

**PARTICIPATION OF SMALLHOLDER AVOCADO FARMERS IN CONTRACT
FARMING AND ITS EFFECT ON INCOME IN KANDARA DISTRICT, KENYA**



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**A Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements
of the Award of Master of Science Degree in Agricultural and Applied Economics of
Egerton University**

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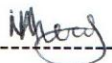
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DECLARATION AND APPROVAL

DECLARATION

I declare that this thesis is my original work and to the best of my knowledge has not been presented for any degree at any other university.

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Date-----18/10/2013-----

APPROVAL

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DEDICATION

This work is dedicated to Fr. Kombo Livingstone Peshu, for his unending financial assistance towards my studies. To my dad, Ezekiel Mwambi Mnyamwezi and mum Prudence Kambe Mwadime, for their sacrifice, inspiration, love and continued support throughout my schoolwork.

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ABSTRACT

Contract farming is seen by its proponents as a tool for creating new market opportunities as well as for providing credit and training, leading to increased smallholder farmers' incomes. Critics, however, argue that contract farming encourages unequal bargaining relationships with agribusiness firms and is likely to pass risks to farmers, thus favouring large scale farmers at the expense of smallholders. Another school of thought contends that the effect of contract farming on the livelihoods of smallholder farmers is context specific and depends on the enterprise in question. Yet, there is a dearth of empirical evidence from such studies in Sub-Saharan Africa. This study used data collected in 2012 from 100 smallholder avocado farmers in Kandara district in Kenya, obtained using multistage technique, to determine the socioeconomic attributes of contract and non-contract farmers. To control for unobservable characteristics that might affect participation, Heckman two stage model was used to assess the factors that influence smallholder avocado farmers' participation and their extent of participation in contract farming. Further, because of lack of pre-treatment data and the possibility of selection bias due to observable characteristics, propensity score matching technique was used to construct controls for the treatment group. The results indicated that contract and non-contract farmers had significant differences in gender, access to credit and education. Further, smallholder avocado farmers' membership in agricultural group, access to credit, number of trees, proximity to a leader in Avocado Growers Association of Kenya (AGAK), perception of price of avocado offered under contract and perception of the ability of contracts to offer ready market were significant in influencing households' decision to participate in contract farming. Findings also showed that contract farming does not improve smallholder farmers' income. Instead, support services such as interlinked credit and provision of information should also be taken into consideration in contract farming because of their potential benefits for smallholders.

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LIST OF ABBREVIATIONS

AGAK-Avocado Growers Association of Kenya
ATE-Average Treatment Effects
ATT-Average Treatment effect for the Treated
ATU-Average Treatment effect for the Untreated
CF-Contact Farming
CIA-Conditional Independence Assumption
EAG-East African Growers
GDP-Gross Domestic Products
HCPA-Horticultural Crop Production Authority
IMR-Inverse Mills Ratio
KDLC-Kenya Development Learning Corporation
KM-Kernel Matching
KTDA-Kenya Tea Development Authority
LR-Likelihood Ratio
NGO-Non Governmental Organization
NNM-Nearest Neighbour Matching
OLS-Ordinary Least Square
PSM-Propensity Score Matching
RBA-Revenue Benefit Authority
RM-Radius Matching
UNCTAD-United Nations Conference on Trade and Development

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture is the backbone of the Kenyan economy with an annual direct and indirect contribution to Gross Domestic Product (GDP) of 24% and 27%, respectively (National Horticultural Policy, 2010). Within agriculture sector is the horticulture sub-sector which has grown over the past few years to become a major foreign exchange earner, employer and contributor to food needs in the country. This growth is attributed to the country's favourable climatic conditions (HCPA, 2010). The sub-sector employs approximately 4.5 million people countrywide directly in production, processing, and marketing while another 3.5 million people benefit indirectly through trade and other activities (KDLC, 2010). Horticulture is the largest subsector in agriculture contributing 33% of the agricultural GDP (agGDP) and 38% of export earnings (Agricultural Sector Development Strategy, 2010-2020, 2010). Other subsectors include industrial crops which contribute 17% of the agGDP and 55% of agricultural exports, food crops contributing 32% to the agGDP and only 0.5% of exports and the livestock sub sector which contributes 17% of agGDP and 7% of exports (Agricultural Sector Development Strategy, 2010-2020, 2010). Out of the total horticultural sector production, 96% is sold domestically while only 4% is exported (National Horticultural Policy, 2010).

The horticulture subsector is characterized by a tremendous diversity in terms of farm sizes, variety of produce and geographical area of production. Horticulture enterprises include flowers, vegetables, fruits, nuts and medicinal and aromatic plants. Farm sizes under horticulture production range from large-scale estates to small-scale farms usually under one acre (KDLC, 2010). Up to 80% of horticultural production in Kenya is undertaken by smallholder farmers who concentrate on fruits and vegetables with the successful production of some of these requiring satisfactory contractual arrangements with an exporter or processing firm (KDLC, 2010).

Production of fruits in Kenya is favoured by the country's tropical and temperate climates. In the coastal areas of Kenya, fruits such as mango, bananas and melons are grown. In the middle altitudes avocado, mango, bananas, pineapple, passion fruit, papaya and citrus are cultivated. At higher elevations avocado and the more temperate fruits such as pears, apples and plums are found (HCDA Marketing Newsletter, 2010). The bulk of the fruits are sold either as fresh produce or processed products on the local or regional market. Fruit exports account for 35% of the total value of the Kenya fruit market and as such are of major

significance to the Kenya fruit producers and exporters. Overall, volume of fruit exports in 2011 increased by a large margin of 41.1% in quantity and 51.7% in value (HCPA, 2010). This was attributed to increased demand for fruits in the European markets. Though the sector's contribution to export market is significant to the country's economy, HCDA Marketing Newsletter (2010) indicated that of the total Kenyan fruit production only 1% is exported while the other 99% of the fruits produced are consumed locally.

Avocado production in Kenya began in the 16th century. By 1939, improved cultivars such as Puebla, Nabal, Lyon, Lula, Linda and 2 strains of Fuerte were introduced (Griesbach, 2005). The main avocado varieties currently grown for export are Hass (20%) and Fuerte (80%) (Mellado and Ferrari, 2011). About 70% of the fruit is grown in Central and Eastern regions with smallholders constituting 85% of total avocado growers in the country (Wasilwa *et al.*, 2007). Avocado accounts for 17% of total horticultural exports and for more than 50% of the export value in the Kenyan fruit sector (Hazikimana and May, 2011). Avocado export is reported to have increased from 23 tonnes in 1970 to 20,000 tonnes in 2003 (Wepukhulu *et al.*, 2006). This high avocado export value is attributed to Kenya's ability to supply avocados during winter, when imports from other suppliers are not widely available.

Although there has been increasing contribution of avocado to Kenya's fruit exports, the smallholder farmers in Kandara district have not benefited much from it (Maina *et al.*, 2010). Limited access to market, underdeveloped agricultural infrastructure, limited access to credit and lack of technical expertise have contributed to the inability of these smallholders to meet the high quality changing preferences of the more sophisticated avocado markets (USAID Kenya, 2008). The challenges noted, specifically relating to access to markets and technical expertise, have had a negative effect on the financial sustainability of most smallholder farmers in the region (Nyoro and Jayne, 1999). As a result, credit providers have been reluctant to fund these farmers due to the fear that they may not be able to recover their funds. Duma (2007) notes that, in general financial institutions view smallholder farmers as high risk and generating high transaction costs and low returns. According to Duma, the challenge for funders is to find mechanisms that can guarantee access to markets and technical expertise for smallholder farmers.

While the government can help ease these constraints through extension services and public investments, contract farming (CF) is an institutional arrangement in the private sector that may eventually help overcome some of the common challenges. Eaton and Shepherd, (2001) defined contract farming as an agreement between farmers, processing and marketing firms for the production and supply of agricultural products under forward agreements,

frequently at predetermined prices. The arrangement often involves the agribusiness firms providing a degree of production support such as technical support, improved farm inputs, credit, product accreditation and assistance in the formulation of farmers' groups while the farmer commits himself to provide a specific commodity in quantities and at quality standards determined by the purchaser. Consequently, poor farmers are able to transform from traditional cultivation and management practices to market-oriented commercial production, resulting in employment generation, income growth, and greater security. In more simple terms, contract farming can be regarded as a partnership between agribusiness companies and farmers.

Contract farming leads to market access and commercialization of smallholder farmers especially for high-value crops, such as horticultural crops (Elepu and Nalukenge, 2009). It also provides access to credit, training and inputs. As indicated in a study in Uganda, organic coffee contract farmers were able to access new markets that would otherwise have been unavailable (Bolwig *et al.*, 2009). This coupled with guaranteed price premiums led to an increase in contract farmers' net coffee revenue by an average of 75 % (Bolwig *et al.*, 2009). Various studies have indicated that CF provides access to inputs and technology to farmers (Brambilla and Porto, 2005; Maertens and Swinnen, 2009). Further, in poor areas where smallholder subsistence production is the norm, CF provides farmers with an assurance for sale of their produce and agribusiness firms with a steady supply of agricultural output required by the market (Setboonsarng, 2008). Contract farming has emerged as one of the innovative ways to fund smallholder farmers and has been adopted as a mechanism that can mitigate against the adverse effect of information asymmetry and moral hazard associated with such farmers (Koranteng, 2010).

