (2000). Organic Farming Enhances Soil Fertility and Biodiversity. Results from a 21 year field trial.

Gautam, Hazarika and Jeffrey Alwang(2003). “Access to Credit, Plot Size and Cost Inefficiency among Smallholder Tobacco Cultivators in Malawi.” *Agricultural Economics, 29: 99-109.*

Gibbon P., Bowlig S., Odeke M. and Taylor A.(2008). Certified Organic Export Production. Implications for economic welfare and gender equality among smallholder farmers in tropical Africa.

Giovannucci, D. (2005). ″Personal communication.″

Giovannucci, D. and F. J. Koekoek (2003). The State of Sustainable Coffee: a study of twelve major markets. Philadelphia.

H. A. M. Vander Vossen (2005). A Critical Analysis of the Agronomic and Economic Sustainability of organic coffee production

Hamoond, R. (1999). The impact of IMF Structural Adjustment Policies on Tanzanian Agriculture. *www.igc.org/dgap/imftanzania.htm*l

Harris, P. J. C., Lloyd, H. D., Hofney-Collins, A. H., Barrett, A. R. and Browne, A. W. (2001). Organic agriculture in sub-Saharan Africa: Farmer demand and potentialfor development. UK: HDRA Publications

Hawassi (1997). The effect of Fertilizer Subsidy Removal on fertilizer use and Production of maize in Mbinga district. Unpublished MSc. Thesis, Sokoine University of Agriculture, Morogoro, Tanzania.

Hine, R. and Pretty, J. (2006). Organic Agriculture and Food Security in East Africa. Presentation at the CBTF Organic Agriculture Regional Workshop: Promoting Production and Trading Opportunities for Organic Agricultural Products in East Africa. Arusha, Tanzania 6-10 March 2006

IFOAM (1996). Basic standards for organic agriculture and processing, and guidelines for coffee, cocoa and tea: *evaluation of inputs. International Federation of Organic Agriculture Movements. Tholey-Theley, Germany, 44 pp*

IFOAM (2005). The IFOAM Organizational Structure.

IFOAM (2002). International Federation of Organic Agriculture Movements basic standards for organic production and processing.

IFOAM (2006b). Website http://www.ifoam.org/about_ifoam/principles/index.html

IFOAM (2006c). Website http://www.ifoam.org/organic_facts/food/ITC/KIOF**.** 1998. On-farm agro-economic comparison of organic and conventional techniques in high and medium potential areas.

Ikeno (2007). The declining coffee economy and low population growth in Mwanga district, Tanzania

Jamison, D.T and L.J. Lau (1982). Farmer education and farm efficiency. London: The John Hopkins University Press

Jamison, D.T., and Moock, P.R. (1984). Farmer education and farm efficiency in Nepal: The role of schooling extension services and cognition skills. *World Development, 12, 67-86.*

Jessa M. Lewis (2005). University of California, San Diego; Strategies for Survival

Johnston, J. (1972). Econometric methods. 2nd ed. Tokyo: McGraw-Hill Kogakusha Ltd.

K. and R.T. Shand (1986). “Estimating location specific and farm specific technical efficiency: An analysis of Malaysian agriculture”. *Journal of Economic Development, 11: 147–60.*

Kalirajan, K. (1981). “An econometric analysis of yield variability in paddy production”.

Kalirajan, K. and R.T. Shand. (1986). “Estimating location specific and farm specific technical efficiency: An analysis of Malaysian agriculture”. *Journal of Economic Development, 11: 147–60.*

Khan, M.H. and Maki, D.R. (1979). Effects of farm size on economic efficiency: the case of Pakistan. *American Journal of Agricultural Economics, 61:64-69*

KNCU, (2001).Annual Report,

KNCU, (2002). Annual Report,

KNCU, (2011). Annual Report.

