ASSESSMENT OF PROFIT EFFICIENCY AMONG SWEET YELLOW PASSION FRUIT FARMERS IN MBEERE SOUTH, EMBU COUNTY

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A152/25630/2013

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A thesis submitted in partial fulfillment of the degree of Master of Science (Agribusiness management and Trade), at Kenyatta University.

June 2016

DECLARATION

I the undersigned, declare that this thesis is my original work and to the best of my knowledge it has not been submitted to any college, University or any other institution of higher learning by anyone for any other degree or award.

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DEDICATION

I dedicate this work to my mentors Dr. MainaMwangi, Dr. NewtonNyairo and ProfessorNjehia and to my whole family.

ACKNOWLEDGEMENT

My sincere thanks go to Kenyatta University for awarding me a MSc. scholarship to enable me further my studies. My gratitude also goes to my supervisors; Dr. MainaMwangi and Dr. Newton Nyairo for their constructive criticism, tremendous guidance, and insightfulness that has helped me completethis thesis. I specially thank Dr. MainaMwangi for the invaluable research financial support he extended to me through KAPAP project that enabled me to carry out this research, May God bless him.I also thank Stanley Karanja and Professor Job Nmadu for their support in the use of Frontier 4.1 efficiency analysis software, may God bless them too. I would also like to thank all my lecturers in the department of Agribusiness management for the knowledge and skills I have gained. My gratitude also goes to my course mate Christopher whom together with we encouraged each other and build a strong academic team.

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OPERATIONAL DEFINATION OF TERMS AND CONCEPTS

Small scale farmers- are farmers that have 0.01 to 3.00 ha of their land under sweet yellow passion fruit production.

Profit efficiency- refers to the ability of a sweet yellow passion fruit farmer expending an optimally balanced level of profit from production resources (ranges from 0 to 1). It indicates production efficiency.

High market value crop- refers to high value crops that fetch high prices per unit. Sweet yellow passion fruit is a high value crop in this study.

Inefficiency- refers to a farmer who is not operating on the profit frontier.

Stochastic frontier analysis- refers to a method that is used to estimate a firm's efficiency levels and factors that could be causing significant inefficiency.

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ABBREVIATIONS

EAG…… East African Growers

EAGA……. East African Growers Association

GDP…… Gross Domestic Product

HCDA…….. Horticultural Crops Development Authority

KAPAP…… Kenya Agricultural Productivity and Agribusiness Programme

KALRO…… Kenya Agricultural and Livestock Research Organization

KBDS……... Kenya Business Development Services

Kgs……... Kilogrammes

KShs…… Kenyan Shillings

MLE…… Maximum Likelihood Estimation

MoA……. Ministry of Agriculture

MT……... Metric tonnes

OLS……. Ordinary Least Squares

USAID…… United States of America International Development Agency

ABSTRACT

The horticulture industry in Kenya has been very successful in the last one and a half decades. This subsector has grown to become a major employer and foreign exchange earner. In 2014, fruits contributed Kshs. 51.5 billions accounting for 22% of the domestic value of horticultural produce. The sweet yellow passion fruit variety is gaining adoption in Mbeere South Sub-county due to its apparent adaptation to the hot arid conditions and a ready market. Efforts had been made to promote the production and marketing to boost smallholder farmer income by various passion fruits stakeholders. Despite the efforts, profit levels were considered to be dismal as some farmers were investing highly to the fruit agribusiness venture but ending up making losses due to high production costs. The causes of the varying profits had not been empirically established. The economic/profit efficiency level of the agro-enterprise was therefore unknown and further the use of agricultural credit on the sweet yellow passion fruit by smallholder farmers in Mbeere South was not known. Therefore, the objective of this study was to analyze profit efficiency levels among smallholder sweet yellow passion fruit farmers, to determine the influence of socio-economic and institutional factors to profit efficiency among sweet yellow passion fruit farmers, and to measure the use of credit among sweet yellow passion fruit farmers in Mbeere South sub-county. This study used primary data which was obtained from smallholder farmers through a semi-structured questionnaire that was administered to farmers through an interview schedule. In this study, the target population was defined by the smallholder farmers producing sweet yellow passion fruit and the sample size was 90. A purposive sampling method was employed to select Mbeere South as the area of study and a systematic random sampling method was used to select two locations from each division in the district. Systematic random sampling at an interval of 1 respondent was used to select a sample from each division for the study; that is every second sweet yellow passion fruit farmer was selected. The obtained data was analyzed using Stochastic Frontier Analysis (SFA) method and descriptive statistics by running a model on frontier 4.1 version and STATA 11 Softwares respectively. The study showed that the profit efficiency levels ranged from 23% to 90% with a mean of 76% implying that an estimated 24% profit loss was being made due to a combination of both technical and allocative inefficiencies. The study also found out that the frequency of farming experience, group membership and access to market information influence profit efficiency significantly. Therefore it is recommended that extension education investments should be scaled up through producer organizations to improve agricultural productivity and agricultural marketing through proper search and use of marketing information.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Agriculture contributes 26% of Kenya's GDP and accounts for 75% of employment(MoAL&F, 2015). The horticulture industry in Kenya has been very successful in the last one and a half decades. This sub-sector has grown to become a major employer and foreign exchange earner (HCDA, 2013). The subsector also directly employs over 4 million people, mainly in rural areas with the majority being women and the youth. By positively creating employment, the sector thus helps in alleviating poverty and in wealth creation. It is ranked the second most important foreign exchange earner in Kenya after tourism (HCDA, 2008).

The total value of horticultural exports in 2014 was 84 billionKshshaving exported 220,000 MT of produce. On the other hand, the domestic value was 201 billion Kshsoccupying an area of 684,912 ha with a total production quantity of 8.4 million tons. There was a 16% increase in quantity exported as compared to 2013. The increase in quantity and value was due to the increase of vegetables, fruits and processed fruits exports,(Directorate, 2014).

In 2014, fruits contributed Kshs 51.5 billion accounting for 22% of the domestic value of horticultural produce(Directorate, 2014). The area under fruit cultivation was 161,472ha with a production of 4.2 million tons. Although the area under fruit increased by 10% as compared to the previous year, the production and value increased by 34% and 7% respectively due to favourable weather. Further, the

report categorizes the main fruits grown in Kenya to be the tropical and temperate fruits. These are grown in order of importance as;

Table 1: Main fruits grown in Kenya

Fruit	**Percentage**
Banana	37.6%
Mangoes	19.6%
Pineapples	12.1%
Avocado	9.8%
Paw paw	5.4%
Oranges	4.6%
Watermelon	4.2%
Passion fruit	3.7%

Source: HCDA (2013)

The potential of most fruits remain unexploited. However, there is potential for growth due to increasing demand both in the domestic and export market for fresh fruits and fruit produce such as juices and concentrates (HCDA, 2013). For the past decade, over 90% of all fruit and vegetable production was consumed domestically, and the domestic market accounted for over 90% of the total growth in quantity of fruit and vegetable production. In 2014, fruits had the second highest contribution by value in the horticultural industry at 30.3%, (Directorate, 2014).

According to COLEACP (2011), Kenya exports around 1000 tonnes of passion fruit per year.

Passion fruit in 2013 was found to account for 3.7% in the main fruits grown in Kenya category. This is very low considering its market demand and nutritious value in the country. There are two main varieties of the passion fruit; the purple and the yellow varieties, with the yellow being distinguished as *P. edulis f. flavicarpa*. The yellow passion fruit has a yellow rind and larger fruit, more acid flavor, resistant to nematodes and Fusarium wilt, and has brown seeds, it is resistant to most pests and diseases (COLEACP, 2011). According to Wangungu(2013), the Kenyan passion fruit has emerged as a high market value crop influenced by the establishment of the (Kevian and Valley orchards among others), and the expansion of existing (Delmonte and Coca cola) large scale processors of fruit juice to include passion fruit juice into their products.

1.2 Yellow Passion fruit production

Mostly, passion fruit is round or oval, 4-6cm diameters. Vines commence cropping at 6 months of age and reach full bearing in 18 months. The vines have a productive life of 3 to 4 years. According to Kormelinck (2012), new plantings should be made on a continuous 3 year rotation to maintain production. He further says that passion fruit grows well in cooler temperatures at an elevation of between 1200m-1800m above sea level east of the Rift Valley and up to 2000m above sea level west of the Rift valley. More specifically, the purple passion fruit

does well in the upper midland to upper highland zones (1200-1800m) while as the yellow passion fruit does well in the lower midland to lower lowland zones (up to 1200m). Further, the fruit does well in optimum temperatures, where the production of purple and yellow passion is between temperatures of 18-25 degrees Celsius and 25-30 degrees Celsius respectively, (Kormelinck, 2012).

According to Carvalho et al., (2011), in order to improve the profitability of yellow passion fruit cultivation, the development of technologies to increase yield productivity, especially those pertaining to the mineral nutrition and irrigation and fertilization is essential. BAOBAB (2012), points out challenges that smallholder farmers face in the production of passion fruit to be low volumes of produced fruits by individual smallholder which is uneconomical to sell individually; pressure to sell to middlemen even at lower prices; poor post-harvest handling due to lack of skills and capacity to maintain good post-harvest quality; pests and diseases, particularly die back disease.

Smallholder farmers in Kenya begun growing passion fruit as a result of the support gained from the Kenyan government, private foundations and bilateral and multilateral donors since the early 2000s. The gross value of an acre of passion fruit with a good harvest was estimated to be Ksh. 600,000 ($8,000), or 12 times as much as that of maize at the time, (USAID, 2012). According to Murithi (2014), yellow passion fruit production has led to farmers earning sh. 10,000,000 in Meru County through a project initiated by Technoserve an NGO whose

primary goal was to encourage farmers to produce more mangoes and yellow passion fruits which can access international markets with required residue levels.

Karuga (2013) states that yellow passion fruit farmers have realized higher profits due to lower growing costs since the purple passion fruit requires spraying six times each fruit season, compared to three times a season for the yellow variety. The new variety has doubled fruit incomes, with industrial fruit processors opting for the yellow passion fruit over the purple passion fruit because it is sweeter, less acidic and bigger with more juice.

1.3 Institutional Arrangements

The horticulture sector which is made up of fruits and vegetables is characterized by a wide array of institutional arrangements such as smallholder farmers selling in spot markets, implicit and explicit contracts, personalized relationships with traders, farmer organizations, medium and large scale farming and vertically integrated producer-exporter relationships. Therefore, the Kenyan government has a role of facilitating institutional innovation by providing market information, establishment of standards, provision of extension services and in the mediation of disputes, (Minot & Ngigi, 2004)

The fruit subsector has many stakeholders that participate in the development of the fruit industry. These include NGOs and private firms which have the aim to

improve the conditions of passion fruit farmers. Some of the institutions that are working with smallholder passion fruit farmers in Embu County include East African Growers Ltd (EAGA), through a project called '*fruit quality enhancement project'* which they implemented by the support of Kenya Business development Services Program (KBDS Kenya), funded by USAID; where HCDA acted as a regulatory body overseeing signing of contracts, (Strohm et al., 2006). Further; according to Strohm et al., (2006), farmers signed a one year contract with EAGA Ltd which set a fixed price for passion fruits that meet quality requirements. EAGA Ltd paid the farmer groups fortnightly by cheque (but sometimes also in cash) based on the produce collection note. Collective action is another form of institutional arrangement in the fruit sub-sector more so in the passion fruit industry. Most farmers participate in collective action/institutional arrangements that help them to reduce transaction costs where the government is not involved in the marketing of horticultural products, (Ondieki et al, 2013). In a study by Ondieki et al., (2013), eight institutional arrangements were identified in Kirinyaga County. These arrangements were found to be characterized by spot markets to contractual forms of relation and farmers participated in them as individuals or as part of a group.

According to USAID (2014), most of the services such as extension services and marketing information provided to passion fruit grower is primarily done through

public and private sector partnerships with local NGOs, Universities, government agencies, input suppliers, processors and exporters.

1.4 Marketing of passion fruit

Poor market access by cereal and passion fruit farmers has consistently denied producers profits while as middlemen and brokers have emerged as the most beneficiaries. In most rural set ups, farmers organize themselves into commodity groups that help them in bulking their produce, bargaining collectively and negotiating for better prices for their produce. Through these groups, farmers achieve economies of scale further reducing transportation and handling costs for the individual farmers, (BAOBAB, 2012).