Most contractual arrangements are carried out by the private sector. Examples of these in Kenya include, Fresh Produce Exporters Association of Kenya (FPEAK) which is a Non- Governmental Organization involved in building smallholder horticultural farmer's capacity in market requirements and linking them to markets. East African Growers (EAGA) is another large fresh produce exporting company in Kenya. Its export produce comprises of vegetables (60%), fruits (25%) and flowers (15%). EAGA exports 20% of avocado from Kenya (Musinga and Dodhia, 2004). Other avocado export firms include Kenya Horticultural Exporters (KHE), Vegpro (K) Ltd, Indufarm (EPZ) Ltd., Kakuzi, and Sunripe (Knopp and Smarzik, 2008). Ruiru Natural Oils Ltd., Avo-Oil Industries Ltd. and Sun Mango Ltd are some of the processing firms in the central region. In 2005 the firms processed between 20 to

40 MT of avocado crude oil per day from smallholders and exported the crude oil to South Africa and Italy for refining into cosmetics (Knopp and Smarzik, 2008).

1.2 Statement of the Problem

Smallholder avocado production in Kenya continues to face production and marketing constraints along the value chain. Specifically, smallholder farmers in Kandara have limited market access to export markets which might in turn affect their household income. To deal with these problems contract farming has been introduced by both the government and non-governmental organizations. While there is evidence that the approach can have a positive impact in increasing productivity and market access, farmers in Kandara still have limited access to market. This study therefore looks into the determinants of smallholder avocado farmers' participation in CF and their extent of participation in Kandara District. Further, the effect of smallholder avocado farmer's participation in CF on household income will be analyzed.

1.3 Objectives

1.3.1 General Objective

To contribute to increase in incomes of smallholder avocado farmers in Kandara through participation in contract farming.

1.3.2 Specific Objectives

- i) To determine the socioeconomic attributes of contract and non-contract smallholder avocado farmers in Kandara District.
- ii) To assess the factors that influence smallholder avocado farmers' participation and the extent of participation in contract farming in Kandara District.
- iii) To examine the effect of participation in contract farming on smallholder avocado farmers' income in Kandara District.

1.4 Research Questions

- i) What are the socioeconomic attributes of contract and non-contract smallholder avocado farmers in Kandara District?
- ii) What are the factors that influence smallholder avocado farmers' participation and their extent of participation in contract farming in Kandara District?
- iii) Does participation in contract farming affect household income?

1.5 Justification of the Study

Local and global agrifood systems are facing dynamic changes. These changes bring about opportunities to smallholder farmers because of their positive effects on market access, but at the same time they present great challenges associated with new procurement systems, which are switching from spot markets to vertically coordinated markets. Contract farming is an example of a vertically coordinated marketing system that is aimed to enhance farmers' production and marketing. This research was focused on investigating the factors that determine the participation of smallholders from Kenya, specifically Kandara District, in contract farming in order to make policy recommendations for helping farmers to compete in the new production and marketing systems.

Understanding the nature and effects of institutional and socioeconomic factors in smallholder avocado fruit marketing is fundamental to improving marketing channels as well as smallholder farmers' welfare. Efficient marketing channels will not only benefit the smallholders but will also improve access to raw products by final consumers. The results of the study indicate opportunities and potential areas of intervention, and pinpoint activities to be undertaken by the private sector, public sector stakeholders and the possible role of development partners in smallholder avocado production to meet local and global demands.

1.6 Scope and Limitation of the Study

The study covered smallholder avocado farmers in Kandara District who were either contract participants or non-participants. Contract farming referred to a form of contractual arrangements whereby smallholder farmers' marketed their avocado produce through Avocado Growers Association of Kenya

The findings of this study apply mainly to the study area and may not reflect the views of all smallholder farmers in Kenya since the influence of contract farming to farmers may differ among different areas and communities. Given that the study dealt with fruit farming which is susceptible to weather changes like drought and natural disasters such as diseases, there were difficulties in revealing the true status of the extent of participation in cases where farmers realized zero volumes of output due to these calamities. The fact that the study specialises in agricultural produce which is seasonal and faces risks from fluctuating yields, preference was given to the use of longitudinal datasets rather than cross-sectional data.

1.7 Definition of Terms

Smallholder farmers- Refers to farmers with land holdings of less than five acres

Participants/Contract farmers-These are defined in this study as those farmers who have contractual arrangements to sell their avocado through AGAK while non-participants are those farmers who do not sell through AGAK and are not in any other form of contract with any buyer

Contract farming- refers to an agreement between buyers and producers, where by producers agree to produce and supply agricultural products according to the agreed quantity, quality, variety, grade, type of packaging and time of delivery

Contract breach- a party's failure to comply with the contract's mutual obligations

Regional based organisation -An organisation consisting of several village farmer groups

CHAPTER TWO

LITERATURE REVIEW

2.1 Theory of Contract Farming

The concept of contract Farming (CF) refers to an agreement between buyers and producers, where by producers agree to produce and supply agricultural products according to the agreed quantity, quality, variety, grade, type of packaging and time of delivery (Bijman, 2008). Man and Nawi (2010) point out that the two parties mutually agree on the pricing of the product, either on a contract price or a market price.

Contract farming has been widely adopted in developing countries. The rapid adoption has been attributed to the rise of supermarkets in food retailing and the reduction of the role of the state in providing marketing, input and technical services (Bijman, 2008). The other main reason is the changes in food consumption habits of people in developed and developing countries that have led to greater demand for a greater variety of value added products which are required to meet certain international market standards. For instance, the importers and the final buyers in Europe, the Middle East or other important trading partners in Kenya more often require exporters from the country to comply with standards such as EurepGap (Strohm and Hoeffler, 2006). It is for this reason that in the recent past, standards and in particular the implementation of EurepGap regulations has gained importance (Eaton and Shepherd, 2001).

Extensive implementation of contract farming has been witnessed in many countries such as Mozambique where 100% of the cotton is supplied through CF schemes with 400,000 smallholders being involved in some form of CF (UNCTAD, 2009). In Brazil, around 75% of poultry and 35% of soya bean production are sourced through CF (UNCTAD 2011). About 60% of tea and sugar is produced under contract in Kenya in addition to the large number of contract growers of horticultural exports mainly fruits and vegetables (Oya, 2012). The author further indicated that Vietnam is involved in the production of some 90% of cotton and fresh milk, 50% of tea and 40% of rice under CF. The study noted that CF is responsible for 100% of cotton and paprika production in Zambia.

Despite its wide adoption, CF has not been successful in most cases due to poor co-ordination among parties, unfavorable terms and conditions and post determination of prices which are dictated by export market (Da Silva, 2005). This has often led to adverse selection and moral hazards. In their case studies done in five countries, Barrett *et al.* (2011) indicated that, smallholders producing different crops such as gherkin, onions, cotton and barley claim

to bear the bulk of downside risks, such as the risk of non-payment due to the product not meeting agreed standards or loss of crops during shipping. Contractors also complain that farmers side sell and fail to deliver the product as agreed (Ibid, 2011). In a different study in Ghana, 56 % of smallholders who had joined pineapple agro-export value chain in 2004 had exited by 2009 citing lack of buyers and or problems with exporters as the main reasons for exit (Harou and Walker, 2010), while 38% of Nicaraguan farmers who supplied horticultural produce to supermarkets since 2001 had exited the channel by 2008 (Michelson, 2010).

To curb these hazards, the mode of interaction between farmers, buyers and other stakeholders involved has to be effective. Over the years, various models have been put across to explain these interactions. Eaton and Shepherd (2001) explained four types of CF models which include; nucleus, informal, centralized, multipartite, and intermediary model. The centralized model involves a centralized processor and/or buyer procuring from a large number of small-scale farmers. The cooperation is vertically well integrated and most of the time several services such as pre-financing of inputs, extension and transport are provided. The centralized model is particularly used by the larger companies in Kenya such as Frigoken, Greenlands and Homegrown, all dealing with vegetables and partly with fruits for the export market (Strohm and Hoeffler, 2006). All these companies handle the payment of the farmers through their own financial departments.

The nucleus estate model is a variation of the centralized model where the contractor not only sources from independent farmers but also has its own production facilities (an estate plantation). The central estate is usually used to guarantee throughput for the processing unit but is sometimes used only for research and breeding purposes. This model is mainly used for perennial crops, but there are examples of applications of this model in other products like dairy.

Multipartite CF involves a company working with other institutions or NGOs. This type of CF is particularly helpful when establishing a new venture. Once the cooperation between the firm and the farmers is working well, the link parties can be circumvented and so the multipartite slowly develops into the centralized model. Examples of these in Kenya include, Kenya Horticultural Exporters, Kevian Kenya Limited and East African Growers. Companies like Kevian Ltd. and Kenya Horticultural Exporters work with other institutions such as Drumnet (NGO), Kenya Gatsby Trust, or other development projects, which connect them to small-scale farmers and handle part of the finances. Tripartite CF is the kind of model used in Kandara District, whereby Avocado Growers Association of Kenya (AGAK) links farmer groups to a buyer known as Vegpro (K) Ltd.

The distinction between the multipartite and intermediary model is that intermediaries organize everything on behalf of the final buyer starting with input supply, extension service, payment of the farmers and final product transport. Meru Greens Horticulture in Kenya shows many characteristics of a centralized model with the difference being that they act as an intermediary on behalf of Frigoken (agribusiness company) and do not export themselves (Strohm and Hoeffler, 2006). Intermediaries handle several thousands of outgrowers. This type of model is also experienced in avocado production in Murang'a where the Avocado Growers Association of Kenya (AGAK) is the intermediary. It organizes for the purchase of produce by Vegpro (K) Ltd who is the buyer and facilitates trainings and payment for several smallholder avocado farmers in the region. Informal arrangements vary between casual oral agreements and regularly repeated marketing transactions but are characterized by the absence of written contracts or equally binding and specifying documents.