Knight, F. (1933). The Economic Organization._Harper and Row: New York. The Global Coffee Marketing Chain' CDR Working Paper

Knox, J.K., Blankmeyer, C.E., and Stutzman, J.R. (1999). Relative economic efficiency in (f) Texas nursing facilities: a profit function analysis. *Journal of Economics and Finance*, *118: 356 - 359*

Koopmans, T.C. (1951). An analysis of Production as Efficient Combination of Activities. *In Activity Analysis of Production and Allocation, Koopmans, T.C., eds, Cowles Commission for Research in Economics, Monograph no. 13. New York.*

Kufa, T. and Shimber, T. (2001). Organic coffee production: Hope for small-scale farmers in Ethiopia.

Lampkin N and Midmore P.(2000). Changing fortunes for organic farming in Europe: policies and prospects. Paper for Agricultural Economics Society Annual Conference, Manchester, UK

Lampkin N H and Padel S (eds). (1994). The Economics of Organic Farming. An International Perspective.

Lansink, A.O. Pietola, K., and Backman, S.(2002). Efficiency and Productivity of convectional and organic farming in Finland 1994- 1997

Lau, I.J., and Yotopolous, P.A. (1971). A test for a relative and application to Indian agriculture. *American Economic Review, 61, 94-109.*

Lau, L.J. and P.A. Yotopoulos (1972). Profit, supply and factor demand functions. *American journal of Agricultural Economics 54: 11-18*

Lewin, Bryan, Daniele Giovannucci, and Panos Varangis (2004). Coffee Markets: New Paradigms in Global Supply and Demand, Agriculture and Rural Development Discussion Paper 3, The World Bank.

Lewis, J. and D. Runsten (2005). Does Fair Trade Coffee Have a Future in Mexico? The Impact of Migration in a Oaxacan Community. Trading Morsels Conference. Princeton University, Princeton, NJ.

Liu, P. (ed). (2008). Value-adding standards in the North-American food market. Trade opportunities in certified products for developing countries.

Lockeretz, & U. Niggli, eds. IFOAM (2000) - The World Grows Organic: Proceedings 13th International

Lyngbæk A (2000) Organic coffee production: *A comparative study of organic and conventional smallholdings in Costa Rica. MPhil Thesis. University of Wales, Bangor, UK, 181pp*

Lyngbaek, A. E., Muschler, R. G. and Sionclair F. L. (2001). *Productivity and profitability of Multistrata organic versus conventional coffee farms in Costa Rica. Agroforestry Systems 53:205–213.*

Mbowa, S. (1996). Farm size and economic efficiency in sugar cane production in Kwazul-Natal. Un published doctoral dissertation, University of Natal, Durban.

Mochebelele, M. T. and A. Winter-Nelson (2002). *"Migrant Labor and Farm Technical Efficiency in Lesothi." World Development 18(1):143-53.*

Mwakalobo, A. B. S. (1998). Impact of Structural Adjustment Policies on Smallholder farming systems in Tanzania. A case study of Mbozi and Rungwe district in Mbeya region. Unpublished MSc. Thesis, Sokoine University of Agriculture, Morogoro, Tanzania.

Mwakalobo, A. B. (2000). Resource productivity and allocation efficiency in smallholder coffee farmers in Rugwe district, Tanzania

Okoruwa, V.O.; Akindeinde, A.O. and Salimonu, K.K. (2009). Relative economic efficiency of farms in rice production: A profit function approach in north central Nigeria. *Tropical and Subtropical Agroecosystems, Vol. 10, Núm. 2, mayo-agosto, 2009, pp. 279*

Owen, T., J. Hoddinott and B. Kinsey (2001). "The impact of agricultural extension on farm production in resettlement areas in Zimbabwe". Working Paper CSAE WPS/2001-6. Centre for the Study of African Economies, University of Oxford.

Oxfam America (2005). The Coffee Crisis Continues: Situation Assessment and Policy Recommendations for Reducing Poverty in the Coffee Sector. Boston, MA, Oxfam America.

Oxfam International (2002). "Mugged: Poverty in your Coffee Cup" Accessed on April. 5,2007http://www.oxfamamerica.org/pdfs/mugged_coffee-report.pdf

Padel S and Uli Z (1994). "Economics of organic farming in Germany"

Parikh, A., F. Ali and M.K. Shah (1995). "Measurement of economic efficiency in Pakistani agriculture". *American Journal of Agricultural Economics, 77: 675–85.*

Parrott, N. & B. van Elzakker (2003). Organic and like-minded movements in Africa: development and status.