According to Kormelinck (2012), East African Growers (EAG) Ltd. a private company that deals in the exportation of horticultural produce, developed contractual relations with a passion fruit farmers' group in Migori County. Through this relation, the firm guarantees the group a ready market at a competitive price. It provided market linkages, inputs and logistics to the passion fruit farmers. Further, Kormelinck (2012) pointed out that the firm had a demand of 16 tons weekly of the passion fruit group, whereas the contracted farmers could supply only 200Kg per week. This therefore implies that the supply was insufficient to meet the demand.

1.5 Marketing information

In Sub-Saharan Africa where smallholder farmers are the majority that live in isolated rural areas; they lack access to markets for their produce and are deprived of agricultural marketing information. These farmers also have limited technical skills, poor access to information and training that can help them boost their marketing capabilities. The access of agricultural markets and marketing information is very essential in promoting competitive markets and improving the agricultural sector, (Magesa et al, 2014). According to FAO (2011), farmers' throughout the world's need for information to ensure effective and profitable marketing is great.

This is because information enables farmers to plan their production more in line with market demand, plan their harvest schedules at the most profitable periods and also make decisions on which markets to send their produce; plus also enhance their negotiations for better prices with traders, (Magesa et al., 2014). The provision of basic marketing information aims at increasing the efficiency of agricultural markets and contribute towards mitigating the issues associated with market failure based on asymmetric access to basic market information, (Ferris et al, 2008).Therefore the lack of marketing information contributes to failure by farmers to negotiate well on the prices of their produce and thus end up getting paid very little. It also results in the introduction of middlemen or intermediaries who have better market information who exploit farmers, (Magesa et al., 2014).

According to FAO (2011), farmers can use marketing information to reduce risks associated with marketing by knowing prices which in turn helps in deciding if it is worth in sending their produce to the market; decide whether to sell or store the produce or not as they wait for better prices; and where to sell and check on the prices he or she is getting. Marketing information also helps farmers in deciding whether to grow-out-of-season by using modern technologies which offer opportunities to harvest when prices are highest and also in deciding whether to grow different crops. According to Shepherd (1997), farmers with good information can compare the prices they are being offered by middlemen at the farm gate with those in the market. Further, price information is more important to those farmers that send their produce "on consignment" to agents and or whole sellers in the market thus enabling them not to get conned by agents or wholesalers. According to (FAO, 2015), efficient market information has great benefits to farmers, traders and policy makers. If the information is up-to-date, it has the capacity to facilitate spatial distribution of agricultural products from rural areas to urban areas and between urban markets. This is through the sending of price signals from urban traders or consumers to rural producers concerning quantities and varieties required.

Dissemination of price information and market news is achieved through various media such as radio, magazines, television, email, internet, and telephone. Lack of access to timely and reliable information acts as a barrier to production and trade,

(Shepherd, 1997). According to (Svensson & Yanagizawa, 2008), due to up-to-date market information aired on radio, traders in Kawangware relayed the information to farmers in Timboroa in Kenya which saw a large supply of potatoes from Timboroa the following market day. Further, one trader observed that farmers were fixing prices on the information obtained from the broadcast.

1.6 Agribusiness Financing

In the Kenyan agribusiness subsector, smallholder farmer financing is one of the factor that limits increased productivity, production and profitability. Agricultural credit is important as it enables farmers to purchase inputs, adoption of technology and finance production activities leading to increased farm income. According to Yegoh (2014), agricultural credit is considered a temporary substitute for lack of personal savings by farmers that acts as a catalyst in the process of agricultural production and productivity. In past studies done, it has been shown that the growth rate of agricultural investment is less compared to the growth rate of other economic sectors hence implying that agricultural financing can be a crucial factor needed to develop rural agricultural economies in developing countries, (Yegoh, 2014).

In Kenya, credit-based arrangements with marketing and processing companies can serve as an important element in improving the chances of smallholders to participate in the production of high value crops,(IFAD, 2003). Therefore, the use of any form of credit by sweet yellow passion fruit farmers either from micro-

finance institutions, banks, farmer groups, marketing or processing companies is essential in improving farm incomes and farmer living standards. However, the literature does not show whether sweet yellow passion fruit farmers do get credit or not.

In EmbuCounty, sweet yellow passion fruit farming is of great importance as it provides a means of livelihood in the semi-arid area. This has made some organizations to start programmes that support farmers so as to make passion fruit farming worthwhile as well as profitable. These organizations such as Kamurugu development initiative located in Mbeere South, offer training in areas such as group organization, value addition, and improved production skills with the sole aim of accessing the available markets for better returns. These efforts point towards the elimination of constraints that smallholder sweet yellow passion face with the goal of helping them reap from sweet yellow production. Further, the development of a passion fruit supply chain is very important as it affects a farmer's profits. Smallholder farmers are faced with the choice of choosing one market channel against another since they offer different prices. The channels also expose the farmers to transaction costs such as searching for the best channel/buyer and bargaining for the best price. Socio-economic factors such as aging, group membership also affect a farmer's yields, (Minai, 2014). These factors therefore have an influence on farmers' yields and consequently their profitability.

1.7 Statement of the problem

Passion fruit has emerged as an important high value horticultural crop in Kenya. The sweet yellow passion variety has beenadopted in Mbeere South sub-county due to its adaptation to the hot arid conditions, it's tolerant to moisture stress, pests and diseases and a ready market for the fruit. The potential for passion fruit to create more employment opportunities, create wealth as well as improve the livelihoods of smallholder farmers and other value chain actors in Embu County is enormous.Despite much promotion by extensionists, farmers have been dropping the enterprise due to dismal profits.The cause of the varying profits has not been empirically established.Therefore to gain an understanding on the performance efficiency of smallholder sweet yellow passionfruit farmers, this research will seek to assess the profit efficiency levels of farmers in Mbeere South as well as the identified socio-economic and institutional characteristics which could be causing profit efficiency variation.

1.8 OBJECTIVES

General objective

The overall objective of this study was to assess the socio-economic and institutional factors that affect profit efficiency of smallholder yellow passion fruit farmers in MbeereSouth, Embu County.

Specific objective:

1. To analyze profit efficiency of smallholder yellow passion fruit farmers in Mbeere South, Embu County.
2. To determine the influence of socio-economic and institutional factors to profit efficiency of smallholder yellow passion fruit farmers in Mbeere South, Embu County.
3. To measure the use of agricultural credit among smallholder yellow passion fruit farmers in Mbeere south, Embu County.

1.9 Hypotheses

1. There is significant difference in the profit efficiency levels of sweet yellow passion fruit producers in Mbeere South Sub-county.
2. Socio-economic and institutional factors have a significant influence on profit efficiency of yellow passion fruit production and profitability.

1.10 Research question

1. What is the number of smallholder yellow passion fruit producers that use agricultural credit in their sweet yellow passion fruit production activities?

1.11 Significance of the study

Despite the economic potential of sweet yellow passion fruit and its ability to generate income and create employment for the rural women and youths in the study area, profit efficiency of the enterprise is not known. This study will establish the profit efficiency levels of smallholder yellow passion fruit farmers,

which will be essential in the fight against hunger, poverty and unemployment by contributing to policy in the sub-sector. The findings will indicate the profit efficiency levels that the efforts to promote passion fruit production and marketing by the KAPAP project have achieved. This information will be useful to farmers who produce the sweet yellow passion variety as well as to the extensionists promoting the crop. The study will also generate knowledge that will consequently be used by other researchers more so in the profit efficiency gap.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter reviews relevant literature that is important for the purposes of this study. The reviewed literature covers the major issues in yellow passion fruit farming as well as methods of measuring profit efficiency plus also identifying the causes of profit inefficiency. Acritical review of empirical studies on profit efficiency is also included. Thence, the research gap is eventually identified.

2.1 Approaches used in efficiency

Efficiency is estimated through the use of two different methods. These methods can either be deterministic where all deviations from the frontier are attributed to inefficiency or stochastic which has the capacity to allow for the discrimination between random errors and differences in inefficiency.

According to Kibaara(2005), a serious criticism of the deterministic frontier model is that there is no account taken of the possible influences measurement errors or other statistical noise might have upon the frontier and therefore all deviations from the frontier are assumed to be as a result of inefficiency of the firms being considered. This therefore ignores the possibility that a firm's performance could be affected by factors that are beyond the firm's control. This then will result in efficiency estimates being lower than those estimated by a stochastic frontier, because the estimates will be estimated in such a fashion that no output values may exceed the frontier; as a result of the non-positive error component as well as the Y_i being bound by the deterministic frontier.

Therefore in this study, stochastic frontier approach was selected due to its ability to take measurement errors or other statistical noise into account when estimating efficiency.

2.2 Measurement of profit efficiency

According to Ali & Flinn(1989), profit efficiency is the ability of a farm to achieve the highest possible profit, given the input prices and levels of fixed factors. According to Abdulai & Huffman (1998), the concept of efficiency has three components: technical, allocative and economic. Technical efficiency is defined as the ability to achieve a higher level of output given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficiency decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost while on the other hand; technical and allocative efficiencies are components of economic efficiency. Rahman (2003) explains out that the concepts of allocative and technical efficiency are measured by the use of a frontier production function which can be deterministic or stochastic. A deterministic frontier production function explains that all deviations from the frontier are attributed to inefficiency where as in the stochastic frontier production function; it is possible to discriminate between random errors and the differences in efficiency. Therefore, the profit function approach combines the concepts of technical, and allocative efficiency in the profit relationships and any errors in the production function translate into lower profits or revenue for the producer, (Rahman, 2003).

It has been argued that using a production function approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowments, therefore the estimation of efficiency should incorporate farm-specific prices and levels of fixed factors (Ali & Flinn, 1989). According to Battese & Coelli(1995), the stochastic profit function is one of the models that measure profit efficiency. The advantage of this model is that it allows the estimation of farm specific efficiency scores and the factors explaining the efficiency differentials among farmers in a single stage estimation procedure. This is done in a two stage method, with the first being the estimation of the efficiency levels on farmer characteristics to explain the differences in efficiency, (Abdulai & Huffman, 1998).

2.2 Critical review of empirical studies on factors influencing profit efficiency

One of the studies done in Kenya on profit efficiency was on milk by (Nganga et al, 2010), which was mainly concentrated in the Central province of Kenya, one of the highest milk producing regions in the country. In this study, profit efficiency level was estimated at 60% using the stochastic profit frontier model. The farm specific variables that explained inefficiency were farming experience, a higher level of education, and farm size tended to be more profit efficient. This study however failed to look at institutional aspects such as access to credit, training as factors affecting profitability of the enterprise.

Ojo et al, (2009)in their study on small scale cowpea profit efficiency using stochastic profit frontier approach, found out that age of the farmer, farmer's educational level, and farming experience in years significantly influenced profit efficiency level positively. However, the researcher in this study failed to assess the implication of family size as compared to (Oguniyi, 2008) in his study on cocoyam where it was found that households with large family size exhibited higher profit efficiency in relation to small households.

In the study of rice farming in Bangladesh, Rahman(1996) found out that the mean level of profit efficiency was 77% among the Bangladeshi rice farmers. The efficiency differences were explained largely by infrastructure, soil fertility, experience, extension services, tenancy and share of non-agricultural income. Farmers who owned their own land were more profit efficient at 78% compared to 76% those with leased land. Farmers who used developed technologies and those that were located at fertile farms, had access to extension services, had more experience were more profit efficient compared to those that were not. This study however did not investigate whether the size of farmers' households had an influence on profit efficiency of the enterprise as compared to (Nmadu & Garba, 2013).

In the study of profit efficiency of cat fish in Benue state, Niger by Tsue et al, (2012); it was determined that years of schooling, off-farm income, and training had a negative impact on profit efficiency. These findings were in contradiction

with Ali & Flinn(1989); andRahman(2003) who found that off-farm income, training (extension), higher number of years spent in school by the farmers had a positive impact to profit efficiency. This study also failed to find out whether the farmers had access to/use of agricultural credit, since the cost of inputs was found to have a negative effect on profit efficiency.

Ogunniyi(2011) in an analysis of profit efficiency of maize in Oyo state, Nigeria used a stochastic frontier profit function. The study results reported profit efficiency levels of the farmers between 1% and 99.9% with a mean of 41.4 percent. The determinants to the profit efficiency were found to be education, experience, and non-farm employment. This is due to the fact that farmers with higher education tend to be more profit efficient than those that are not since they are able to read and get information on agricultural trends and new technologies; further, farmers with more experience and off-farm income tended to be more profit efficient since more income makes it possible to purchase inputs for production. These study results were consistent with those of (Rahman, 2003).