2.2 Structure and Organization of Contract Farming in Kandara

The organisation of contract farming in Kandara is based on the intermediary model. The common feature of this model is the formal subcontracting by companies to intermediaries. A limited range of inputs is provided in this model and it is popular for production requiring fair-trade and organic certification (Prowse, 2012). The intermediary involved in Kandara is the Avocado growers Association of Kenya (AGAK), which works closely with other two partners; smallholder avocado farmer groups and the export company (Vegpro (K) Ltd). AGAK has its own informal arrangements with the farmers which include facilitation of trainings and enhancing contract enforcement by building trust among group members. AGAK however, disconnects direct link between the company and the farmer. As such farmers are not fully aware of contractual terms and conditions. The association performs various roles such as contract evaluation, liaison with the contractor, providing links to training and is actively involved in receiving and making payments. Working with this intermediary (AGAK) in the region can be risky. Some of the major risks are that the association can lose control over the production base predominantly due to passing of distorted information to farmers. Furthermore, the association can lose control over prices paid to farmers as well as failure to maintain the avocado quality standards. A similar approach has been used in some other countries such as Mexico, where Asesoría y Servicios Integrados Agropecuarios (ASIA) acts as an intermediary between smallholders and agribusiness firms in negotiating contracts and facilitating arrangements in contract flower production (Simmons, 2003). To market avocado through AGAK, farmer groups must be

registered members of the association. Registration fee costs Kshs.1000 per group. In addition, the association deducts fifty cents for each piece of avocado sold by the members which is used for maintenance of AGAK activities.

Farmer groups and the buyer have different roles in the contract. The farmer groups organise smallholder farmers to achieve economies of scale which benefits both the farmers and buying companies. The groups are crucial in fostering farmer relationships. Further, they reduce contract default by farmers through peer pressure. The export company is the buyer. It provides training, packaging materials and transport of produce. Unlike other contractors, the buyer in Kandara does not provide credit and input facilities.

Despite the existence of groups in the region, cases of contract default are prevalent. Generally, there is weak enforceability when the contract is breached. Contract default occurs when the buyer refuses to accept produce, delays payments or arbitrarily raises quality requirements. Farmers might also fail to honour contract by side selling.

2.3 Participation in Contract Farming

The aspect of smallholder farmer participation in contract farming is essential for rural economic growth and poverty reduction. Back in the 1980s to 1990s, governments were more concerned with macroeconomic and sectoral policies which did not capture smallholder households (Grosh, 1994). However, in the recent past, focus has shifted to microeconomic and institutional policies aimed at boosting smallholder farmer's production and access to markets. In particular, contractual arrangements with downstream processors, agro-exporters, and retailers, often orchestrated through farmer groups, are increasingly seen as a means of overcoming the market imperfections that led to the failure of macroeconomic and sectoral adjustment policies (Gow, 2000).

The importance of CF can be indicated by the number of smallholders joining contractual schemes. In a case study done by Oya (2012), CF was found to be a dominant institution for smallholders in many countries in Sub Saharan Africa. For instance, Kenya was cited to be most successful in CF for smallholders. The author cited that Kenya Tea Development Agency (KTDA), a tea outgrowing scheme in Kenya, showed an increase from around 350,000 small-scale outgrowers in 2002 to 598,000 in 2010. USAID Kenya report (2008) further showed the rising importance of CF in Kenya, where USAID's efforts to link farmer groups in Kandara with East African Growers (EAG), a large horticulture export firm, led to the recruitment of 1086 smallholder farmers in contractual basis during the first year (2003) of their project.

2.3.1 Determinants of Smallholder Farmers' Participation in Contract Farming: A Review

Even with the growing role of CF in developing countries, not all farmers adopt the approach. Studies have used different measures to identify determinants of farmer's participation in CF, some of which include farmers' socioeconomic characteristics and farmers' institutional and technical factors. Commonly used socioeconomic traits such as ethnicity, educational attainment, the size of the household, income, proximity to market and asset ownership have revealed mixed results in different studies as discussed below.

Analyses on farmer's asset ownership and its influence on the decision to participate in CF yield different results. A study on rice contract farming in Cambodia indicated that farmers with less asset value were not likely to join contract for they tended to produce rice for subsistence (Junning *et al.*, 2008). On the other hand, Patrick (2004) observed that contractors in rice farming in Indonesia had more non-agricultural and agricultural assets than non-contractors who owned slightly less land including significantly less irrigated land. In a similar study by Barrett *et al.* (2011), asset ownership did not influence farmers' participation in the value chain of different horticultural crops like papaya, pineapples, leeks, onions, tomatoes among others.

Evaluating gender participation in contract farming disclosed that there was less involvement of women. Miyata *et al.* (2009) argued that women had less access to contract farming than men. These findings corroborate those of a study done in the Kenyan horticulture export industry which found out that women comprised less than 10 % of contracted farmers and in a sample of 59 contract farmers for French beans exported from Senegal; only one was a woman (Maertens and Swinnen, 2009).

Most findings on the effect of age, education, household size and proximity to market on the farmers' decision to participate in CF are consistent. Musara *et al.* (2011) found out that education level and young age had positive effects on farmers' participation in CF while a study on rice CF in Cambodia indicated that farmers with larger family sizes, younger and more educated household heads and those with farm locations closer to the highway were found to be more likely to join the contract (Junning *et al.*, 2008).

Likewise past studies have reported that farmers' off-farm and farm income has an influence on the decision to participate in CF. In some cases access to these income sources was found to increase the household's likelihood to participate whereas in others there was no effect. In a study on the impact of CF on smallholder poultry farmer's income in Kenya

Wainaina *et al.* (2012) found that the levels of farm and non-farm incomes positively and significantly influenced the decision to participate in poultry contract farming.

Most studies revealed that membership in a cooperative or farmer group increased the likelihood of farmer participation in CF. For example in Ghana, group membership increased smallholder participation in value chains since firms contracted cooperatives (Harou and Walker, 2010). Similar results were noted in a study of onions, leeks and tomato production in Madagascar (Bellemare, 2011).

Smallholder contract acceptance is also influenced by the benefits farmers expect to derive from the contract, including revenue implications, cost implications and risk reduction (Simmons *et al.*, 2005). Farmers join CF to resolve market failures (Arumugam *et al.*, 2011; Key and Runsten, 1999) since most agribusiness firms provide access to inputs, extension services and guaranteed prices for outputs.

Several studies on factors determining farmer's participation in CF and the determinants of their extent of participation have used the Heckman two stage model. Benfica *et al.*, (2006) used the model to determine factors influencing participation and performance of tobacco farmers in Mozambique. The results pointed out that participation in the schemes was driven by factor endowments, asset ownership and alternative income opportunities. Using Heckman two stage model, Miyata *et al.*, (2009) found out that age, education and distance to the house of the village elder influenced farmers decision to participate in apple and green onion contract farming in Shadong province, India, with the farmers living near the village head being significantly more likely to participate.

From the literature cited, it is clear that determinants of participation in contract farming differ. This might have been caused by the difference in agro-ecological zones and the type of farming enterprise under contract. The results of these studies are therefore not applicable to other areas or enterprises. For this reason, this study was done to fill the literature gap that exists on the determinants of smallholder avocado farmers' participation in CF in Kandara district, Kenya.

2.4 Effect of Contract Farming on Farmers Income

Analysis of the effect of CF on farmers' income, profitability and gross margin give different results. Smallholder contracting farmers have generally been found to have more production hence more income and profits than smallholder non-contracting farmers. This trend has been linked with the role of CF in reducing transaction cost, information asymmetry and risks and uncertainties associated with production and marketing of agricultural products.

Contracting is seen as a way of allocating risk between producer and contractor, with the former taking the risk of production and the latter the risk of marketing (Baumann, 2000). Ramaswami *et al.* (2006) in their study on poultry farming under contract in India estimated that CF could reduce 88% of farming risks to firms. In a different study done on rice farming in Cambodia by Junning *et al.* (2008), contract farming provided stable market access, credits, extension services, infrastructure and other benefits to farmers.

Stipulating the types of inputs and cultivation methods to be used in the contract reduces uncertainty about the quality of product the contractor will receive. For instance, there was reduced price and yield uncertainty in potato contract farming in Haryana, India, whereas in the non-contract farming system price uncertainty existed to a large extent due to variations in the price of potatoes sold in the market (Tripathi *et al.*, 2005). Bijman (2008) further indicates that CF reduces opportunistic behaviour of both parties through repetitive agreements and reduces cheating on quality by providing proper inputs and technical assistance, and by regularly monitoring cultivation practices. Further, literature on the contribution of CF on production and marketing costs show largely that CF reduces these costs. Birthal *et al.* (2005) noted that contract producers faced transaction costs that were 90 % less than that of independent producers, and smallholders benefited the most from the contracts.

The factors mentioned above, contribute to the improvement of contract farmers' income. For instance, in his study on the welfare impacts of contract farming in Madagascar, Bellemare (2011) indicated that every 1-% increase in the likelihood of participating in contract farming was associated with a 0.5 % increase in household income. Similarly, there was increased income in the contractual farming of broiler production and rice in Indonesia (Patrick, 2004), rice farming in Thailand (Setboonsarng *et al.*, 2006), soybean and tobacco in Nigeria (Olomola, 2010), small scale maize farming in south Africa (Anim, 2011) and smallholders farming of apples and green onions in India (Miyata *et al.*, 2009). Contract farmers also have higher productivity (hence higher returns), as revealed in Nigeria where rice yield for the contract farmers (2,651 kg) was significantly higher than that of the non-contract farmers (1,898 kg) (Olomola, 2010).