Parrott, N., and Marsdey, J. (2002). "Certified and non-certified organic farming in the developing world"

Pinheiro, A. (1992). "An econometric analysis of small farms in the Dominican Republic". MS thesis, University of Connecticut, Storrs.

Ponte, S. (2001). The Latte Revolution? Regulation, Markets and Consumption in the Global Coffee Chain. *World Development 30 (7), 1099 – 1122*

Pretty J N., Brett C., Gee D., Hine R., Mason C., Morison J., Rayment M., van der Bijl G. and Dobbs, T. (2001). Policy Challenges and Priorities for Internalizing the Externalities of Modern Agriculture. *Journal of Environmental Planning and Management 44 (2), 263-283*

Quismbing, A.R. (1994). *Gender differences in agricultural productivity: A survey of empirical evidence. The World Bank: Washington D.C. (Paper Series No.36) Education and Social Policy Department.*

Rachel, H. Jules, P. (2006). Promoting Production and Trading Opportunities for Organic Agriculture Products in East Africa.

Reganold J P. (2004). Organic agriculture as a form of sustainable agriculture. In Encyclopedia of Plant and Crop Science. Marcel Dekker, New York results. *American Economic Review, 63(1), 214-223.*

Rice, P., McLean, J. (1999). Sustainable coffee at the crossroad. White paper, the Consumer's Choice Council Washington, DC.

Rice, R. A. (2001). Noble goals and challenging terrain: organic and fair-trade coffee movements in the global marketplace. *Journal of Agricultural and Environmental Ethics 14:39–66.*

Rice, R. A. (2001). ″Noble Goals and Challenging Terrain: Organic and Fair Trade Coffee Movements in the Global Marketplace.″ *Journal of Agricultural and Environmental Ethics 14(1): 39 ‐ 6.*
Rice, R. A. (2001). ″Noble Goals and Challenging Terrain: Organic and Fair Trade Coffee Movements in the Global Marketplace.″ *Journal of Agricultural and Environmental Ethics 14(1): 39 ‐ 6.*
Rice, Robert A. (2001): 'Noble goals and challenging terrain: Organic and Fair Trade coffee movements in the global marketplace', *Journal of Agricultural and Environmental Ethics, Vol. 14, No. 1*

Rundgren, G. (2002). Best Practices for Organic Policy. What developing country Governments can do to promote the organic agriculture sector.

Sadoulet, E., and De Janvry, A. (1995). *Quantitative development policy analysis. Baltimore: The Johns Hopkins University Press Vol.567,No 6.*

Sciallaba N El H and Hattam C. (2002). Organic Agriculture, Environment and Food Security. FAO, Rome.

Seyoum, E. T., Battese, G.E., and Flemming, E. M. (1998). Technical efficiency and productivity of maize producers in eastern Ethiopia*: A study of farmers within and outside the Sasakawa-Global 2000 project. Agricultural Economics. 19, 341-348.*

Shirsagar K.G. (2008). Impact of organic farming on economics of sugarcane cultivation in Maharashtra, Working paper no.15, Gokhale Institute of Politics and Economics, Pune

Simon, M. S. M. (1998). Peasant Strategic Resource use under free market conditions and the factors affecting its optimal allocation. A case study of Tobacco based farming systems in Tabora, Tanzania. Unpublished MSc. Thesis, Sokoine University of Agriculture, Morogoro, Tanzania.

Sogn, O and Mella, E. (2006). Tanzanians Interest and access to Organic Food, available at *www.orgprints.org*

TACRI, (2006). Annual Report Moshi, Tanzania

Timmer, C.P. (1971). Using a probabilistic frontier production function to measure technical

TMoA, (2007). The Economic Survey -The President's Office – Planning and Privatization, Dar es salaam.