Karafillis & Papanagiotou(2009) in a study on innovation and profit efficiency on olive farmers used a stochastic frontier profit function: translog approach. The study results showed a mean profit efficiency level of 61.5% which increased more among innovative farmers. In this study, the main and only determinant to profit efficiency was innovation and there were no other factors such as socio-economic or institutional considered in the study.

In the study of impact of infrastructure on profit efficiency of vegetable farming in west Java Indonesia by Rachmina et al., (2014); it was found out that factors affecting vegetable farming profits were seed price, chemical fertilizer price, wage and non-land capital accumulation. In this study profit efficiency level was found to have an average of 53%.This study however failed to look at institutional or socio-economic factors that could be influencing the profit efficiency levels of the farmers.

Tuffour(2014)assessed profit efficiency of broiler production in Accra, Ghana. The results indicated a mean profit efficiency level of 54% among the commercial broiler producers in the Accra region of Ghana. Further, farm experience was revealed to significantly reduce economic inefficiency thereby increasing efficiency whilst sole-proprietorship status of the farmer was found to significantly increase economic inefficiency thereby decreasing economic efficiency. However, factors such as credit access, marketing information access, and trust on trader price and group membership were not included in the study as part of factors contributing to inefficiency.

In another study by Kolawale (2006) to analyze the determinants of profit efficiency among small scale rice farmers in Nigeria, he used stochastic frontier analysis method. The study findings indicated that faming experience was significantly influential to profit efficiency. These results were consistent with (Tuffour, 2014).

Most recently,Bamiro et al., (2013) in the study of poultry profit efficiency in Peri-urban Lagos, Nigeria employed translog profit frontier model. Profit efficiency in the study ranged from 11-97% with a mean of 72%. Further, the results revealed that gender, family farm, finance, fulltime employment, and number of broilers significantly determined profit efficiency. In the study, the researcher did not specify which kind of finance was used either borrowed, from savings or from sale of poultry and its products.

In Malawi, Assa et al (2012) employed stochastic frontier analysis to measure the profit efficiency of sampled Irish potato farms and to assess the determinants of profit inefficiency in the Dedza district of Malawi. The efficiency indices ranged from 0.31 to 0.99 with an average of 0.74%. The study found variables such as farming experience, frequency of weeding, degree of specialization, extension visits, credit status and non-farm employment to negatively influence profit inefficiency; these results were consistent with those of Abdulai & Huffman, (1998)where as age affected profit inefficiency positively which is consistent with the findings of Abu et al.,(2012), and (Mussa et al., 2012).

Minh & Long (2009) undertook a study to determine efficiency estimates for the agricultural production in Vietnam where they employed the use of parametric and non-parametric approaches. The results from the study showed that from both approaches, the average technical, allocative and economic efficiency estimates were not high, and that there was still a large room to improve the agricultural

efficiency. This study however did not employ stochastic frontier analysis approach to determine efficiency. The study also failed to undertake an analysis of factors that could be influencing inefficiency in the study area.

Okoruwa et al.(2009) in the study of relative economic efficiency of farms in rice production where they used a profit function approach in North Central Nigeria. The study findings showed sex/gender and rice production system to significantly influence economic/profit efficiency. The two variables negatively influenced inefficiency. The study however did not analyze the influence of credit access and use, group membership and trust on trader price's influence of inefficiency.

2.3 Criticism and research gap

In view of the reviewed literature, no study has been found to have assessed profit efficiency and socio economic and institutional factors such as credit access and use, trust on trader price, market information access and use, market channel, farming experience and extension contact influencing profitability of sweet yellow passion fruit. Most studies done on passion fruit in the previous past had been on diseases and pests affecting the crop, production and technical efficiency. These studies include Wangungu (2013),Karani(2013), Ramos et al., (2012) and (Saptarini et al, 2013).

Undertaking this study therefore enabled the determination of the factors that influence profitability of the sweet yellow passion fruit enterprise, found out the

causes of profit inefficiency, marketing channels preferred by the producers, as well as identified institutional attributes of the farmers.

2.4 Theoretical framework

The theoretical framework is based on the stochastic profit frontier approach in the examination of smallholder farmers' profit efficiency of sweet yellow passion fruit.

Kolawole (2006), defined profit efficiency as profit gained from operating on the profit frontier while taking into consideration farm-specific prices and other factors. The technique that was applied in this study included stochastic frontier profit function which was in line with Nmadu & Garba (2013), Ojo et al (2009) and Oguniyi (2008) who adopted Battese & Coelli, (1995)'s model to postulate a profit function that is assumed to behave in a manner consistent with the stochastic concept. According to Nmadu and Garba (2013), the model commences by considering a stochastic profit function with a multiplicative disturbance term of the form:

$$\Pi = f(Pi, Zik\beta i)ei(Ei) \quad \ldots\ldots (1)$$

Where; Π = normalized profit defined as gross revenue less variable cost divided by output price, Pi= normalized price of variable inputs by the farm divided by output price, Zi= level of k^{th} fixed factor on the farm, βi= Vectors of parameters,

ei= error term used, Ei= stochastic disturbance term consisting of two independent elements v and µ.

Where; Ei = vi+µi…….. (2)

vi' is assumed to be independent and identically distributed random errors having normal N (0, σ^2) distribution independent of the µi while the µi is the one-sided disturbance form used to represent profit inefficiency and is assumed to be non-negative truncation of the half normal distribution N (µ , $\sigma^2\mu$).

Nmadu and Garba (2013), the model can be used to estimate the individual profit efficiency of the respondents as well as the determinants of profit efficiency. The frontier of the farm is given by combining equation 1 and 2 as presented in equation 3:

$\Pi = f(Pi, Zik, \beta)\, e^{(\mu+v)}$…….. (3)

The profit efficiency of an individual farmer is defined as the ratio of predicted actual profit to the predicted maximum profit for a best practical passion fruit farmer and this is represented in equation (4).

$$\text{Profit efficiency } (E\Pi) = \frac{\pi}{\pi^{max}} = \frac{\exp[\pi(p,z) \exp(\ln V) \exp(\ln\mu) - \theta}{\exp[\pi(p,z)] \exp(\ln V)\theta} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where π= predicted actual profit, π^{max} = predicted maximum profit.The profit function can be estimated by the maximum likelihood technique given the density

function of μi and vi. The profit efficiency E(π) takes the value between 0 and 1. Therefore if iμ=0, that is lying on the frontier, the farmer has potential maximum profit given the price he faces and the level of fixed factors of production, while if μi>0, the farmer is inefficient and operates on lower profit as a result of inefficiency.

Following Nmadu and Garba (2013), Coelli and Ojo et al (2009), the stochastic frontier function with behavioural inefficiency components will be used to estimate all parameters together in one step maximum likelihood estimation procedure. The explicit Cobb-Douglas functional form for the yellow passion fruit producers in the study area will be therefore specified explicitly as presented below in equation (5):

$$Ln\pi = \beta o+\beta_1 lnZi+\beta_2 lnP_{1i}+\beta_3 lnP_{2i}+\beta_4 lnP_{3i}+\beta_5\ lnP_{4i}+\beta_6\ lnP_{5i}+(vi-\mu i)\text{.....(5)}$$

Where π= normalized profit function computed as the total revenue less variable cost per output price, Zi= farm size (ha), P_1= normalized price of fertilizer (Kshs), P_{2i}= normalized price of labour (Ksh per man day of labour), P_{3i} =normalized price of seed (Kshs per Kg of seed), P_{4i}= normalized price of agrochemical (Kshs per litre of agro-chemical), P_{5i}= normalized price of irrigation (cost of irrigation per day), βo=Intercept/constant, β_1-β_6= parameters to be estimated, μi= non-negative (Zero mean and constant variance) random variable called profit inefficiency effect associated with the profit efficiency of the ith farmer. μij's are

the profit inefficiency effects which are assumed to be independent of vijs such that μij's are the non-negative truncation (at zero) of the half normal distribution with mean μi and Variance ($\sigma^2 v$). Where μi is defined by the following equation (6):

$$\mu i=\delta_0+\delta_1 G_{1i}+\delta_2 G_{2i}+\delta_3 G_{3i}+\delta_4 G_{4i}+\delta_5 G_{5i}+\delta_6 G_{6i}+\delta_7 G_{7i}+\delta_8 G_{8i}+\delta_9 G_{9i}+\delta_{10} G_{10i}+ \delta_{11} G_{11i}+\delta_{12} G_{12i} \ldots (6)$$

Where μi= profit inefficiency of the ith farmer, G_{1i}= age of the ith farmer in years, G_{2i}= level of education of the ith farmer (years spent in school), G_{3i}= farming experience of the ith farmer in years, G_{4i}= household size of the ith farmer, G_{5i}= extension contact and use (number of meetings during production), G_{6i}= Gender (I for male, 0 for female), G_{7i}= credit status of the ith farmer(1 for access, 0 for otherwise), G_{8i}= Status of membership to a group or cooperative society of the ith farmer (1 for membership,0 for otherwise)$\delta_9 G_{9i}$= Trust on trader price, $\delta_{10} G_{10i}$= Access to market information, $\delta_{11} G_{11i}$= Access to off- sweet yellow passion farm income, $\delta_{12} G_{12i}$= Market channel, ,. δ_{1i}-δ_{12i}= Unknown parameters to be estimated.

1.5 Conceptual Framework

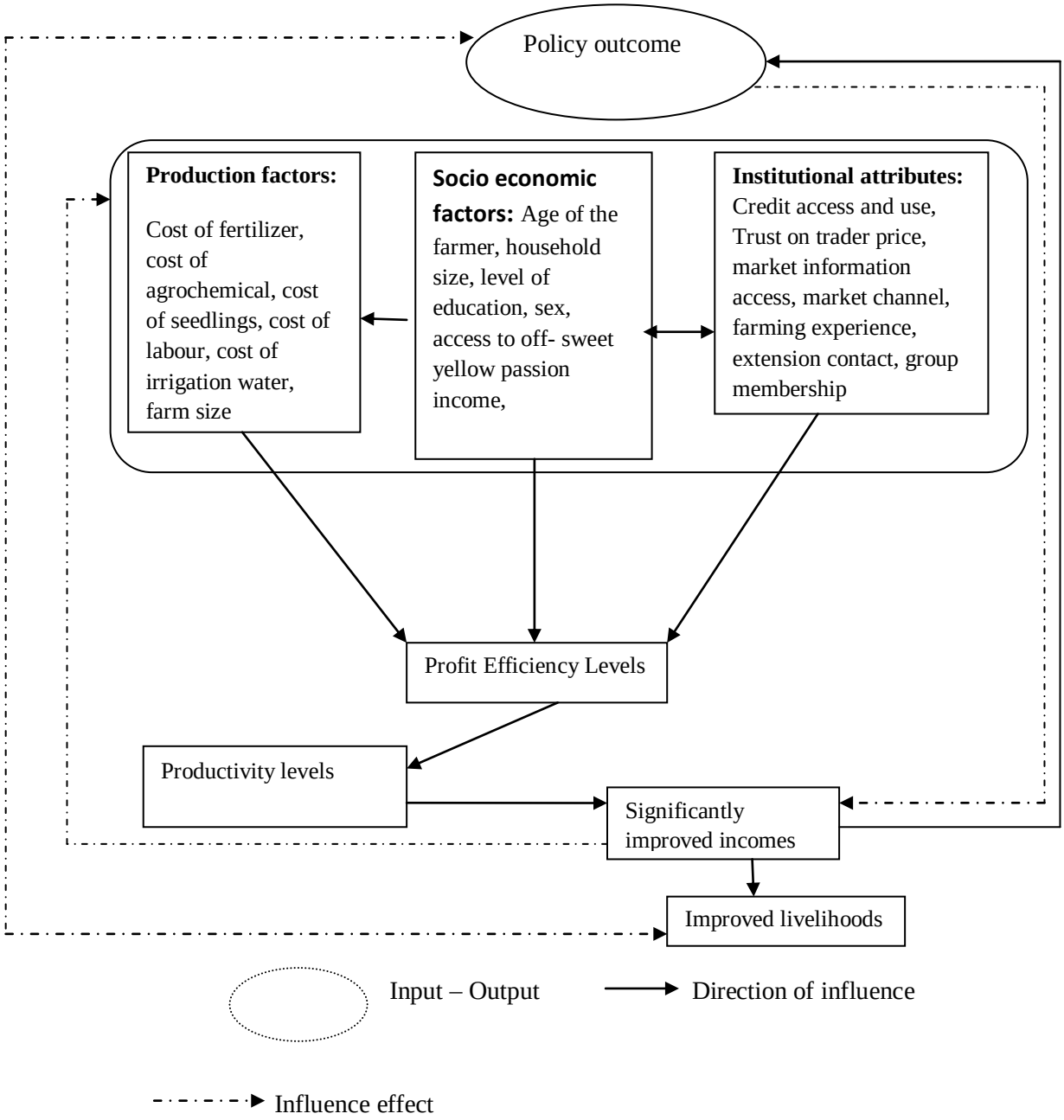


Figure 1: Conceptual Framework

Source: Modified from Cobb and Douglas (1928), Sibiko (2013) and Karani (2013)