While contract farming provides benefits for growers in many cases, recent studies have indicated that in some instances members of the rural population have realized limited gains (Oya, 2012; Patrick, 2004) or have been directly or indirectly harmed by contract farming (Little and Watts, 1994). Contract farming has been critiqued as being a tool for agro-industries to exploit an unequal power relationship with growers (Key and Runsten,

1999). In the African context, contract farming has been observed to disrupt power relations and increase tensions within farm households, especially between male household heads and their wives and children (Carney and Watts, 1990). The impact of CF on rural development depends on the growers contracted by the agro-processing industries. If rich firms are contracted the poor members of the rural community fail to benefit directly from contractual arrangements. As a result, CF may tend to affect income distribution in rural areas and can exacerbate existing patterns of economic stratification (Korovkin, 1992). In a study by Romero (1998), on CF and producer participation in avocado industry, CF is not on its own sufficient to guarantee integration of smallholder producers in the international market.

The effect of participation in contract farming on smallholder farmers' income gives mixed results. While CF has been found to have positive impacts to some, it has been a threat to smallholders in other scenarios. Factors behind this difference could include the contract model used, the specification of the contract, the type of enterprise under contract and farmers' factor endowments. Due to these variations, it was necessary to establish the effect of CF on the income of avocado smallholder farmers in Kandara district, Kenya.

2.5 Theoretical and Conceptual Framework

2.5.1 Theoretical Framework

A smallholder avocado farmer's choice on whether to participate in contract farming or not will depend on marginal utility derived from participating in the program, evaluated in terms of utility gained due to increased income, price risks involved, input accessibility among others compared to utility derived from non-participation decision. In this case a farmer will be willing to participate if the utility derived U_i from contract farming is higher than that derived from non-participation U_j . The observed indicator (participation decision) is equal to 1 if $U_i > U_j$ and 0 if $U_i < U_j$. The utility level obtained is, however, dependent on the socioeconomic and institutional characteristics of a farmer (x) and other factors (ε). A farmer's participation decision in contract farming could be denoted by $z = 1$ if the farmer is contract farming participant.

Therefore,

$$\begin{aligned}
 pr(z = 1/x) &= pr(U_i > U_j) \\
 &= pr(\beta_i'x + \varepsilon_i - \beta_j'x - \varepsilon_j > 0/x) \dots\dots\dots (1) \\
 &= pr[(\beta_i - \beta_j)'x + (\varepsilon_i - \varepsilon_j) > 0/x]
 \end{aligned}$$

$$= pr(\beta' x + \varepsilon > 0/x) \dots\dots\dots (2)$$

Where, *pr* and β represent probability and coefficients, respectively; U_i and U_j are perceived utilities in the market with choices *i* and *j*. *x* represents the explanatory variables vector, β_i and β_j are utility shifters while ε_i and ε_j are error terms assumed to be independently and identically distributed (Greene, 2000).

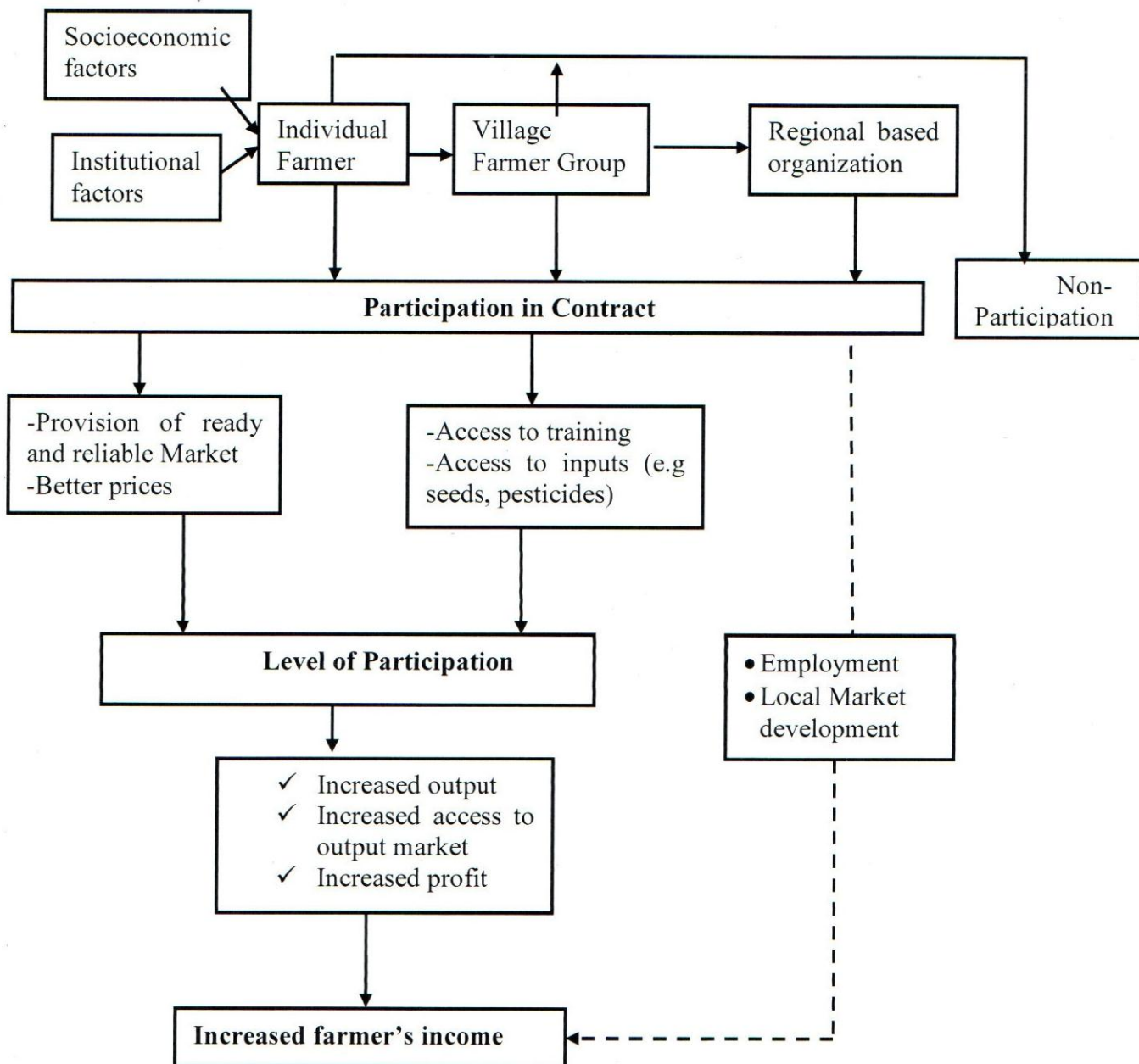
2.5.2 Conceptual Framework

The main aim of this study was to evaluate the determinants of farmers’ participation in contract farming, factors that determine farmers’ extent of participation in CF and effect of participation in CF on income. Figure 1 below presents interrelations of socioeconomic and institutional factors, their influence on household decision to participate in CF and hence the income. Sex of the household head determines farmers’ participation in CF. Female household heads are less likely to participate since they are resource constrained in terms of labour and cash than their counterparts.

The effect of age on determining farmers’ decision to participate in agricultural technologies is controversial. Younger farmers are likely to participate because they are risk takers and can invest in long term projects. Contrary, old farmers are experienced and have more knowledge of market risk and can therefore make feasible decisions on participation. The mixed effect of age on participation makes it difficult to predict on its’ influence on participation in CF.

It is hypothesized that marital status will have a positive influence on farmers’ participation in CF. Households where the head and spouse live together are likely to have more labour available and therefore more likely to participate in agricultural technologies. Apart from the marital status, education of the household head is likely to positively affect households’ choice to participate in CF. Formal education increases the farmers’ ability to understand and respond to information concerning new technologies.

In terms of household size, larger households tend to adopt CF because they can provide the labour required for production. Further, farmers’ participation in contract farming is likely to be positively influenced by group membership. This study considered membership in any agricultural group apart from the avocado group. Generally, farmer groups are channels through which individual farmers can access information on market, credit and new agricultural technologies provided by the government, the private sector and the development partners. This information is necessary in improving agricultural productivity.



—————→ Illustrates contract farming channel in Kandara

-----→ Indirect effect of contract farming in Kandara

Figure 1: Conceptual Framework on Smallholder Farmers Participation in Contract Farming

Source: Authors Conceptualization

Households with higher incomes would be more likely to participate than those with lower incomes, since the former would even hire labour if they were constrained in that direction. Another critical variable included in this study was asset ownership. Higher household asset ownership is likely to have a positive effect in determining farmers' participation in CF. This could be due to the high capital required to invest in new technologies. Availability of extension is likely to increase farmers' participation in CF. Extension services are important sources of information for farmers which aids them in their decision making process. Furthermore, credit availability is considered essential in enhancing households' participation in CF since it enables farmers to purchase inputs necessary for increasing their productivity.

Proximity to AGAK leader was likely to influence farmers decision to participate in CF. In this study, proximity to AGAK was considered as a dummy where farmers living in the same village with an AGAK leader were regarded as being close to the leader and otherwise. Size of farm owned has been found to have twofold effects. Generally, it is expected that farmers with large farms are more likely to participate due to their ability to expand production and to benefit from economies of scale. Regardless of this, smallholders have been found to participate in CF as well. Farmers' decision to adopt new agricultural technologies is influenced by their perception. In this study, farmers' perception on fruit prices as well as on the ability of CF to offer ready market was considered. Farmers with positive perception on CF are expected to participate. More so, it is hypothesized that households with high number of avocado productive trees are more likely to participate in contract as opposed to those with fewer trees. Farmers with more trees, hence more production, benefit from economies of scale. Contracting companies might be attracted by these types of farmers.