Turuka, F. M. (1995). Price Reforms and Fertiliser use in Smallholder Agriculture in Tanzania. Studien Zur Landlinchen Entwcklung; *Lit Verlag Munster-Humburg, Pp 264.*

Tzouvelekas, V., C.J. Pantzios and C. Fotopoulos (2001). Technical Efficiency of Alternative Farming Systems: The Case of Greek Organic and Conventional Olive-Growing Farms. *Food Policy, 26: 549-569.*

(UNCTAD), (2008). Organic Agriculture in Africa. www.unctad.org

Van der Vossen, H. A. M. (2005). Coffee breeding practices. In *Coffee: Recent Developments, 184–201 (Eds R. J. Clarke and O. G. Vitzthum) Oxford: Blackwell Science Ltd.*

Vangelis Tzouvelekas, Christon J. Pantzios, and Christos Fotopoulos (2001). The economic efficiency of organic Farming: Evidence form cotton farms in Viotia, Greece. *Journal of agricultural and Applied Economics, 33: 35 -48*

Weir, S. (1999). "The effects of education on farmer productivity in rural Ethiopia". Working Paper CSAE WPS99-7. Centre for the Study of African Economies, University of Oxford.

Weir, S. and J. Knight (2000). "Education externalities in rural Ethiopia: Evidence from average and stochastic frontier production functions". Working Paper CSAE WPS2000-4. Centre for the Study of African Economies, University of Oxford.

Willer, H. & M. Yussefi (eds.) (2007). The world of organic agriculture: Statistics and emerging trends 2007. IFOAM (Bonn) and FiBL (Frick).

Wilson, P. (1998). "Detecting Outliers in Deterministic Nonparametric Frontier Models with Multiple Outputs." *Journal of Business and Economic Statistics*, 11(3): 319 323.

Wilson, Paul, David Hadley, and Carol Ashby (2001). "The Influence of Management Characteristics on the Technical Efficiency of Wheat Farmers in Eastern England."*Agricultural Economics* 24*: 329-338.*

World Bank (2007). Tanzania's Coffee Sector: Constraints and Challenges in a Global Environment

Wozniak, G.D. (1993). Joint Information Acquisition and New Technology Adoption: Later versus Early Adoption. *Review of Economics and Statistics, 75: 438-445*

Wynen E. (1994) "Economics of organic farming in Australia" in The economics of organic farming – An international perspective (ed) by Lampkin N.H and Padel S., CAB International Publishers.

Wynen w and Vanzetti (2002). Certified Organic Agriculture: Situation and Outlook.

Wynen, E. (2003). "What are the key issues faced by organic producers?" in Organization for Economic Cooperation and Development, ed., *Organic Agriculture: Sustainability, Markets and Policies* (Wellingford, CABI Publishing).

Yotopolous, P.A. and Nugent, J.B. (1976). Economics of development: empirical Investigations. Harper and Row Publishers, New York. *American Economic Review, Vol. 81, No. pp. 104-110*

Yotopolous, P.A., and Lau, L.J. (1973). A test for relative economic efficiency: Some further

Yotopoulos, P.A. and Lau, L.J. (1971). A test for relative efficiency and application to Indian agriculture. *American Economic Review, Vol. 61, No. pp. 94-109*

Yussefi M and Willer H**. (**2002). Organic Agriculture Worldwide: Statistics and Future Prospects. Foundation Ecology and Agriculture (SOL) in collaboration with the International Federation for Organic Agriculture Movements (IFOAM)

APPENDICES

APPENDIXES 1.0 Farm Level Questionnaires
INTRODUCTION:

Name of Enumerator--

Date of Interview --

District ---

Division--

Ward -- --

Village --

Subivallage____

Part I: SOCIO-DEMOGRAPHIC

Respondent name and number---

1. Respondent sex. Male/Female

2. Head of household Yes No

3. If no above, what is your relation to the head of household ---------------------------------

4. The following questions concern the members of the household (those that live within the household).

Table1 8.0: Household Demographic Characteristics for all Household Members

ID Code	Name	Relation to HH head [HH head=1, Father/Mother=2 Daughter/Son=3, Other relative=4 Non-relative=5]	Sex [M=1 F=2]	Age (Yrs)	Formal Education [Yrs]	Marital Status of HHH [Married/living together=1 Married but not living together=2 Divorced/separated=3 Widow/widower=4 Single=5]	Main Occupation [Farming = 1 Salaried worker =2 Self-employed=3 Student=4 Retired/not able to work=5]
1							