The above conceptual framework was based on the production theory, by applying the stochastic frontier profit function. The conceptual framework was organized in stipulations of feedback and influence mechanisms of farm level profit efficiency levels. It focuses on input-output transformation efficiency, policy recommendations, and effects. The production factors (price of seedlings, farm size, price of fertilizers, price of agrochemicals, expenditure on labour and cost of irrigation) were used as inputs in the sweet yellow passion fruit production activities. It was therefore expected as more inputs were applied by a farmer; fruit yields would increase but on the other hand result to a negative effect in cases of overuse. Optimality was therefore a crucial factor in deciding the level of inputs that were to be applied. The profit efficiency levels were affected y the efficiency of production of a farmer. The socio-economic and institutional factors were expected to influence a farmer's efficiency. The socio-economic factors expected to influence efficiency of a farmer included; age, household size, level of education, gender, access to off-sweet yellow passion income, while the institutional factors included credit access and use, trust on trader price, market information access, market channel, farming experience, extension contact, and group membership. The profit efficiency and its influencing factors were anticipated to influence policy which the study had proposed to recommend. The recommended policies were expected to play a feedback effect in improving profit efficiency and profit levels. Further, improved livelihoods and income levels were

also anticipated. The improved income levels among sweet yellow passion fruit farmers anticipated to have a feedback effect on profit efficiency, institutional and socio-economic factors through improved and informed use of inputs, the alteration of the current socio-economic aspects of the farmers and institutional services accessibility.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

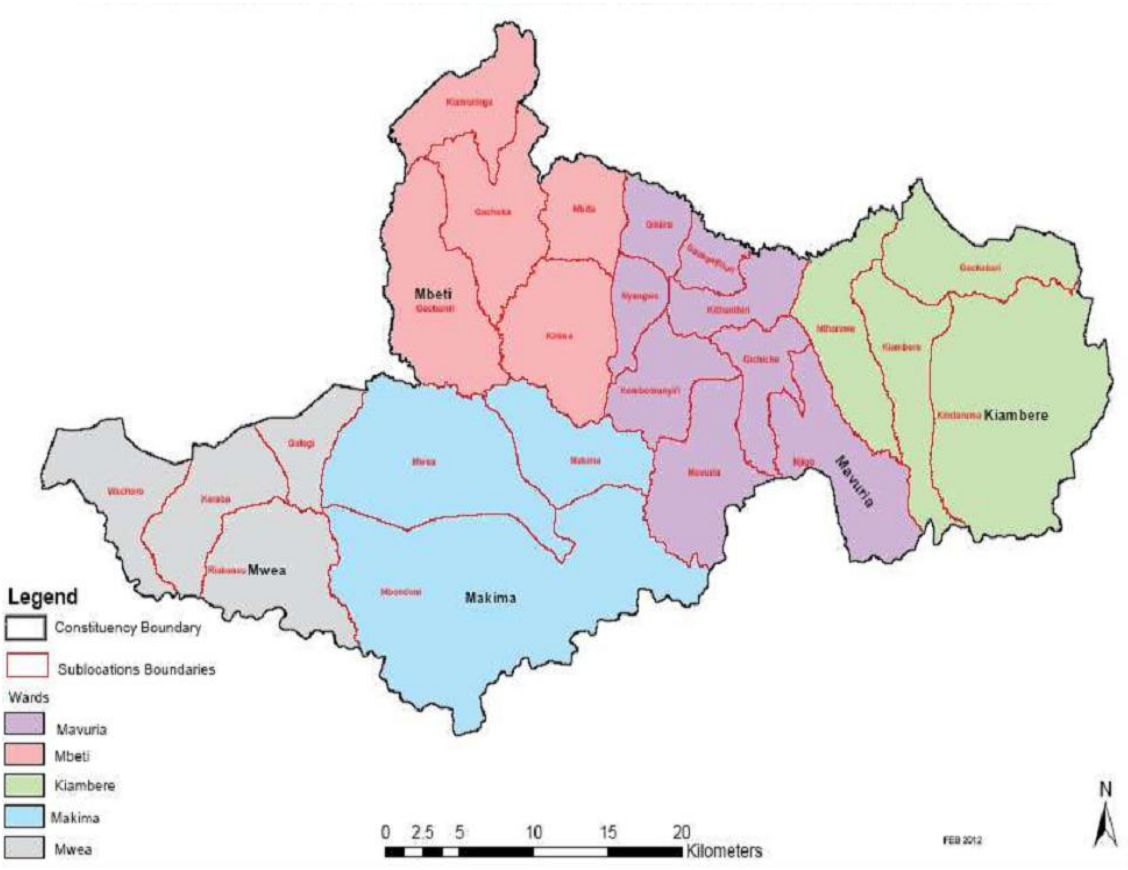
This chapter highlights the important aspects of the research methodology for this study. This part covers the study area, the sampling design, research instruments, and data analysis. Further, this part identifies and justifies the study area selected as well as the data analysis tools that were applied in the research.

3.1 Study Area

This study was carried out in Mbeere-South, Embu County which is among the major sweet yellow passion fruit producing Counties in the country. Sweet yellow passion fruit is better suited in Mbeere South due to its reported adaptation to the climatic conditions in the area. The farmers in the study area face different institutional and socio-economic factors which makes them more suitable for this study. The area is also one of the Counties selected for the implementation of the KAPAP project which aims at improving incomes for smallholder farmers as well as other value chain actors through enhanced productivity of passion fruit. The various parameters that describe the county well are as shown in the following table.

Table 2: Description of the study area

Parameter	Embu	Source
Area (km^2)	1,321.50	www.embu.go.ke2014
Altitude (m.asl)	Above 1200	Kenya Decides
Rainfall in mm	500-1495	Kenya Decides (2012)
Temperature range (^oc)	12-30	www.infotrackea.co.ke 2014



The above map shows the study area: Mbeere South Sub-county

3.2 Research design

This study used both primary and secondary data. In this study, smallholder farmers were considered in obtaining primary data. Primary data that was obtained from questionnaires was used to obtain information on institutional and socio-economic characteristics of the producers. Secondary data was obtained from publications and institutions such as MoA and HCDA and was used for literature review and in the discussion after data collection and analysis. Mbeere South was purposively identified as the area where this study wasconducted due to its favourable climate and also being the major area where the KAPAP project had been implemented. A systematic random sampling method was used to select two locations from each division in the Sub-county. Systematic random sampling at an interval of one respondent was used to select a sample from each division for the study that is every second sweet yellow passion fruit farmer was selected.

3.3 Sample size and Target population

The target population was defined by the smallholder farmers producing yellow passion fruit mainly in Mbeere south, Embu County which was estimated to be less than 5000 yellow passion fruit farmers according to Kamurugu development initiative field office statistics. In this study, the following formula was used to calculate the sample size(Kothari, 2004).

$n=\underline{z^2Pq}$ Where:

e^2

n= the desired sample size

q=1-p (1-0.05)

Z= the standard normal deviation at confidence level (95%) which is 1.96

e= acceptable error (precision)

P= is the proportion of the population with the desired characteristics in the target population which was 0.05 of the total population. The total population of Mbeere South constituency was 130,185 (National census 2009). Therefore, from the above formula the sample size was determined as follows.

$$\frac{1.96^2\ (0.05)\ (0.95)}{0.05^2} = 73$$

Computing the above equation gives an estimated sample size of 73. However due to some cases of incomplete questionnaires the sample size was boostedto 90, to reduce cases of non-response and spoilt questionnaires. A total of 79 questionnaires were used in the analysis.

3.4 Data analysis

The sweet yellow passion fruit production data such as cost of inputs for agrochemicals, fertilizer, irrigation, labour, and seedlings; farm size, amount of fruits harvested in Kilogrammes (Kgs), price of output per Kg sold either to middlemen, contracted buyers or at spot-markets; all these data helped in meeting

objective one which was to assess the profit efficiency of smallholder farmers. Famers' socio-economic and institutional factors such as gender, credit access, membership to a group, trust on trader price, access to market information, market channel, access to off-farm income, extension contact, farming experience, age of the farmer, level of education and household size data was collected to help in meeting objective two which was to determine the influence of socio-economic and institutional factors to profit efficiency.

Objectives one and two were analyzed simultaneously using stochastic frontier analysis (SFA) method by running the model on Frontier 4.1 version software. Data for the first objective was analyzed using the Stochastic Frontier Profit function model to determine the relationship between profitability and output, output price and input price. Profit efficiency of each selected farmer was also determined. Objective two was analyzed using an inefficiency model where profit inefficiency (μ) is the dependent variable while the inefficiency factors are the independent variables.

Using Frontier 4.1 version software and STATA, the stochastic frontier profit model that was used is as shown in equation 5:

$$Ln\pi = ln\beta o + ln\beta_1 Zli + ln\beta_2 P_{1i} + ln\beta_3 P_{2i} + ln\beta_4 P_{3i} + ln\beta_5 P_{4i} + ln\beta_6 P_{5i} + (vi-\mu i) \ldots\ldots\ldots\ldots (5)$$

Where:

π= normalized profit function computed as the total revenue less variable cost per output price, Zi= farm size (ha), P_1= normalized price of fertilizer (Kshs), P_{2i}= normalized price of labour (Ksh per man day of labour), P_{3i} =normalized price of seed (Kshs per Kg of seed), P_{4i}= normalized price of agrochemical (Kshs per litre of agro-chemical), P_{5i}= normalized price of irrigation (cost of irrigation water in Kshs/litre), βo=Intercept/constant, β_1-β_6= parameters to be estimated, µi= non-negative (Zero mean and constant variance) random variable called profit inefficiency effect associated with the profit efficiency of the ith farmers. The Inefficiency model is as shown in equation 6:

$$\mu i=\delta_0+\delta_1 G_{1i}+\delta_2 G_{2i}+\delta_3 G_{3i}+\delta_4 G_{4i}+\delta_5 G_{5i}+\delta_6 G_{6i}+\delta_7 G_{7i}+\delta_8 G_{8i}+\delta_9 G_{9i}+\delta_{10} G_{10i}+\delta_{11} G_{11i}+\delta_{12} G_{12i} \ldots\ldots(6)$$

Where:

µi= is the inefficiency of the ith farm

δ= Parameters to be estimated

G_{is}= The factors influencing inefficiency; these include gender, credit use, membership to a group or cooperative, trust on trader price, access to market information, market channel, access to off-farm income, extension contact & use, farming experience, age of the farmer, level of education, household size. This data was used in determining and in achieving objective two.

Lambda which is {σu/σv} was computed to evaluate the goodness of fit and also to determine the correctness of the specified normal half-normal distribution assumption. Further, gamma {γ} also referred to as variance ration that is $[\sigma^2u/\sigma^2u+\sigma^2v]$ or $[\sigma^2u/\sigma^2]$ was computed to evaluate the inefficiency level in the variance parameters that range from 0 to 1.

The analysis for objective one and two followed a three step estimation method using Frontier version 4.1 Software and STATA. The factors determining inefficiency were estimated by the use of the Maximum likelihood estimation method (MLE) using the frontier model which is the second stage approach. The MLE estimated all the parameters as it is mostly preferred due to its consistent estimates compared to Ordinary least squares (OLS)(Aigner et al, 1977). This was by running a multi regression analysis of the variables influencing inefficiency using MLE approach.

Objective three was analyzed by using STATA to derive descriptive statistics to measure.