Farmers' participation in contract farming in Kandara is tied to group membership. However, not all farmers participate in groups. Farmer groups either join a regional based association such as AGAK, or operate independently. The associations are critical in linking farmers to buyers through contracts, providing economies of scale and other services such as banking and training, enhancing collective bargaining, and reducing moral hazard and information asymmetry between the farmers and contractors. Once farmers enter into an agreement with buyers, either through regional based associations or individually, there are several enforcement mechanisms that need to be put in place for continuity of the contract. These include; encouraging group or co-operative action among producers to lower costs and ensure better compliance (through trust), identifying parties that will compensate farmers or

the buyer in case of risks and laying clear sanctions for breach of contract to curtail pre- and post-contractual opportunism of adverse selection and moral hazard.

Further, as shown in figure 1, participation in contract farming might offer numerous opportunities for smallholders such as access to a reliable market, better prices, reduced transaction costs and most importantly provide access to credit, inputs and production services such as training and extension. It is further assumed that contract farmers will gain new skills and technologies and hence adopt Good Agricultural Practices leading to increased production of quality goods which fetch better prices in the market. As a result, farmers realise increased profits eventually leading to increased income.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

Kandara district is located 10 kilometers south of Kigumo and 30 kilometers north of Thika. It covers an area of 237 km² and has a population of 156,663 (Census, 2009). The district has the highest density of persons (664 persons per km²) in Kenya (Ibid, 2009). It has one division known as Kandara, which consists of seven locations namely: Kibage, Gaichanjiru, Ng'araria, Ithiru, Kagunduini, Muruka, Githumu and Ngurueini.

Moderate temperature, high rainfall, and rich volcanic soil make the district a favourable location for agricultural production. Main agricultural enterprises found in the region include banana, avocado, macadamia, maize and beans, dairy cattle, pig farming, coffee and tea among others. The district was purposively selected for this study because smallholder avocado farming is the main enterprise carried out under contractual arrangements. Additionally, the district has the highest concentration of avocados compared to other avocado producing zones in the country (Kabbucho, 2004). The district is the largest supplier of avocado for export and local markets in the country making avocado growing one of the major agricultural enterprises in the region (USAID Kenya, 2008). Its proximity to Nairobi and closeness to the airport eases access to markets which has favoured growing of perishable products like avocado.

3.2 Sampling Design

Multistage sampling was used to arrive at the desired sample size of 100 households. Kandara division was purposively selected because it is the only division in Kandara district. Out of seven locations in the division, Muruka and Ngararia were selected purposively because they had higher number of farmers in contract farming and higher number of avocado trees. A source list from AGAK was used to get the sample of participants from each location using systematic sampling. Non-participants were sampled randomly from the two locations to form the control group.

3.3 Sample Size

The desired sample size was determined using a formula by Kothari (2004). Since there was no estimate available of the proportion in the target population assumed to have the

characteristics of interest, 50% was used. To determine the sample size from the population the formula below was used:

$$n = \frac{z^2 pq}{e^2} \dots\dots\dots (3)$$

n is the sample size, *p* is proportion of the population (50%) containing the major attribute of interest, *q* is 1-*p*, *z* is the standard variation given confidence level of α =0.05 and *e* is the acceptable error of 9.8%. This resulted in a sample size of 100.

$$n = \frac{Z^2pq}{e^2} = \frac{1.96 \times 1.96 \times 0.5 \times 0.5}{0.098 \times 0.098} = 100 \dots\dots\dots (4)$$

Out of the 100 farmers sampled, 62 were non contract farmers while 38 were contract farmers.

3.4 Data Collection

The study involved household surveys for producers conducted using a structured questionnaire administered to the 100 selected respondents by the researcher and trained enumerators. The questionnaire captured information on the following aspects: demographic characteristics of household members, crop production, input and labour use, produce marketing, financial services (credit and savings) and contract farming. Information collected in the household questionnaire was restricted to the May 2011 to April 2012 production season.

3.5 Data Analysis

Both qualitative and quantitative methods of data analysis were used to answer the research questions and address the objectives. SPSS package was used for data entry while STATA was used for data cleaning and analysis. STATA was also used in analysis of socioeconomic attributes of contract and non-contract farmers and in running the Heckman two stage model for evaluating factors determining participation and extent of participation in CF and in running the Propensity Score Matching model for analyzing the impact of participation in contract farming on household income.

3.5.1 Socioeconomic and Demographic Characteristics

Descriptive statistics entailed a narrative of the findings from the questionnaires on the socioeconomic attributes of contract and non-contract farmers. Further, information on

why farmers participate or do not participate in CF was also provided. These were presented using percentages, frequencies and means.

3.5.2 Estimation of the Determinants of Participation in Contract Farming

The second objective of this study was to evaluate factors that determine farmers' participation in contract farming and their extent of participation. Previous studies have used different types of models to measure participation, for instance OLS, Tobit and double hurdle models. The OLS method was inappropriate for this study since non contract farmers accounted for a larger fraction of the sample hence most of the values of the dependent variable would have been equal to zero. OLS produces bias and inconsistent estimates when a significant number of dependent variable observations are equal to zero (Hien, 2012). While the Tobit model has been found as an appropriate approach for dealing with zero values, it has a limitation in that it assumes the choice of participation and the level of participation are determined by the same factors (Sindi, 2008). The model also considers dependent variable to be censored at zero but ignores the sources of zeros which might have been caused by deliberate households' decisions or other factors such as financial constraints (Newman *et al*, 2003; Martinez-Espineira, 2006). Due to these assumptions, Tobit was found not suitable for this study.

Cragg (1971) proposed a double hurdle model which is developed from Tobit model. The first hurdle indicates participation decision and the second hurdle estimates the level of participation. The disadvantage of the model is that it assumes the decision to participate and the extent of participation are determined simultaneously (Humphreys and Ruseski, 2009). This might not give reliable results in this study since factors influencing participation might be different from those influencing the extent. This model too, was discarded as it was found to have a great limitation in this study.

Heckman (1979) proposed the two-stage estimation procedure to deal with zero observation. The first stage estimates the probability of participation and the second stage estimates the level of participation conditional on observed positive values. The model assumes that the two stages are affected by different sets of independent variables, which is contrast to Tobit model. Heckman two stage model therefore, accounts for unobserved factors that may affect both likelihood of participation and extent of participation and for that reason, it was chosen for this study.

Using Heckman two stage model in this study, the first step involved the estimation of a Probit model as a function of variables that determine participation in CF. In the second

step, OLS was used to determine the extent of farmers participation in contract using the quantity of avocado pieces produced from Fuerte and Hass varieties as the dependent variable. The model assumes that the decision to participate in CF and the extent of participation may not be jointly determined and thus factors that determine the decision to participate and the extent of participation could be different.

The Probit model was estimated as follows:

$$C_i = \gamma Z_i + e_i$$

Expanding the equation to include the variables used in this study:

$$Curcf = \beta_0 + \beta_1 grpagak + \beta_2 yrheduc_1 + \beta_3 agehhead + \beta_4 agehh_sq + \beta_5 mstatus_hhd + \beta_6 gender_1 + \beta_7 hhead_agrgrp + \beta_8 hhsize + \beta_9 tottrees + \beta_{10} offfarminc + \beta_{11} farminc + \beta_{12} perpri_cf + \beta_{13} creditacc + \beta_{14} dextn + e_i \dots \dots \dots (5)$$

After estimating equation (5), an inverse of the mills ratio (IMR) was computed for each observation and included as an independent variable in the second stage model.

The OLS was specified as:

$$tqtyav_cf = \beta_0 + \beta_1 yrheduc_1 + \beta_2 agehhead + \beta_3 agehh_sq + \beta_4 grpagak + \beta_5 hhsize + \beta_6 perpri_cf + \beta_7 gender_1 + \beta_8 totprt + \beta_9 dextn + \beta_{10} offfarminc + \beta_{11} creditacc + \beta_{12} permkt_cf + e_i \dots \dots \dots (6)$$

The variables that were used in the estimation of the Heckman two stage model are shown in Table 1 below.

Table 1: Model Specification

Code	Variable	Description and measurement	Expected sign
Dependent variables			
Curcf	Participation in contract farming	Dummy participant=1, non-participant=0	None
tqtyav_cf	Quantity of avocado pieces sold under contract	Quantity sold in pieces	None
Independent variables			
grpagak	Proximity to AGAK leader	Dummy Close=1, Not close =0	+
yrheduc_1	Education	Number of years	+
agehhead	Age of the household head	Number of years	+
agehh_sq	Age squared	Number	+
mstatus_hhd	Marital status	Dummy, With spouse=1, Without spouse=0	+/-
gender_1	Gender	Dummy, 1=Male, 2=Female	+/-
hhsize	Household size	Number of persons	+
	Agricultural group		
hhead_agrgrp	membership	Dummy 1=Yes 0=No	+
hh_offinc	Off-farm income sources	Number	+
	Perception of the price		
perpri_cf	offered under contract	Price, Higher-1, Lower=0	+
creditacc	Access to credit	Access; Yes=1, No=0	+
dextn	Distance to the market	Distance in km	+
totprt	Total productive trees	Numbers of trees	+
permkt_cf	Perception on availability of ready market	Market; 1=Readily Available, 0=Not readily available	+

3.6 Estimation of the Impact of Participation in Contract Farming on Income

A simple approach in estimating the impact of participation in a program on income would be to compare the outcome of participants and non-participants. This approach would be applicable if those participating in the program were a random sample of all those qualified (Bryson *et al.*, 2002). However, this is unlikely to happen and therefore would result in a possible over-estimation of the effectiveness of the program giving rise to a selection problem which must be dealt with for one to get a valid estimate of the program impact. Another problem is the selection bias which arises when some of the determinants of participation also influence the outcome. However, this bias can be avoided when the relationship between the two processes can be accounted for by observable characteristics but in cases where there are unobservable characteristics then selection bias becomes a concern. Experimental approaches (random assignment) and non-experimental approaches (before and after estimators, difference in difference and cross-sectional estimators) have been used to deal with the selection issue.