9.0 Table 9.0: The following questions concern membership to different social organization or groups that you might be involved in

Name of your group(s)	Type [Work group=1,Farmer group=2; Self-help or credit group=3	Number of meetings per month	Leadership position that you might hold [Ordinary member=0,Chairman=1, vice-chair=2, Secretary=3, vice secretary=4, organizing secretary=5,Treasurer=6, Vice treasurer=7, Other = specify]

The following table will help to calculate annual income (e.g. by calculating annual averages)

Table 10: Off-farm Income Sources during the last 12 months

Type of off-farm activity	Household member ID (copy down from table 1)- Monthly Income	Total Annual Income in TSHS
HH member 1		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)/Business		
HH member 2		
Farming activity (employed)		
Non-farming activity (employed)		
Non-farming activity (self-employed)/Business		

* To include rental income obtained from rental houses or land

7.0 The following questions relate to items that you have in your household or use for farming

Tables 11: Household and Agricultural Assets and Access to Services

	Does you household own or have access to the following items	Yes = 1 / No = 0		Does you household own or have access to the following items	Yes = 1 / No = 0
1.	Electricity		10.	Gas stove	
2.	Piped water		11.	Charcoal stove (jiko)	
3.	Radio		12.	Fridge	
4.	Bike		13.	T.V. set	
5.	Car		14.	Solar panel	
6.	Motorbike		15	Phone	
7.	Ox cart		16.	Water tank	
8.	Plough		17.	Sprayer (pesticides)	
9.	Wheelbarrow		18	Coffee pulping machine	

8. Table 12: Animal Ownership: The following questions relate to animals that you own;

	Does your household own the following animals	How many?	Does your household own the following animals	How many?
1.	Cow		4. Pig	
2.	Ox		5. Chicken	
3.	Donkey		6. Sheep/Goats	

PART II; AGRICULTURAL PRODUCTION

9. Table 13: The following question is related to the Farm Profile

Farm Identification	Size in Acres	Area under Crops (including coffee, banana, beans maize, and vegetables 1 for coffee; 2 banana; 3 maize; 4 beans	Area under maize and beans	Tenure status- Owned (titled)=1, Owned (not titled)=2 Rented=3]	Method of Acquisition [Bought=1, Gift=2 Inherited=3, Rented=4
Main Farm (Homestead)					
Farm 2					
Farm 3					

10. How many coffee tree plants do you have? No of coffee tree ----------------------------

11. Is your farm certified organically, Yes-------- No----------------

11a.If yes how many years have you been practicing organic coffee farming system……………

11b. In your household who made decision whether or not to convert farm into organic

Mother……………… Father…………..others (specify)……………………………

11c In your household what are their main reason made you to convert your farm to organic

(Ranking **reasons)**

a…...Save the money which could have bought agrochemicals 1- Most important

b. …..Motivated by premium price offered for organic products 2- Second in important

c. …..To ensure safe health and conserve environment 3- third important

d …..Others

11d In your household what are their main reason made you to continue with convectional farming practices in your farm? Ranking reasons

a ___high infestation rate of pest and diseases 1- most important

b. ____.fear of high yield decreases after conversion to organic 2- second in important

c.____.high profit from conventional farming 3- third important

d._____others

12. If your farm is not organic how many years have you been involved in coffee farming system?

13. Mention seasonal crops intercropped with coffee in the last season: a________b_______c_____d_______

14. Table 14.How many days did the member of the household take in each activity for coffee production?

Number of hours an adult person from your household can normally take to complete stated activity in coffee plants								
Activity	Application of	Spraying of coffe	Pruning of coffee	Picking of coffee	Coffee pulping washing	Dying of coffee	Weeding of coffee	Marketing of coffee

	man ure	e						
No of days								

15. Table 15. How many days did the member of the household take in each activity for banana?

Number of hours an adult person from your household can normally take to complete stated activity in coffee plants				
Activity	Banana thinning/pruning	Harvesting of Banana	Activity	Marketing of Banana
No of days			No of days	

16. Table 16. How many days did the member of the household take in each activity for maize/beans production?

Number of hours an adult person from your household can normally take to complete stated activity in coffee plants						
Activity	Land preparation for maize/beans	Planting of maize/beans	Weeding of beans/maize	Harvesting of beans/maize	Maize/ Beans cleaning	Marketing of maize and beans
No of days						

17. Did you hire labor in farm activities last season? Yes /No. ------------------

17. Table 17: If yes let us discuss about farmers who hired labor last season

Activity	Coffee	Beans/maize	Banana	Wage rate (shs)

(19) What do you consider as appropriate wage rate for samba work by

family members_______________________________?