The description of the hypothesized signs of the inefficiency variables $G_{is}$and expected signs are as follows:

Table 3: Hypothesized signs of variables

Variables	**Unit of measure**	**Expected sign to Profit Efficiency**
Age	No. in years	+/-
Gender	Male=1, Female=2	+/-
Level of education	Number of years of schooling	+/-
Household size	persons	+/-
Farming experience	Number of years	+
Extension contact	Number of trainings	+
Credit status	Yes=1, No=0	+/-
Membership to a farmer group	Yes=1, No=0	+/-
Access to market information	Yes=1, No=0	+/-
Access to off-sweet yellow income(income from other activities except SWY passion)	Kshs	+
Market channel	Channel used	+/-
Trust on trader price	1=Trusted 0=Mistrusted	+/-

CHAPTER FOUR: RESULTS

4.0 INTRODUCTION

This chapter reports the results of the study. Descriptive statistics and statistical inference has been used in the analysis. The descriptive statistics results for the production, socio-economic, institutional characteristics and profit efficiency scores are presented in this section. Further, validation tests, stochastic frontier profit function and the inefficiency model results are presented.

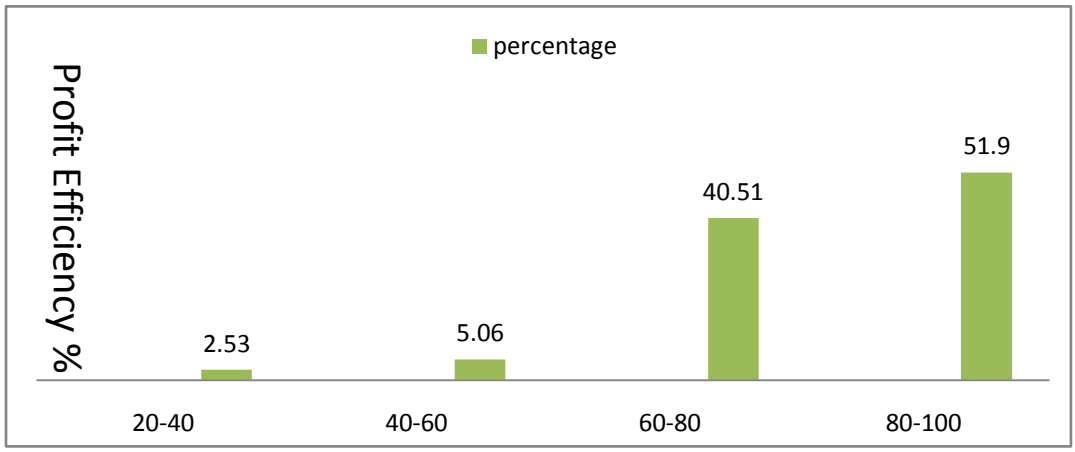
4.1 Profit efficiency descriptive results

The results of profit efficiency were analyzed and were computed by use of frequency percentages as presented in table 4 and figure 5.

In the study, 51.90% of the farmers attained over 80% profit efficiency levels. Only 2.53% of the farmers had recorded 20-40% profit efficiency levels, 5.06% of the farmers recorded a profit efficiency of 40-60% while 40.51% recorded profit efficiency of 60-80%. From the table it is shown that the mean profit efficiency was 77%, minimum of 23% and a maximum of 90% respectively.

Table 4: Profit Efficiency levels

Efficiency index	Frequency	Percentage
0.20-0.40	2	2.53
0.40-0.60	4	5.06
0.60-0.80	32	40.51
0.80-1.00	41	51.90
Total	79	100.00
Mean 0.77		
Minimum 0.23		
Maximum 0.90		
Standard deviation 0.12		



Source: Own survey, 2015

Figure 2: Profit efficiency range of sweet yellow passion fruit smallholder farmers in Mbeere South

4.1 Descriptive results of Socio-economic and Institutional characteristics of Mbeere South district

The socio-economic characteristics are age in years of the farmer, level of education, farming experience, extension contact, household size and non- sweet yellow passion income (income from other activities apart from sweet yellow production).

The age of the head of a household is considered an important factor in efficiency determination, since it determines if a household benefits from the experience of an older person or base its decisions on a risk taking attitude of a younger farmer. The age of the youngest farmer and the oldest farmer was 19 and 66 respectively.The mean age of the farmers was 43.09 implying that most farmers

from the sample were middle aged. Approximately 25, 46, 29% were youths (19-35), middle aged (36-50) and the elderly (>50) respectively.

Table 5: Descriptive results of Socio-economic and Institutional characteristics of Mbeere South Sub-County

Variable	Mean	Std. Dev.	Min	Max
Age in years	43.09	12.19	19	66
Level of education (years of schooling)	10.20253	3.770261	0	16
Farming experience (years)	2.040633	1.163393	.11	6
Extension contact (number of trainings)	2.696203	4.389248	0	30
Non-passion income (KShs.)	32,565.82	56,796.06	0	400,000
Household size (number of persons)	5.316456	2.267633	1	13

Source: Own survey 2015

The above table presents results for selected socio-economic variables descriptive statistics.

Another characteristic of importance is the level of education attained by the head of the household or decision making unit (DMU). It was measured as the total

number of years spent in school. The mean number of years spent in school was 10 years with a minimum of 0 and a maximum of 16 years. For 0 it means that some head of households did not gain any formal education while 16 years means that somehousehold heads had completed university education. However, considering the mean of 10 years, it means that most sweet yellow passion fruit farmers had acquired secondary school education basing it to the Kenyan education system. The respondents who were owners of sweet yellow passion fruit orchards constituted 72.2% males and 27.8% females.

The average household size was 5 persons;the smallest household had 1 person while the biggest household had 13 persons. The sampled farmers had a mean experience of 2 years farming experience on sweet yellow passion production, the least being0.11 and the highest being 6 years' experience of farming sweet yellow passion fruit. The average number of trainings or average of extension contact attended by farmers was 2.69, with the least being 0 and the maximum being 30. Sweet yellow passion fruit farmers were trained by governmental extensionists, farmer groups and Non-governmental extension officers such as the Wilmar company extension officers in which they mostly sold their fruits to.

In Mbeere South Sub-County, 72.2% of the sampled farmers were male while 27.8% were female. This suggests that in most households it is the men who control passion fruit production and thus the ones who are involved in decision making. Among the respondents, only 13% used credit in their sweet yellow

passion fruit farming activities. Of the 13% farmers who used credit; 5% accessed credit from throughlending models, 3% got their credit from microfinance institutions, 2% from cooperative societies and the others from commercial banks. The farmers who never used credit in their farming activities cited various reasons such as lack of collateral(23.9%), inaccessibility of credit (24.6%), high interest rates charged by banks (13%), lack of financial training (such as financial management) on credit (18%), 20%of the farmers did not feel the need for credit in their sweet yellow production activities.These results helped in meeting objective three.

In the study area, 93.7% farmers had access to off-farm income (non-sweet yellow farm income), while 6.3% had no access. The off- farm income (non-sweet yellow) ranged from 0 toKShs. 400,000 with a mean of KShs. 32,565 per month.

Table 6: Off-farm (Off-swy) economic activities

Economic Activity	***Percentage***
Miraa production	*40%*
Business	*22%*
Subsistence farming	*19%*
Formal employment	*18%*
Dairy farming	*1.3%*

The farmers engaged themselves in miraa farming to generate income. In the district, among the selected sweet yellow farmers; 39.7% were producing miraa, 21.8% were business people, 19.2% were subsistence farmers producing other crops such as maize, watermelons and tomatoes, 17.9% had formal employment while 1.3% engaged in dairy farming.

Results indicate that 64.56 sweet yellow farmers were members to a farmer group while 35.44 were non-members to any farmer group. The farming experience was averagely 2.04 years while the lowest experience in months was 11 while the highest experience was six years. This can be attributed to the fact that sweet yellow passion fruit farming is a new passion fruit variety and technology that is being adopted by farmers as an agribusiness venture.Approximately 67% farmers responded to have accessed agricultural marketing information in their agribusiness trading activities while the remaining percentage did not access any agricultural marketing information prior to trading their fruits. As shown in figure

3, it was found out that67% trusted accessed marketing information, and 33% mistrusted the accessed marketing information.

From the results, a high percentage of farmers trusted marketing information at 67%.

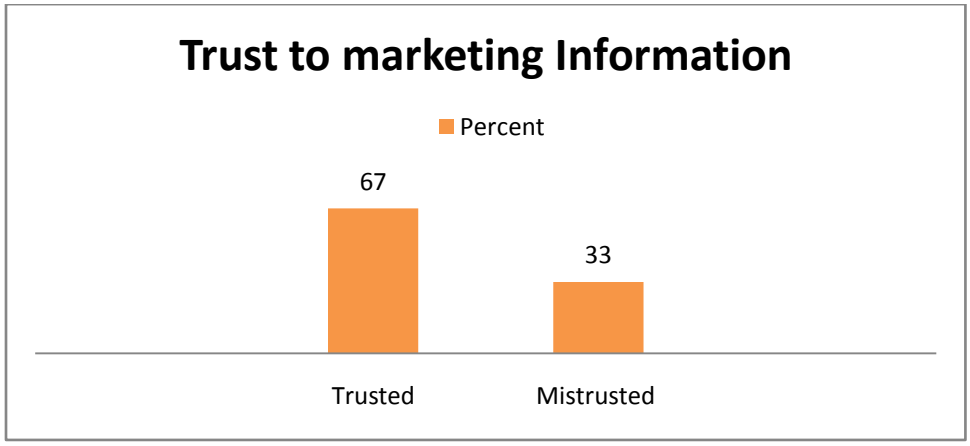


Figure 3: Trust on marketing information

From figure 3, the study area farmers' trust on the prices was that68% % trusted the prices while 32% mistrusted the prices.

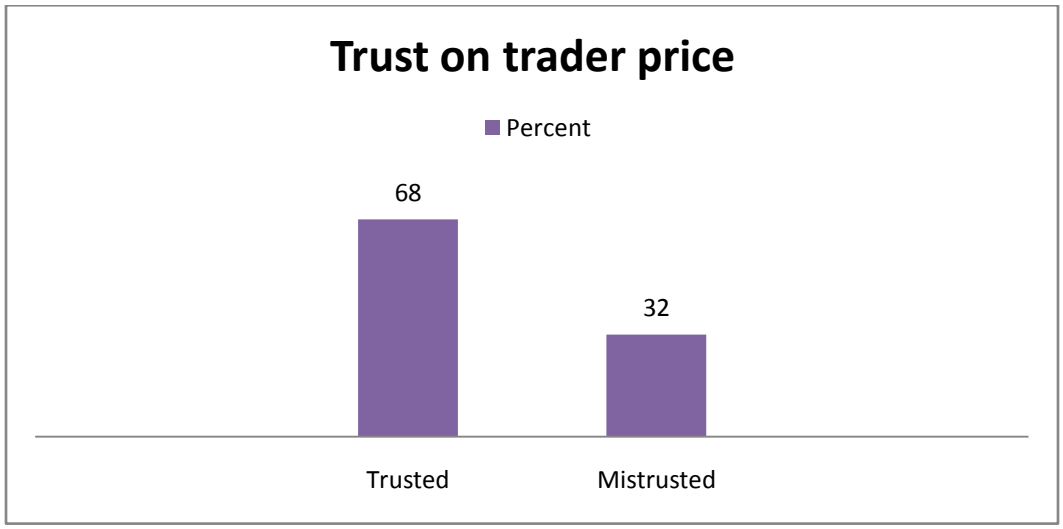


Figure 4: Trust on trader price

Marketing channel

The results indicated that 68% passion fruit farmers sold their fruits to more than one buyer. The most popular channels used were contracted buyer (Wilmar), middlemen and local buyers (at spot market) and sales at the farm gate.

Table 7: Marketing channel

Marketing channel	proportion (%)	Average price (Kshs)
Home/farmgate	16.550	
Middlemen	17.5	90
Spot market	17.560	
Contracted buyer	47.486	

Source: Own survey 2015

As shown in table 6: 47.4% of farmers sold their fruits to a contracted buyer (Wilmar), 17.5% sold their fruits to middlemen and spot markets, while 16.5% farmers sold their fruits at the farm gate to neighbours. From the table, farmers got an average price of 50 Kshs at the farm gate, 90 Kshs from middlemen, 60 Kshs at spot markets and an average price of 86 Kshs from a contracted buyer. The lowest price that was offered to farmers was Kshs 50, and the maximum price was

130Kshs while the average price was 76 Kshs. The best price was offered by the contracted buyer depending with the weight of the fruits of each farmer.

4.2 Normality Test

A kernel density function was plotted in Stata to assess the correctness of the normality assumption as shown in annex 3. A normal curve was then super imposed on the kernel density curve to test for normality as shown in annex 4. Therefore, the normality figure in annex 2 is a confirmation that μ had a normal distribution. Profit efficiency estimation in the study was therefore made possible.