Before and after estimators compare outcomes of a group of individuals after participating in a program with outcomes of the same or an equivalent group before participating to obtain the estimated treatment effect. This approach assumes that there are two unobservable characteristics namely individual effects and transitory effects. It has a strong assumption that participation in a program is dependent on the fixed and not the transitory effect. Unlike the before-after estimators, the difference in difference approach compares a before-after estimate for participants with a before-after estimate for non-participants to give the estimated treatment effect. The disadvantage of this method is that it cannot control for transitory effects which can result to biased estimates (Hausman and Kuersteiner, 2004). Conversely, it has the ability to eliminate trend and individual effects.

In the random assignment approach, selection problem is overcome by creating a control group with similar distributions of observable and non-observable characteristics to those of the treatment group. Estimated treatment effect is given by the mean outcome of participants relative to that of non-participants. This approach has various limitations. It is costly and requires close monitoring (Bryson *et al.*, 2002). Furthermore, it gives rise to a randomization bias in that random exclusion from a program may demotivate those randomized out resulting in their poor performance which eventually boosts the advantage of participation (*Ibid*). In some cases, those receiving treatment might also drop out leading to biased estimates.

Other common cross sectional methods that have been used to deal with selection of observables are instrumental variable (IV) and Heckman selection estimator. The instrumental variable method is only possible when a variable can be identified that is related to participation but not outcomes. This is known as the instrument variable. The major drawback to the IV approach is that it is difficult to find a suitable instrument (Blundell and Costa Dias, 2000). The other approach is the Heckman selection estimator. In this estimation, it is possible to derive a variable in the participation decision that can be used to control for unobserved variation in the outcome equation resulting in unbiased estimates of treatment effects. Heckman Selection estimator uses a variable which appears with a non-zero coefficient in the selection equation but does not appear in the equation of interest, known as an instrument. The main limitations of this method are that it is difficult to obtain a significant instrument and secondly the approach depends on the restrictive assumption of normally distributed errors (Wainaina *et al.*, 2012).

The Propensity Score Matching (PSM) method has gained popularity in carrying out evaluation techniques. This approach assumes that selection can be explained purely by observable characteristics. In this technique, individuals from the treatment group are matched with those from the control group sharing similar characteristics. The mean effect of treatment is then calculated as the average difference in outcomes between the treated and the non-treated. The main disadvantages of PSM is the use of Conditional Independent Assumption, in that selection is based on observables only and the PSM only estimates treatment effects where there is support for the treated individuals among the non-treated. Its main advantages over experimental evaluation techniques are that it controls for randomized bias and it is less costly to generate data. Compared to non-experimental designs, PSM gives robust results since it only evaluates individuals within the common support region. Secondly, matching does not require functional form assumptions for the outcome equation (Bryson *et al.*, 2002).

Most analysis done using PSM comprise of large sample sizes. However, recent studies have employed the model using smaller sample sizes. Propensity Score Matching can be applied when the variables used for the model are appropriate, that is, variables should have a direct impact on the outcome (Pirracchio *et al.* 2012). Further, the author noted that decreasing a sample size from 1,000 to 40 subjects does not substantially alter the Type I error rate, and leads to relative biases below 10 %. Moreover, the relative bias remained inferior to 10 %, even with small sample down to 40. Further, PSM has been applied in project and policy evaluation studies because it formulates comparison of treatment groups

better than previous models and enables estimation of the reduced-biased treatment effect (Saigenji and Zeller, 2009). Based on these findings, PSM was considered appropriate for this study.

Taking farmers under contract or selling directly to consumers as treatment groups and farmers selling in the spot market as a control group in the study, the value of average treatment effects (ATE) is defined as the average difference between household income with and without treatment for those who actually participated in treatment. The first step in the PSM model involves estimation of a binary model which enables us to estimate farmers' probability of participating (propensity scores) based on their basic characteristics. The propensity score is defined as the conditional probability of receiving a treatment given pre-treatment characteristics (Rosenbaum and Rubin, 1983). The value of the propensity score ranges from 0 to 1 with the larger score indicating a strong likelihood of participation. The binary model, in this case Logit, is specified as follows:

$$p(X \equiv Pr(D = 1|X) = E(D|X)) \dots\dots\dots (7)$$

Where $D = \{0, 1\}$ is the indicator of exposure to treatment and X is the multidimensional vector of pre-treatment characteristics.

It is important to note that Propensity Score Matching operates under Conditional Independence Assumption (CIA) which states that given a set of observable covariates X which are not affected by treatment, potential outcomes are independent of treatment assignment (Caliendo and Kopeinig, 2008). This implies that selection is only based on observable characteristics and that all variables that influence treatment assignment and potential outcomes simultaneously are observed by the researcher. After estimation of the propensity scores, the potential outcomes are then defined by $Y^1 (D^1)$ for the total population. The treatment effect for the population is written as:

$$\tau = Y^1 - Y^0 \dots\dots\dots (8)$$

A problem arises because only one of the potential outcomes is observed for each individual. Therefore estimating the individual treatment effect τ is not possible and one has to concentrate on average treatment effects (Roy 1951; Rubin 1974). Three parameters of interest for measuring average treatments effects have been used in literature. The Average Treatment effect on the Treated (ATT), gives us the expected treatment effect of contract participation which is the difference between the actual income and the income if households did not participate in contract farming. ATT is defined as:

$$ATT = E(Y^1 - Y^0|D = 1) = E(Y^1|D = 1) - E(Y^0|D = 1) \dots\dots\dots (9)$$

Where:

Y^1 is the income when the farmer participates in contract, Y^0 is the income when he does not participate in contract and D denotes contract participation, 1=participate, 0=otherwise.

ATT is conditional on contract participation. The true parameter of ATT is only identified if the outcome of treatment and control under the absence of contract are the same. This is as shown below:

$$E(Y_0|D = 1) = E(Y_0|D = 0) = 0 \dots\dots\dots (10)$$

The second parameter is the Average Treatment Effect on the Untreated (ATU). ATU is the average response to treatment for non-contract farmers (untreated group), which is stated as:

$$ATU = E(Y^1 - Y^0|D = 0) = E(Y^1|D = 0) - E(Y^0|D = 0) \dots\dots\dots (11)$$

The third parameter of interest is the Average Treatment Effect (ATE) which is the average response to treatment for a random sample from the population. This is given as:

$$ATE = E(Y^1 - Y^0|D = 1) = E(Y^1|D = 1) - E(Y^0|D = 1) \dots\dots\dots (12)$$

Since the aim of the study is to find out the effect of participation in contract farming on smallholder farmers' income, ATT was used. This parameter gives the expect income for participants.

Matching estimators

After estimating propensity score, matching of controls to each treatment using selected matching algorithm is done. Common matching algorithms used are Nearest-Neighbor Matching, Radius Matching, Kernel Matching, and Stratification Matching. Nearest Neighbour Matching (NNM) method assigns a weight equal to one to the nearest comparison unit in terms of propensity score. Generally, this can be done with or without replacement. The former creates a possibility of matching a given comparison unit to more than one treated unit while in the latter case a comparison unit is matched once. If replacement is allowed, the quality of matching will increase and the resulting treatment effect bias will decrease (Caliendo and Kopeinig, 2008).

Radius Matching (RM) or Calliper is where an individual from the control group is chosen as a matching partner for a participant that lies within the specified radius in terms of the propensity score. This is normally defined priori and it corresponds to the common

support assumption. The problem with radius matching is that the common support is forced resulting in reduced matches hence increasing the variance of the treatment effects (Caliendo and Kopeinig, 2008). However, this matching method helps to avoid poor matches which may arise through matching too distant neighbours (Smith and Todd, 2005). Kernel-Based Matching (KM) was recommended by Heckman *et al.* (1997). It matches each treated unit to a weighted sum of comparison units, with the greatest weight assigned to units with closer scores. This matching gives less variance in the estimated treatment effects and observations are seldom dropped from the sample.

Stratification Matching involves partitioning the common support of the propensity score into a set of intervals and calculating the impact within each interval using the mean difference in outcomes between treated and control observations. Generally, most scientists present their findings using a number of matching algorithms (Simtowe *et al.*, 2012; Mutasa, 2012). In cases where control and treatment groups differ significantly in their pre-treatment characteristics, nearest neighbour matching with replacement and Kernel based matching are preferred. In this study, kernel, nearest neighbour and calliper matching were used because they have been found to give limited bias in estimation as discussed above. Bootstrap standard errors based on 500 replications were reported. Nearest neighbour matching was implemented using five nearest neighbours with replacement and calliper (0.03). Kernel based matching was done using a bandwidth of 0.01 while calliper matching used a calliper of 0.05.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Household Socioeconomic Characteristics

This section presents an analysis of the socioeconomic characteristics of farmers. The sample households selected consisted of 100 farmers out of which 38% were contract farmers and 62% were non-contract farmers. As indicated in Table 2, 65% of the sampled households were male headed while 35% were female headed. This implies that the gender distribution among farmers in avocado production is skewed slightly towards males. However, the proportion of men in CF was about 71% while that of non-contract farmers was 61%. Even though findings in this study revealed that there was no significant difference in gender involvement, there were more men in CF than in non-contract farming. This could have been due to the fact that for a long time, effort to boost Africa's agricultural outputs have focused primarily on men as heads of households and best positioned to engage in commercial farming (SIANI, 2012). Additionally, it might be for the reason that men prefer engaging in cash crop farming leaving their counterparts in subsistence production. As an example, women only represent 20 percent of cocoa farmers in Ghana (Vigneri and Holmes, 2009).