20. Table 18. Let us discuss about the inputs you used in your shamba last season; Table 12

Coffee					
Name of input		Own /bought	units	Price per unit	Total cost
Rock phosphate (Minjungu)					
Manure/compost					
	UREA				
	Sulphate of Am.				
Pesticides					
Herbicides					

Organic pesticide	Copper oxide				

21. Table 19. Let us discuss about the inputs you used in your banana plant last season

Banana					
Name of input		Own or bought	units	Price per unit	Total cost
Manure/compost					
Fertilizer(any)					
Organic pesticide					

22. Table 20. Let us discuss about the inputs you used in your maize/beans last season

Coffee					
Name of input		Own or bought	units	Price per unit	Total cost
Manure/compost					
Fertilizer	CAN				
	UREA				
	SA				
Pesticides					

Organic pesticide					

23. Table 21: What farm implements did you use in coffee/beans/maize/banana production?

Type of equipment	Number owned	Year bought	Value when bought shs.
Hoes			
Pangas			
Pulping machine			
Basket			
Wire mesh			
Gunny sheet for coffee drying			
Pruning scissors			
Wheel barrow			
Sprayer			
Others (specify)			

24. Table 22: The following question related to the organic farm internal inspection and certification

Activity	Responsible company/organizatio	Year	Donor	Farmer's contribution	Total costs

	n				
Internal inspection					
Certification					
Trainings on organic coffee productions					

PART III: HARVESTING, STORAGE and MARKETING

25. Table 23**:** Let us discuss about the records of yield in your coffee for the last year; Table 17;

Coffee				
Year	No of Unit of yield	Price per unit	Total value in TSHS	Where did you market
2008				

26. Table 24: Let us discuss about the records of yield in your banana plant for the last year

Year	Total Yield	Units	Amount eaten at home and given to friends	Amount Sold	Total value of total yield in TSHS	Where did you market
Unripe banana						
2008						

27. Table 25: Let us discuss about the records of yield in your beans for the last year;

Beans						
	Units of yield	Units	Amount eaten at home and given to friends	Amount Sold	Total value of total yield in TSHS	Where did you market
Dry beans						
2008						

28. Table 26: Let us discuss about the records of yield in your maize for the last year

Maize						
	Total units of yield	Units	Amount eaten at home and given to friends	Amount Sold	Total value of total yield in TSHS	Where did you market
Dry maize						
2008						

29. Table 27: Let us discuss about the records of yield of other crops in your farm for the last year

Other crops	Total Units of yield	Price per unit	Total value in TSHS	Where did you market

30. Did you get any credit (formal or formal) to use in your farm last 3 seasons? Yes/No.

31. Table 28: If yes, go to Table 24 if no go to question 32

Year	Formal/Informal	Type of credit	From where	Amount	Interest rate
2008					

32. If no, why not---

33. Did extension office visit you farm last season? Yes / No.

34. If yes, how many times last year? 1) Once a month 2) 3 times a month 3) Once in 6 months 4) Not at all.

35. If visited, what message did they carry? Message --

36. If they did not come, did you try to look for advice from extension agents? Yes/No

37. If yes, what type of information did you look for and from whom?

a_____ Government Extension officers | Ranking

b. ____Neighbors | 1- Most important

c. _____Church | 2- Second in important

d. ____Organic inspectors | 3-third in important

e. _____Friends

f______Others

38. If farming advices were received from non-family members how was the source of advice met?

A___They visited the samba | Ranking

B___I met them in the seminars | 1. Most important

C____I met them in church 2. Second in Important

D____ I met them in the demonstration farm 3. Third in important

E_____others