4.3 Determination of profit efficiency

Stochastic frontier profit function model results

In the stochastic frontier profit function model of the study area, farm size under sweet yellow passion, cost of fertilizer, and cost of seedlings variables were significant. The log likelihood for the fitted model of the study area was -80.15 and the chi-square was 73.51 and strongly significant at 1% level. Farm size had a positive and significant relationship with sweet yellow passion fruit normalized profit at 5% significance level. The cost of fertilizer and cost of seedlings both had a positive relationship with normalized profit and were significant at 1% significance level. The cost of agrochemicals and the cost of irrigation had a negative relationship to normalized profit while the cost of labour showed a positive relationship.

The stochastic frontier profit function model results for Mbeere South district are as shown on table8 and annex 1.

Table 8: Stochastic frontier profit function results for Mbeere South

Variable	**Coefficient**	**Standard error**	**P>t**
lnfarmsize	.07**	.03	0.035
lncosfertilizer	.41***	.09	0.000
lncosagrochem	-.05	.10	0.589
lncosseedlings	.35***	.09	0.000
lncoslabour	.05	.07	0.479
lncosirrigation	-.10	.12	0.411
cons	8.12***	.52	0.000
lnsig2v	-1.76**	.53	0.001
lnsig2u	.37	.30	0.217
Variance parameters			
Sigma_V{σ_v}	.42	.11	
Sigma_U{σu}	1.20	.18	
Sigma2 {σ^2}	1.61	.38	
Lambda {λ}	2.89		
Gamma {γ}	0.89		
Log likelihood	-80.15		
Mean Profit efficiency	77%		

NB: Values in parentheses are t-ratios, ** significant at 5%, *** significant at 1%.

The profit efficiency (PE) of smallholder sweet yellow passion fruit farmers ranged from 23% to 90% with a mean PE of 77%in the study area. Therefore, the mean PE shows that a mean inefficiency of 23% was prevalent among the sweet yellow passion smallholder farmers in the study area. The

lambda {λ} value was 2.894 while the estimated gamma {γ} was 0.894 as shown in Table8 and Annex 1.

4.4 Factors influencing Profit efficiency among sweet yellow passion fruit farmers in MbeereSouth District

Farming experience variable was negative and significant at 5% while group membership variable was also negative but significant at 10% level of significance. Access to marketing information was negative and significant at 10% level of significance. In addition, age, level of education, extension contact, sex, market channel, and trust on trader price negatively influenced profit inefficiency. Household size, credit status and access to off- sweet yellow passion fruit income positively influenced profit efficiency.

Table 9: Inefficiency Model Results for Mbeere South

Variable	Coefficient	Standard error	P-value
Age	-.07	.050	.156
Gender	-1.02	1.06	0.336
Level of education	-.05	.13	0.722
Household size	.27	.18	0.145
Farming experience	-1.19*	.62	0.054
Extension contact	-.13	.09	0.158
Credit status	.67	1.15	0.559
Group membership	-2.77*	1.54	0.073
Trust on trader price	.07	1.81	0.930
Access to market information	-1.60*	.94	0.091
Access to off-swy income	2.01	1.49	0.178
Market channel	-1.10	1.03	0.288

Source: Own Survey 2015

4.5Comparison of Profit efficiency scores to selectedSocio-economic and Institutional Characteristics

The results of profit efficiency versus socio-economic and institutional characteristics are presented in table 10.

The age variable of farmers showed some different performance in terms of profit efficiency. Farmers between the ages of 18-29 were the least profit efficientat 73.79% while farmers between the agesof 49-56 had the highest profit efficiency level of 81.08% and were the most efficient. Male farmers had a profit efficiency of 79.34% compared to female farmers who had 70.43% profit efficiency; therefore male farmers were more efficient. Farmers who had formal education and those without formal education performed quite differently in terms of profit efficiency levels. Farmers without formal education had the least profit efficiency of 70.07%, those with primary education had 78.67% profit efficiency, those with secondary level education had 79.56%, those with tertiary (certificate/diploma) level of education had 75.91%, and those with university level of education had 74.78% profit efficiency. This therefore clearly indicated that farmers with secondary school education were more efficient.

Farmers who were members of a farmers' group association were more profit efficient (81.08%) than those who were non-members (69.16%). Farmers who had used/accessed extension services were more profit efficient (78.00%) than those who had not had any extension contact or used extension services (75.34%). Farmers who did not access market information were the most profit

efficient than farmers who accessed marketing information at 72.81% and 85.11% respectively. Farmers who did not have access to off-sweet yellow passion income were more profit efficient than those who had access to off-sweet yellow passion income at 76.79% and 77.84% respectively. Further, farmers who had accessed/used credit for sweet yellow passion fruit production were the most profit efficient at 79.05% compared to those who had not accessed/used credit at 76.54%.

Table 10: Comparison of profit efficiency scores to selected Socio-economic and Institutional characteristics

Variable	Description	PE%
Age (years)	18-29	73.79
	29-39	77.70
	39-49	75.52
	49-56	81.08
	>56	77.08
Gender	Male	79.34
	Female	70.43
Education level	No education	70.07
	Primary	78.67
	Secondary	79.56
	Tertiary (certificate/diploma)	75.91
University		74.78
Group Membership	Member	81.08
	Non-member	69.16
Extension contact	Used extension	78.00
	Didn't use	75.34
Access to marketing information	Access	72.81
	No access	85.11
Access to non-passion income	Access	76.79
	No access	77.84
Credit access	Access	79.05
	No access	76.54

Source: Survey, 2015

The above table presents a comparison of profit efficiency scores to socio-economic and institutional characteristics.

CHAPTER FIVE: DISCUSSION

5.0 Introduction

This chapter interprets the results generally and in great detail. This chapter also looks at the findings and tries to relate them to what has been reported in the literature with the purpose of evaluating the factors that possibly explain the observed outcomes in the study.

5.1 Determination of Profit efficiency

The log likelihood for Mbeere South and the study area model was different from zero while the chi-square value was strongly significant at 1% implying therefore that the explanatory variables that were used in the models collectively explained the variations in sweet yellow passion fruit profitability.

Three out of six production variables (farm size, cost of fertilizer, and cost of seedlings) significantly influenced sweet yellow passion fruit yield. It is therefore evident that the three variables were the major determinants of productivity and profit efficiency in the study area. This therefore means that their intervention has the ability to influence the resulting or resultant productivity and profit efficiency. The estimated gamma {γ} coefficient of 89%which is the variance of farm specific profit efficiency to total variance of the profit indicated that the variation in actual profit from maximum profit (profit frontier) among sweet yellow passion fruit farmers was mainly due to differences in farmers' practices, the one sided error (μ-which is the profit inefficiency); therefore 11%

was due to stochastic disturbance with the two sided error and not due to random variability.The large lambda value (λ) of 2.89 was also an indication that the one sided error term (μ) dominated the symmetric error (v). It also indicated goodness of fit and correctness of the specified normal/half-normal distribution assumption as observed by Karani (2013) and (Kibaara, 2005).

5.2 Estimates of the Stochastic Frontier Profit Function

The maximum likelihood estimates of the parameters of the stochastic frontier profit function are presented in table7. From the MLE estimates, the coefficient estimates of farm size (ha) and fertilizer were both statistically significant at 5% and 1% respectively. The cost of fertilizer was the most important variable determining profit efficiency. The normalized cost of fertilizer is positive and significant at 1% significance level, this therefore means that with a unit increase in inputs with positive coefficients will lead to an increase in the normalized profit of sweet yellow passion fruit and the reverse is true. The cost of fertilizer had a coefficient of 0.405, therefore implying that for every 1% increase in the expenditure on fertilizer, profit would increase by 0.405%. The cost of seedlings was also found to be positive with a coefficient of 0.349 and significant at 1%. This means that an increase in expenditure on seedlings would positively lead to profit efficiency by 0.349%. Farm sizewas significant at 5% level of significance and its coefficient was positive implying that an increase on farm size under sweet yellow passion fruit production would lead to increased profits. The cost of agrochemical, irrigation and expenditure on labour were found not to be

significant. The cost of agrochemicals and the cost of irrigation had a negative relationship to normalized profit whereas the cost of labour showed a positive relationship to normalized profit.

5.3 Factors influencing efficiency

The parameter estimates of the influence of socioeconomic and institutional characteristics on profit efficiency are presented in table 8. The results of the factors explaining inefficiency were computed by the maximum likelihood estimation model by running the second stage of the model.The results of the inefficiency coefficients show either a negative or positive sign that indicates the effect of the variable on efficiency. Hence, a negative sign indicates that the presence of the variable has a decreasing effect on inefficiency while a positive sign indicates an increasing effect on inefficiency. All variables that were hypothesized were run in the model.The results of the analysis of the inefficiency model show that farming experience, group membership, and access to marketing information variables had negative coefficients and were significant at 5 and 10% respectively therefore implying that the variables had a positive influenceon profit efficiency. This result agrees with those of Nmadu & Garba(2013) who found out that as farming experience increases, profit inefficiency of spinach farmers in Nigeria decreases. Therefore, it means that as these variables increases, the profit inefficiency of the sweet yellow passion fruit farmers with high levels of farming experience and group membership show less loss of profits than those without.

Hence they are able to perform significantly better in operating at higher levels of efficiency.

For every transaction to take place, trust is an essential factor that is needed more so where the need for market information is required for an efficient functioning of the horticulture industry. Trust on market availability in the fruits sector by smallholder farmers is of great importance. Access to market information was negative and significant at 10% level. This implies that as a farmer's access to market information increases, the profit inefficiency of the farmer also decreases(hencetheir efficiency levels increases). This resonates well with theoretical expectations that states that access to marketing information increases profit efficiency. It was expected that as farmers' access to market information increased, they would make more informed decisions as stated byMagesa et al., (2014) when it comes to the marketing/sale of their fruits and thus benefiting from the information accessed than those who did not have access to market information. Access to market information also helps in reducing transaction costs of farmers that tend to lower their profit levels. According to FAO (2015), timely market information on agricultural commodity quantities and prices play a significant role in the reduction of risks associated with loss of money in a market transaction since such high risks lead to higher marketing costs and high margins are required to compensate for the losses.Therefore, since this was the case, it

appears that the farmers did use the market information to their advantage and that the source of their information was quite reliable, trustworthyand up-to-date.

The farmers'level of education which was measured in the number of years spent in school had a negative coefficient as was hypothesized implying that it decreased profit inefficiency thus increasing profit efficiency of the farmers. This results were consistent with those of Ogunniyi (2011) who found a statistical significant correlation between education and profit efficiency of maize farmers in Oyo state, Niger. This therefore means that farmers with more years of education obtain higher levels of profit efficiency than farmers with less years of education since they are able to seek more information on new technologies and farming practices to improve their profitability.

Age of farmers had a negative coefficient indicating that there was a negative relationship between age of the farmer and profit inefficiency. This implies that older farmers were able to decrease their inefficiency thus increase their efficiency more than the young farmers. This is in agreement with theory as farmers with more age gain from experience and are able to improve their productivity. These results are in contradiction with Abdulai & Huffman (1998) and Nmadu & Garba, (2013) who found age to be positive and significant in rice farmers in North Ghana and smallholder spinach farmers respectively.

Extension contact was also found to be negatively influencing profit inefficiency meaning its presence increased profit efficiency levels of farmers. This results contradict those of Ojo et al., (2009) who found extension contact to have a positive coefficient and therefore to positively influence profit inefficiency but they however conform to those of Nmadu & Garba, (2013) who found extension contact to be negatively significant among smallholder spinach farmers in Niger state in Nigeria. These results therefore imply that as farmers got more extension contact, they were able to improve their profit efficiency. However, farmers don't need too much extension contact from providers to be more efficient. Farmers who get at least three trainings and then implement what they have been trained on can still be able to attain high profits, otherwise without implementing what they have learnt; extension will lack meaning to them.

Gender had a negative coefficient and therefore had a negative relationship with profit inefficiency by increasing inefficiency. This is in line with Nmadu & Garba(2013) who found sex of smallholder farmers to be negative and statistically significant. From the descriptive results it is shown that there were more profit efficient male farmers than female farmers. It can therefore be deduced that male farmers are able to reduce inefficiency and increase their profit efficiency better than their female counterparts.