About 44% of the sampled household heads were married whereas 55% were unmarried. There were 63% married farmers in contract farming compared to 52% married farmers in non-contract farming. Even though no significant difference was reported in the percentage of married members in contract and non-contract farming households, there were slightly fewer single headed households in CF. Single headed households may not participate since they may be burdened by family needs and would only enter avocado contract farming after producing enough staple food. Similarly, Ngugi *et al.* (2003) found out that households that were married had a higher likelihood of participating in rural development projects in Zimbabwe.

Those who were members of agricultural groups formed 56% of the total sample. This shows that majority of the farmers in the area are involved in farmer groups. In relation to participation in CF, a larger percentage of contract farmers were agricultural group members represented by 82% while non-contract farmers in groups only constituted 45%. The P-value for membership in agricultural groups was highly significant, implying that there was an association between membership in agricultural groups and participation in contract farming.

Table 2: Socioeconomic Characteristics of Avocado Farmers (Dummy Variables)

	Contractors=38 (38%)		Non-contractors= 62 (62%)		Pooled data (100)	
Variables (Dummy)	Frequency	%	Frequency	%	Frequency (%)	Chi2
Gender						
Male	27	71.05	38	61.29	65	
Female	11	28.95	24	38.71	35	0.987
Marital status						
Unmarried	14	36.84	30	48.39	44	
Married	24	63.16	32	51.61	56	1.274
Group membership						
Yes	31	82	28	45	59	
No	7	18	34	55	41	12.917***
Access to Credit						
Yes	31	81.58	39	62.9	70	
No	7	18.42	23	37.1	30	3.913***
Proximity to AGAK						
Yes	16	42.11	3	4.84	19	
No	22	57.89	59	95.16	81	21.261***

Significance at 1%***, 5%***, 10%*

Similar results were reported by Simmons *et al.* (2005) where smallholders who attended agricultural groups were found to be more likely to participate in seed corn CF in East Java. Groups enrich farmers with information on agriculture predominantly through

seminars, trainings or discussions with other farmers during group meetings. This information is vital for households decision making on participation in CF. With respect to this, Conley and Udry (2000) noted that network effects are important for individual decisions. Further, some groups also provide credit, which as noted earlier is a necessity for involvement in CF which requires the use of certified inputs. This is consistent with findings by Bosc *et al.* (2002) that farmer groups enhance members access to inputs.

Majority of sampled households, that is 70 % had access to credit while only 30 % did not depicting that credit services are accessible in the area. About 82 % of contract farmers were found to access credit compared to 63 % of non-contractors who did, with the statistical analysis indicating a strong association ($p < 0.001$) between access to credit and participation in contract farming. Since contract farming in Kandara did not offer credit, farmers who obtained these facilities from other institutions were more likely to participate in contract farming. Access to credit enables farmers to buy farm inputs like pesticides and fertilizers. This coincides with a study by Wanyama *et al.* (2008) who reported that farmers access to credit increased technology adoption. Contrary, most studies have found that contract farming in itself helps farmers to access credit (Deb and Suri, 2012; Prowse, 2008).

In this study, farmers who resided in the same village with AGAK leaders were considered as being close to them. Farmers' proximity to a leader determines their engagement in farm activities. Overall, only 19 % of the farmers were close to an AGAK leader which clearly depicts an element of information asymmetry in Kandara. About 42% of farmers in contract farming resided closer to a leader whereas only 5% of non-contract farmers were. The results indicated that proximity to a leader and participation in contract farming were highly correlated. This implied that farmers who were in close proximity to an AGAK leader had a higher chance of being in a contract. There is a possibility that leaders disseminated information on new technologies, contract farming in particular, which aided farmers in making decisions on contract participation. Further, it could be that farmers observed and followed farm management practices of their leaders. To augment this finding, Rogers (2003) found out that opinion leaders may assist with the innovation diffusion process.

Table 3 presents the results of continuous variables with respect to farmers in contract and non-contract farming. In the current study, sampled households were on average 64 years old. Indications are that majority of farmers were above the retirement age of 60 in Kenya. Contract farmers had a mean age of 63 years while non-contract farmers had a mean age of 65 with no statistically significant difference. In this study, the avocado enterprise is dominated by the elderly. Possible explanations could be that the enterprise does not require much labour. Further implications are that avocado farming is not attractive to young members of the population who are probably engaged in other labour intensive enterprises like vegetable, tea and coffee farming or even off-farm activities. Additionally, it could be that farmers are reluctant to disinherit farms to their children. Unlike young members, older farmers are more experienced on avocado farming hence they are more likely to practice this type of farming. Similar results were drawn in a study on pig farming by Tiongco *et al.* (2009).

The sampled households spent a mean of 7 years in education implying that they were literate. Yet, on average contract farmers attained 8.8 years in education whereas non-contract farmers attained 6.6 years with the difference being statistically significant at 5% level. This suggests that education was key in determining farmers' participation in CF. Educated household heads are expected to better comprehend the benefits of CF. This finding concurs with that of Dhillon and Singh (2006) who reported that contract farmers involved in tomato growing in India had higher levels of education than non-contract farmers.

Overall, the household size of the whole sample was 4 members, consistent with the constituency population and density data (2009) which indicated that the average household size in Kandara is 3.8 people. Household size did not vary significantly between contract and non-contract households. This could be because farmers in both categories were in the same age bracket. Kumar's study (2006) on CF in Punjab also had similar inferences where the average household size of contract farmers versus that of non-contract farmers was not different across the two categories

Table 3: Socioeconomic Characteristics of Avocado Farmers (Continuous Variables)

Variables (continuous)	Units	Contractors=38			Non-Contractor=62			Total=100		
		Mean	Std. dev		Mean	Std. dev		Mean	Std.dev	t-test
Age	Years	63.24	11.52		64.55	10.52		64.07	10.87	-0.584
Household size	Number	3.71	2.00		3.98	2.18		3.88	2.10	-0.628
Education	Years	8.79	4.78		6.57	4.46		7.41	4.69	2.356**
Dependants	Number	1.37	1.08		1.65	1.24		1.54	1.18	-1.136
Economically productive members	Number	2.16	2.10		2.08	1.64		2.11	1.82	0.205
Distance to the nearest extension	Km	3.87	2.99		4.30	3.91		4.14	3.58	-0.590
Distance to the nearest market	Km	3.39	2.62		3.67	3.72		3.58	3.36	-0.443
Farm size	Acres	2.30	1.80		2.02	1.38		2.13	1.86	0.715
Fuerte productive trees	Number	6.16	4.40		6.56	4.61		6.41	4.51	-0.436
Hass productive trees	Number	8.68	5.26		6.05	5.63		7.05	5.61	2.330**
Total productive trees	Number	14.84	7.24		11.85	7.53		13.46	7.21	1.510*

Significance at 1%***, 5%**, 10%*

Household size was further analysed using age distribution categories as proposed by Mattee *et al.* (1998) where people of the age between 15 and 64 years were considered economically productive and non-productive or dependants if the age was outside that range. Non-contract farming households had 2 dependants on average while contract farmers had an average of 1 dependant per household, with no significant difference between the groups. However, there was a marginally higher number of dependants in non-contracting households, meaning that dependency level is higher than that of contracting households. This might imply that non-contracting households can only participate in contract farming after producing enough for subsistence. Additionally, such farmers will not risk engaging in emerging enterprises like avocado which is characterised by market uncertainties, but will opt for tea and coffee which have local established markets. In line with this, Beyene (2008) reported that a household with more number of dependants in Ethiopia was less likely to participate in off-farm activities.

Results in Table 3 further show that the mean number of economically productive members was 2, with no significant differences between contracting and non-contracting households. The number of economically productive members did not influence households' decision to participate in CF in Kandara probably due to the low labour requirement in the avocado enterprise. This is contrary to a study by Mendola (2006) who found significant differences in the number of adults in the household of adopters and non-adopters of modern technology which was accredited to the importance of family labour for adoption of agricultural technologies.

The significance of extension services in determining farmers' adoption of farming technologies has been discussed in various studies (Doss and Morris, 2001; Ransom *et al.*, 2003). In the current study, the households were on average 4.1 km away from the nearest agricultural extension service. Non-contract farmers covered a mean distance of 4.3 km while contract farmers covered a mean distance of 3.89 km. Though the t-test was not statistically significant, it is clear that contract farming households were nearer to extension offices than non-contract farming households. The reason could be that extension officers were key in providing farmers with information on production and marketing which in turn influenced farmers engagement in contract farming. In line with this, Mazvimavi and Twomlow (2009) found out that farmers who had access to extension were more likely to participate in maize CF in Zimbabwe.

The average distance to the nearest market for the sampled households was 3.58 km. Both contract and non-contract farmers covered almost similar distances of 3.39 km and 3.67 km, respectively. The t-test showed no significant difference in the mean distance covered designating that distance to market did not influence farmers' choice to participate in avocado CF in Kandara. Contrary to the results of this study, Junning *et al.* (2008) found out that rice non-contract farmers were closer to the market than contract farmers.