Trust on trader price also showed a negative relationship to profit inefficiency meaning that farmers who had more trust in the prices being offered

by the buyers increased their profit efficiency than those who did not. This is because with trust, farmers were willing to create good working relationships with traders and thus sell more produce based on their farm output quantities. Market channel had negative coefficient thus decreased profit inefficiency and thereby increased the sweet yellow passion fruit farmers' profit efficiency. Farmers used middlemen, contracted buyer, spot market, and co-operative society and farm gate points of sale. This therefore implies that farmers chose only those channels with better prices thereby improving their returns.

Household size had a positive influence to profit inefficiency meaning that it increased inefficiency of sweet yellow passion fruit farmers therefore reduced their profit efficiency levels. This contradictsOjo et al., (2009) who found household size of small-scale cowpea farmers negative and statistically significant but in line with Oguniyi, (2008) who found household size of cocoyam producers in Osun state, Nigeria positively significant implying that families with large family sizes obtained less profits than small families. This contradicts theory since it is expected that large family sizes are able to offer family labour thereby reducing the cost of labour. This could indicate that such large family sizes prove to be a constraint to the achievement of higher profits as the income gained from income generating activities is used up in meeting the many needs of the large household size therefore exhausting the financial resources which could be used to

buy better inputs for farm production and which could be used to maintain and expand the passion fruit enterprise.

Credit access had a positive coefficient indicating a positive relationship with profit inefficiency where it increased inefficiency and hence decreased profit efficiency. This is consistentwithOguniyi(2008) and Ali & Flinn, (1989) who found credit unavailability to significantly contribute to the loss of profits of cocoyam producers in Osun state, Nigeria and among basmati rice producers in Pakistan, Punjab respectively. The results are consistent to Abu et al.,(2012) who found credit access to be positively significant among sesame farmers in Nasarawa state, Nigeria. This implies that farmers who accessed credit had low profit efficiency levels. This contradicts theory as it is expected that farmers who access credit for agricultural production do so in order to improve their productivity. Therefore it is an indication that thefarmers did not use the accessed credit on sweet yellow passion fruit production.Farmers who accessed credit should have used the credit in meeting the costs of production and orchard maintenance since sweet yellow production is an investment intensive enterprise since it requires the use of financial resources in buying inputs such as fuel used in irrigation, fertilizer, agrochemicals and in meeting labour costs.

Access to off-farm (non-sweet yellow passion) income had a positive relationship to profit efficiency. The variable had an increasing effect on the farmers' profit efficiency thereby reducing their profit efficiency levels.

Theseresults are consistent to those of Ogunniyi(2011) who found off-farm income of maize producers in Oyo, state Nigeria to be positively significant but are in contradiction to Abu et al., (2012) who found access to off sesame farm income to be negatively significant to profit efficiency. This therefore implies that the farmers who had access to off-sweet yellow passion fruit farm income obtained lower profits. This contradicts theory as farmers who access off-farm income are able to purchase productive inputs and invest in their farm hence lead to the achievement of higher profits.

5.4 Comparison of Socio-economic and Institutional characteristics to Profit efficiency

The results obtained showed that farmers who were between the ages of 49-56 were more profit efficient than their younger counterparts. This can be understood to mean that farmers with more age are able to maximize their profits and minimize their production costs due to experience gained over more years of agricultural production compared to young farmers. Male farmers were found to have attained more profits than female farmers. This can be attributed to the fact that in most households, it is men that solely make decisions concerning their farms' production activities plus productive resources. In most rural settings it is the males that own all the land that could be used as collateral, most have gone to school compared to women and can access extension more than female farmers who mostly have numerous workloads that hinder them from going to trainings.

This therefore places female farmers at a great disadvantage in attaining higher profit efficiencies.

Level of education influences efficiency either in quality or quantity terms. It also boosts the levels of new technology adoption by farmers (Oladeebo & Oluwaranti, 2012). Farmers who had formal education up to secondary school level were more efficient than those who did not, or had primary level education, tertiary and university education. It therefore means that farmers with secondary school education were able to manage their sweet yellow passion fruit orchards better and minimized their costs, made proper decisions on their farming practices. On the other hand, farmers who had tertiary/university education had less efficiency mainly because they did not use their wide education in managing their farms or they let their workers manage their farms without proper guidance to ensure good yields that bring better profits. This contradictsAssa et al., (2012) who found out that more years spent in education led to higher profit efficiency.

Involvement in farmer groups as a form of collective action holds greater benefits for farmers. The farmers who were members to groups enjoyed benefits such as training, market information, and savings. Farmers who were members to groups or farmer associations were found to exhibit higher and better profit efficiency levels of 81.00% than those who were not. This is because through famer groups or associations; farmers are able to collectively make savings from which they can grant each other loans to improve their farms, get trained since it is

easy for most extension service providers and other business development service providers to access them due to reduced transaction costs in locating each and every individual and bringing them together. This is because most farmers were widely spread thus being in groups reduced transaction costs. Farmers in groups also were able to access and share market information, and group savings which they used to boost their farming activities.

Access to and use of extension services by farmers showed higher profit efficiency levels compared to farmers who did not access or use extension services. This is consistent with Nmadu & Garba, (2013) whose results showed that extension contact had theeffect of improving profit efficiency among smallholder spinach producers. Further, farmers who had access to marketing information showed less profit efficiency levels compared to their counterparts who did not access marketing information. This implies that the ones who did access marketing information did not use it to their advantage to improve their efficiency. Farmers with marketing information are able to make important decisions when it comes to selling their produce, when to store and which market to take their fruits to. Information also helps farmers in negotiating for a better price from brokers or unscrupulous traders who are out to exploit them.

No access to off-farm (sweet yellow passion) income showed higher efficiency as compared to access to off-farm (sweet yellow) income. Farmers who had no access to off-farm (sweet yellow) income were more profit efficient than

their other counterparts. This is an indication that the farmers who did not have any other source of income took more care of their orchards to ensure their profitability while those who had other sources of income did not take good care of their orchards but left them under the care of workers. It would have paid more to always supervise the work being done by the workers. It also means that the association with other income generating activities apart leads to misallocation of time to sweet yellow passion fruit. The results contradict theory that access to off-farm income leads to increased efficiency as the income is invested in the farm in buying inputs and maintaining it.

Credit access had high profit efficiency while no access to credit had low efficiency levels. This suggests that farmers who access credit to buy proper agricultural inputs such as high yielding seeds,fertilizer, agrochemicals, technologies and other production inputs are able to increase their efficiencies. These results contradict Abdulai & Huffman, (1998), who reported that access to credit lowers profit efficiency. Therefore it is important for farmers to take loans to improve their farms' productivity. The use of credit/loans has the impact of boosting agribusiness activities such as value addition, transportation of output and input from the farm to the market and from the agro dealers to the farm respectively. Sometimes farmers are forced to buy food items and inputs at times when prices are high; with agricultural loans they can be able to meet financial barriers and thus enhance their farms' profitability.

5.5 Profit efficiency estimates of the farmers

The profit efficiency ranged from 0.23 to 0.90 for the worst and best practiced farmer respectively and with a mean of 0.77 in the study area. This mean indicates that the sweet yellow passion fruit farmers could improve their profit efficiency by 23% if they improved their technical and allocative efficiencies. This is an indicator that the sweet yellow passion fruit farmer has an opportunity to improve and increase their farm income thus improving their living standards and reducing poverty. Despite the variation in the efficiency estimates, these results are similar to those of (Tsue et al., 2012). They are also similar to Rahman(2003), who found out that the mean efficiency of rice farmers in Bangladesh was 0.77 and also similar to Bamiro et al., (2013) who found the mean profit efficiency of poultry farmers to be 0.72 with a minimum of 0.11 and a maximum of 0.97 efficiency level. These indices imply that farmers were not using production resources efficiently in order to achieve higher profits.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the conclusion and recommendations from this study. The conclusions have been based on the findings of each objective. The recommendations are based on identified gaps and are targeting the farmers, policy makers and other researchers-private and public.

6.1 Conclusion

The primary objective of this study was to assess the profit efficiency levels of smallholder farmers in Mbeere-South, Embu County. This study employed a stochastic frontier profit function approach to evaluate the efficiency of sweet yellow farmers in terms of profit in the study area. The Frontier 4.1 software, stochastic frontier analysis (SFA) estimateresults showed that profit efficiency levels of farmers ranged between 0.23-0.90 (23%-90%), while the mean efficiency level was 0.77 (77%). This therefore suggests that there is room for improvement by the average farmer by 23%, so as to operate at the frontier level by improving their technical and allocative efficiencies.

The cost of fertilizer was the most important significant variable determining profit efficiency. Farm size (ha) and cost of fertilizer were both statistically significant factors of production implying that they also had a significant influence to sweet yellow passion fruit profitability. The cost of

agrochemicals, irrigation and expenditure on labour were found not to be significant.

Group membership was found to influence profit efficiency since most farmers who were members of groups showed higher profit efficiency levels. Farming experience was also found to positively influence profit efficiency while access to market information was found to negatively influence profit efficiency.

The average normalized profit in the study area was 32,565 Kenyan shillings by the sweet yellow passion fruit farmers. It was also found that most farmers sold their fruits to a contracted buyer (Wilmar), thereby implying that contracted buyers were the most preferred buyer.

6.2 Recommendations

In view of the fact that the results showed that profit efficiency was significantly influenced by group membership, farming experience, and marketing information, policies targeting these variables could play a significant impact to improve the productivity and profitability of sweet yellow passion fruit farmers.

One important area that could be considered for further study is on the value of marketing information in the passion fruit sub sector. This is because it was found that most farmers who accessed marketing information registered low levels of efficiency compared to those who did not. Credit access and use by sweet yellow passion fruit farmers to invest in their agribusiness enterprise should be adopted. This is more so since the passion fruit sub-sector is a highly capital

intensive enterprise and therefore need financial capital.Farmers should be sensitized through their farmer groups/associations or and by the ministry of agriculture or their county governments in order for themto be able to know the importance of farm credit and its significance in combating poverty and hunger in semi-arid areas like Mbeere area. Therefore, credit access and use by sweet yellow passion fruit farmers should be enhanced to meet the start-up and running costs of the enterprise,and then their productivity levels would be improved.

Participation by women farmers in sweet yellow passion fruit should be encouraged. Gender disparity issues and discrimination by their male counterparts should be discouraged and women should be sensitized and empowered to take up economic activities such as sweet yellow passion fruit farming. This would reduce the low levels recorded by female farmers and their low profit efficiency level. Productive resources should also be allocated to women to enable them play a significant role in improving their families' living conditions. Further, if more women are trained on sweet yellow passion fruit agribusiness enterprises; decision making in their families would increase and hence their participation in economic activities such as sweet yellow passion fruit farming.

Another area that could be taken up for further research would be on the 'analysis of the sweet yellow passion fruit supply chain and governance'. This would bring out the main players in the value chain, how much power they possess

in influencing decisions such as prices of the fruits and how their decisions affect all the other players in the chain.

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Appendices

Passion Fruit Trend on Exports

Country	2006	2007	2008	2009	2010	2011	2012	2013
Uganda	1,129	470	453	2,431	2,014	1,258	1,107	647
Rwanda	-	-	0	60	38	39	37	36
Others	521	665	559	325	582	994	585	753

Figure 6: Volume of Regional Exports in MT

Source: Kenya National Bureau of Statistics and compiled by KHCP (2014).

QUESTIONNAIRE

This questionnaire will be used to generate information for academic purposes only and the information obtained from the respondent will remain confidential.

1. **Identification**

i. Division_____ Sub-location_____ Village_____

ii. Date…… starting time…… End time……

2. Farmers Name……
   Tel:.....
3. **Background information**

i. Are you the head of this household?

Yes	1	No	2

ii. If No, who is the head of the household?

…….

iii. **Sex :** Male☐ Female☐

iv. What is the highest level of education you have completed?

IF RESPONDENT IS NOT HEAD OF THE HOUSEHOLD AT Q9 THEN ASK:

v. What is the highest level of education the **head of your household** has achieved?

	Q9	Q10
No formal schooling	01	01
Some primary schooling	02	02
Primary school completed	03	03
Some secondary school	04	04

Secondary school completed	05	05
Post secondary qualifications, other than University e.g diploma/certificate	06	06
Some University	07	07
University completed	08	08
Post-graduate	09	09
Don't know[**do not read**]	98	98
Refused [**do not read**]	99	99
Determine total number of years spent in school		

vi. How many people live in this household?

vii. Which of the following age groups do you fall into?

18-24	1
25-30	2
30-34	3
35-40	4
41-44	5
45-50	6
51-55	7
56+	8
Don't know [**do not read]**	**98**
Refused [**do not read]**	**99**

4. For how many years have you been growing sweet yellow passion?

5. How many trainings on sweet yellow farming have you attended since January 2014?……..

6. Who were the facilitators of the trainings you attended?

Government extension officers	

Non-governmental extension officers	
Farmer group	
Others (specify)	

7. What kind of information did you receive?

_____

_____

_____

8. What is the cost of the following inputs?

Input	**Cost per unit of input(e.g per Kg)**	**Number of units used monthly**
Fertilizer		
Agrochemical		
Seedlings		
Labour		
Irrigation water		

9. Production

	Amount produced	Total output	Consumed	Given to workers	Sold	Type of buyer	Prices per unit	Amount received
Weekly								
Bi-weekly								
Monthly								

10. What size of your farm is under yellow passion fruit cultivation in (acres) ?.....
11. Buyers

Buyer	**Unit of measurement**	Price per unit	Trust market information	Trust Price	Trust unit of measurement	Cost involved in sale
Spot market						
Wilmar(institutions)						
Middlemen						
Cooperative						
Farmer group						
Processor						

Trust- highly trusted, trusted, untrusted, very untrusted

Unit of measurement- Kgs, pile of four, others (specify)

12. **Marketing information**.

A

Type of information	Source	Cost involved	Amount
Price			
Quality			
Market availability			

Source: 1. Neighbours/friends/traders 2. Media 3. Government extensionists/Research institution 4.None 5. Others (specify)……

Cost: 1. Calling 2. Buying information, 3.Subscription, 4. Opportunity cost of time

B

Do you have access to market and price information?

Yes	**1**	**No**	**2**

13. **Institutional arrangements**

Type of institutional arrangement	**Tick**	**Costs involved**	**Unit costs**	**Total costs**
Spot market				
Contract				
Membership to a group/cooperative				
Access to off-farm income				
Trust on trader price				
Early application of fertilizer				

Length of Supply Chain

i. Do you sell your fruits directly to consumers at:

- Home/farmgate ☐
- Middlemen ☐
- Spot Market ☐
- Cooperative society ☐
- Contracted buyer ☐

14. Do you sell your fruits at the farm gate?

Yes	1	**No**	2

If No, do you take your fruits to the market?

Yes	1	**No**	2

If Yes, what is the distance to the market in Kms?.....

How much do you incur to transport your produce to the market?.....

15. **Groups**

Do you belong to any group?

Yes	1	**No**	2

If yes, fill the following table.

Type of group	**Tick**
Passion fruit group	
Self-help group	
Cooperative	
None	

If respondent belongs to a group, **ASK.**

What benefits do you get from the group?

Passion fruit marketing	
Input procurement	
Training	
Security for credit	
Market information	
Savings	
None	
Others(specify)	

16. What are the main activities your group is involved in?

Yellow passion fruit production	1
Marketing activities	2
Merry go rounds	3
Processing (value addition) of yellow passion	4
Savings	5
Others (specify)……..	

17. Do you use credit on your farm?

Yes	1	**No**	2

18. If**Yes**, what are your sources of credit?

Co-operative society	1
Commercial banks	2
Group lending	3
Micro-finance firms	4

Marketing agent	5
Others (specify)……	

19. Is the credit obtained adequate?

Yes	1	**No**	2

20. If No, what are the reasons for not using credit on sweet yellow passion fruit farming?

Lack of collateral	1
Inaccessibility of credit	2
High interest rate charges by banks	3
Lack of financial training on credit	4
Don't need credit for passion fruit farming	5
Other	

21. What challenges do you face in the production of sweet yellow passion fruit?

Challenges	**Tick**
Lack of agrochemicals	
Lack of funds	
High cost of inputs	
Pests and diseases	
High cost of labour	
Lack of market information	
Drought/inadequate water for irrigation	
Inadequate/lack of extension services	
Price fluctuations	
Technology too complex	
No farmer associations	

22. Do you have any other source of cash for passion fruit farming?

Yes	1	**No**	2

23. Other sources of income (cash).
    1. Employment 2. Business 3. Dairy 4. Miraa 5. Others (specify)…….
24. Approximately, how much do you earn per month/year from all other activities excluding (on sweet yellow passion income)?.....

THANK YOU SO MUCH FOR YOUR TIME

Annexes

Annex 1: Stochastic frontier profit function results for Mbeere South district

Variable	Coefficient	Standard error	P>t
lnfarmsize	.07**	.03	0.035
lncosfertilizer.41***	.09	0.000	
lncosagrochem	-.05	.10	0.589
lncosseedlings	.35***	.09	0.000
lncoslabour	.05	.07	0.479
lncosirrigation	-.10	.12	0.411
cons	8.12***	.52	0.000
lnsig2v	-1.76**	.53	0.001
lnsig2u	.37	.30	0.217
Variance parameters			
Sigma_V{σ_v}	.42	.11	
Sigma_U{σu}	1.20	.18	
Sigma2 {σ^2}	1.61	.38	
Lambda {λ}	2.89		
Gamma {γ}	0.89		
Log likelihood	-80.15		
Mean Profit efficiency	77%		

NB: Values in parentheses are t-ratios, ** significant at 5%, *** significant at 1%.

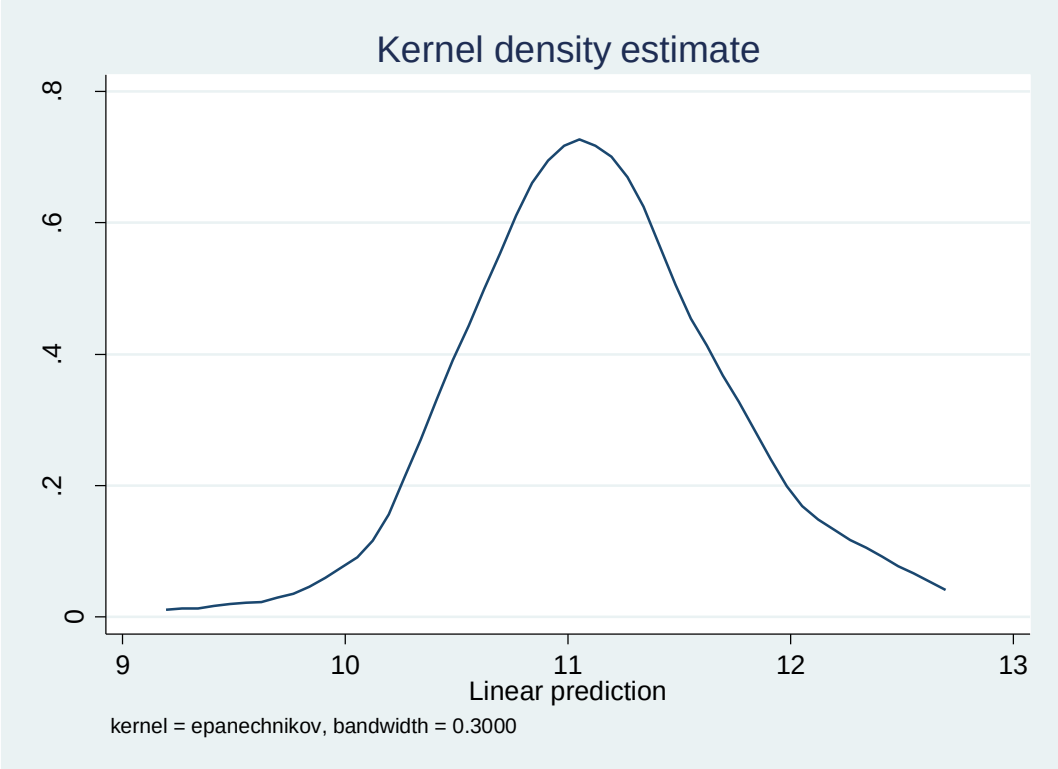
Annex 2: Inefficiency Model Results for Mbeere South District

Variable	Coefficient	Standard error	P-value
Age	-.07	.05	0.156
Gender	-1.02	1.06	0.336
Level of education	-.05	.13	0.722
Household size	.27	.18	0.145
Farming experience	-1.19*	.62	0.054
Extension contact	-.13	.09	0.158
Credit status	.67	1.15	0.559
Group membership	-2.77*	1.54	0.073
Trust on trader price	.07	.81	0.930
Access to market information	-1.60*	.94	0.091
Access to off-swy income	2.01	1.49	0.178
Market channel	-1.10	1.03	0.288

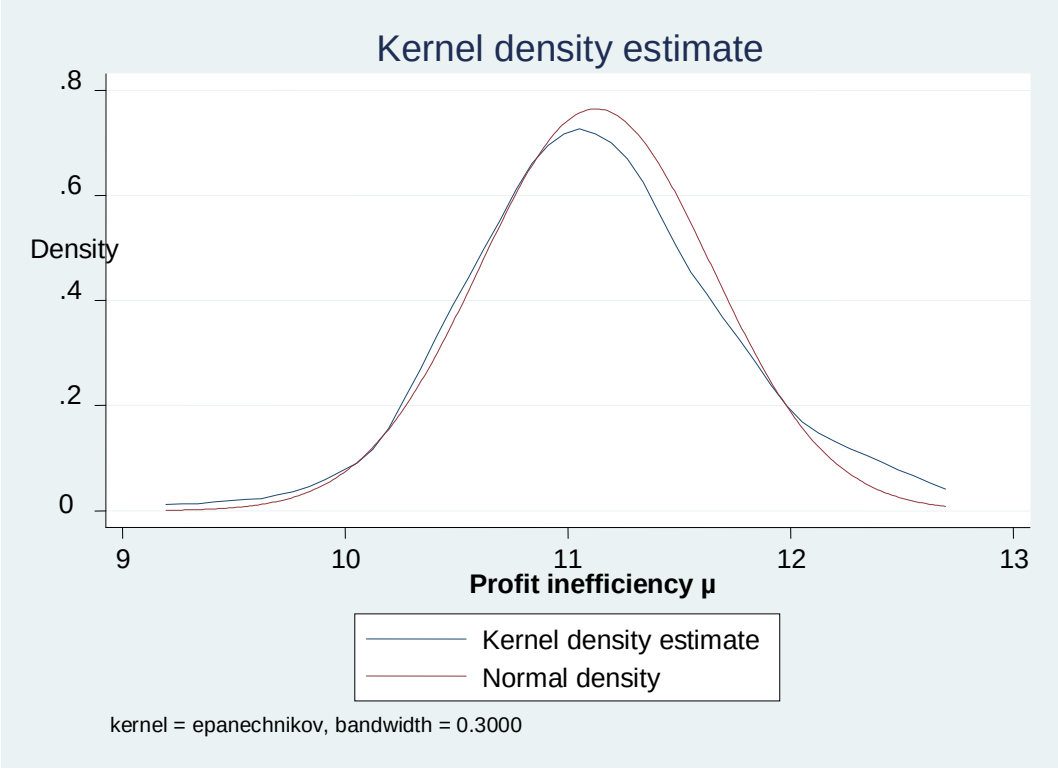
Source: Own Survey 2015

NB: Values in parentheses are t-ratios, ** significant at 5%, * significant at 10%.

Annex 3: Kernel density estimate



Annex 4: Kernel density super-imposed on normal curve



Annex 5: Individual Profit efficiency levels of sweet yellow passion fruit farmers in Mbeere South.

Farmer	PE	Farmer	PE	Farmer	PE	Farmer	PE
1	0.50	21	0.83	41	0.75	61	0.88
2	0.56	22	0.84	42	0.75	62	0.87
3	0.71	23	0.83	43	0.78	63	0.61
4	0.76	24	0.84	44	0.80	64	0.64
5	0.78	25	0.84	45	0.81	65	0.67
6	0.78	26	0.85	46	0.83	66	0.69
7	0.82	27	0.85	47	0.85	67	0.70
8	0.86	28	0.86	48	0.85	68	0.73
9	0.87	29	0.88	49	0.86	69	0.73
10	0.39	30	0.88	50	0.86	70	0.74
11	0.49	31	0.88	51	0.88	71	0.79
12	0.57	32	0.90	52	0.89	72	0.81
13	0.72	33	0.23	53	0.90	73	0.83
14	0.72	34	0.61	54	0.90	74	0.84
15	0.75	35	0.64	55	0.71	75	0.85
16	0.76	36	0.65	56	0.74	76	0.86
17	0.77	37	0.65	57	0.80	77	0.87
18	0.79	38	0.68	58	0.81	78	0.87
19	0.81	39	0.70	59	0.82	79	0.90
20	0.82	40	0.74	60	0.85		