Smallholder farmers in Kenya possess landholding of less than five acres. Results in Table 3 show that the land size owned by sampled farmers was on average 2.13 acres an indication that that they were smallholders. Contract farmers had a mean of approximately 2.3 acres whereas non-contract farmers possessed a mean of 2 acres. There was no significant difference between the size of land owned by contract and non-contract farmers suggesting that the land size did not determine farmers' participation in avocado CF in Kandara. The small pieces of land owned by farmers in Kandara district could be as a result of land subdivision caused by increasing population which is a common phenomenon in Africa. Further, smaller land size implies limited potential for expansion of the avocado sector. Miyata *et al.* (2009) revealed similar results in their study on apple growing under contract in China where both contractors and non-contractors had small landholdings.

The total number of productive trees in this study comprised of the sum of Fuerte and Hass productive trees. On average the total sample had 14 avocado productive trees, which is greater than an average of 7 trees reported by Knopp and Smarzik (2005) confirming that avocado farming has grown in the region. Nevertheless, contract farmers had a mean of 15 productive trees while non-contract farmers had 12 and the difference was statistically significant at 10% level of significance. This depicts that the number of productive trees is an important factor in determining household decision to participate in CF. The higher number of trees owned by contract farmers as compared to non-contract farmers in the study could be as a result of the expected benefits of reliable market and better prices offered in CF. Further, a farmer with more trees is likely to have more production as well as gain from economies of scale which may in turn attract contract buyers. Similar results were obtained by Andersson *et al.* (2009) in their study on impact of safety net program on livestock and trees in Ethiopia where participants had more number of trees than non-participants.

With regard to the variety of trees owned, the total sample had a mean of 7 Hass productive trees. Contract farmers had a mean of 9 Hass productive trees whereas non-contract farmers had a mean of 6. The number of Hass trees owned was significant at 5% level and this shows that there was a difference in the ownership of Hass trees between

Table 4: Household Asset and Income Profile

Variables (continuous)	Units	Contractors=38		Non-Contractor=62		Total=100		t-test
		Mean	Std. dev	Mean	Std. dev	Mean	Std.dev	
Agricultural asset	Value	43508.87	28445.75	43020.74	28324.64	43206.23	28227.78	0.084
Non-agricultural asset	Kshs	4958.29	3684.06	3813.63	3266.42	4248.60	3458.09	1.62
Total Household asset	Kshs	48467.16	29619.38	46834.37	29252.31	47454.83	29253.47	0.27
Farm Income	Kshs	110994.5	61390.32	116071.4	68627.76	114142.20	65701.17	0.373
Non-farm income	Kshs	44537.63	43544.05	30357.03	29009.36	35745.66	41840.96	1.66
Total household Income	Kshs	134487.6	62331.84	134297.9	62055.98	134370	61845.61	0.015

Significance at 1%***, 5%***, 10%*

Similarly, Patrick (2004) found out that broiler contract farmers in Indonesia had more non-agricultural assets than non-contract farmers. Altogether, the mean of total household asset for the surveyed sample was Kshs.47454. Nevertheless, the mean of total asset owned by contract farmers was valued at Kshs.48467.16 which was higher than a mean of Kshs.46834.37 of non-contract farmers. The P-value was insignificant hence there was no significant difference in the total household asset ownership between contractors and non-contractors. The old age of sampled household heads symbolises that farmers had equal time to acquire assets. Warning and Key (2002) found out that asset ownership did not determine farmers' participation in peanut CF in Senegal.

The mean farm income for the total sample was Kshs.114142 per year. Disaggregating into contract and non-contract farmers, it was found that contract farmers had a lower mean farm income of Kshs.110994.5 per year compared to non-contract farmers who had Kshs.116071, but the difference was not statistically significant. This could be because farmers have similar land sizes and hence production is limited for both contract and non-contract farmers. Contrary, Serman and Filson (1999) reported that high farm income improves the capacity to adopt agricultural innovations as farmers have the necessary capital to jumpstart the innovation.

The total off-farm income in this study consisted of income from business, salary, pensions, transfer payment and any other income apart from farm income. The mean off-farm income of the sampled surveyed was Kshs.35745 per year. Contract farmers had a mean of Kshs.44537 per year while non-contract farmers had Kshs.30357, with no significant difference. Off-farm income was much lower compared to farm income, perhaps because farmers had attained the retirement age of 60 meaning that they could not engage in formal employment which is a source of off-farm income but spent most of their time farming. Likewise, a report by Revenue Benefit Authority (2008) indicated that farming is the key source of income for retirees in Kenya.

For this study, total household income was given by the sum of farm income and off-farm income. The results show that the mean total income earned per household per year was Kshs.134370. On average both contract and non-contract farmers had almost the same amount of the mean total household income of Kshs.134487 and Kshs.134297 per year, respectively. The t-test was not significant indicating that income did not favour farmers' decision to participate in CF. Similar results were found for contract and non-contract rice farmers in Lao (Junning *et al.*, 2008). Contrary, a study by Ngugi *et al.* (2003) on the determinants of households' participation in rural development projects in Zimbabwe

reported that households with lower income were more likely to participate than households with more income.

4.2 Determinants of Smallholder Avocado Farmers' Participation in Contract Farming

A Probit analysis was done to examine the probability of participation in contract farming and provide the inverse mill's ratio for the second stage analysis of the Heckman two stage model. The Probit results are as shown in Table 5. As hypothesized age of the household head, access to credit, membership in agricultural group, proximity to AGAK leader and farmer's perception towards prices offered under contract farming had a likelihood of influencing households' decision to participate in contract farming. In this study, age was squared to take care of non-linearity. Age was negatively significant at 5 % with a marginal effect of 0.06 indicating that as the farmer's age increased by 1 year from the mean the probability of participation in avocado contract farming reduced by 6 %. However, after attaining a certain age, any increase in age had a positive impact on participation in CF as indicated by positive age squared. Older farmers were therefore seen to be reluctant to participate in avocado contract farming probably because avocado farming is a long term investment. In accordance with this, Adesina and Zinnah (1993) and Langyintuo and Mulugetta, (2005) posit that as farmers grow older, there is an increase in risk aversion and decreased interest in long-term investment in the farm. Different results were reported by Junning *et al.* (2008) who found out that older household heads tended to participate more in rice contract farming in Cambodia.

Access to credit was significant and positively affected farmers' participation in CF. An increase in access to credit increased the farmers' likelihood of participation in CF by 27 %. The positive significance implies that access to credit encourages farmer's participation in CF. Access to credit enhances farmers ability to acquire capital necessary for purchasing farm inputs, proper storage and transport facilities. This ensures that they deliver fresh and quality fruits fetching better prices hence boosting their income. The importance of access to credit as a source of capital for investing in new agricultural technologies has been emphasized by Llanto (1987). Nhundu (2010) found similar results where irrigation participants had more access to credit compared to non-participants since credit enabled farmers to increase their income base, procure irrigation equipment and enhance production in Zimbabwe.

Table 5: Probit Model Results for Determinants of Participation in Contract Farming

Explanatory Variable	Marginal Effect	Standard Error	z
Age	-0.062	0.030	-2.05**
Age squared	0.000	0.000	1.7*
Education	0.012	0.011	1.1
Marital status	0.146	0.153	0.95
Gender	0.158	0.178	0.89
Household size (14-65yrs)	0.014	0.029	0.5
Access to credit	0.263	0.099	2.65***
Agricultural group membership	0.278	0.085	3.28***
Distance to extension provider	-0.012	0.012	-0.94
Proximity to AGAK official	0.430	0.089	4.84***
Number of avocado trees	0.004	0.006	0.67
Off-farm income sources	0.028	0.099	0.29
Farm income sources	-0.140	0.129	-1.08
Perception on price	0.208	0.098	2.13**
Number of observations	100		
Prob>chi2	0.000***		
Pseudo R2	0.4192		

Significance at 1 %***, 5 %**, 10 %*

Membership in agricultural groups was highly significant and had a positive effect in influencing households' participation in contract farming. Engagement in agricultural group increased the probability of participation in CF by 28 %. Through groups, farmers can access information on new agricultural production technologies and marketing. Availability of information speeds up the adoption of new farming technologies. Moreover, groups promote economies of scale and bargaining power. Similar results were reported by Sharma (2008) in a study on Indian smallholder contract farming. Further emphasis was put across by Simmons *et al.* (2005) who found membership in agricultural groups as a significant factor in determining participation of seed corn farmers in contract farming in East Java, Bali and Limbok.

Proximity to an AGAK leader was highly significant and positively affected household participation in CF with a marginal effect of 0.43. This implies that households closer to the AGAK leader had a 43 % more chance of participating in CF. A leader is seen as a source of information therefore being close to the leader increases the frequency of interaction and information diffusion. This is consistent with findings by Rogers (2003) that opinion leaders may assist with the innovation diffusion process. Furthermore, this could be explained by the fact that the leader represents the interest of the farmers to the contractor through the association and has quick and easier follow up on contractual events like time of harvest and payment. Timely payment might encourage farmers participation in CF.

As expected in this study farmers' perception of price of fruits in contracts was positively significant at 5 % level with a marginal effect of 0.21. This suggests that an increase in the perceived price offered on contract increased the farmers' likelihood of participation in CF by 21 %. The perceived attributes of new technologies are known to condition adoption behaviour. Positive perception of price offered is associated with an expected increase in income. This concurs with findings from a study by Sribooncitta and wiboonpoongse (2008) that farmers who expected high prices in contracts had more chance of participating in CF.

4.3 Determinants of Extent of Participation in Contract Farming

The results of the second-stage of the Heckman Model used to measure the determinants of the extent of participation in contract farming are presented in Table 6. Total quantity of avocado pieces sold was used as the dependent variable. The model was appropriate as it was significant at 1 % level. Farmers' education, household size, gender, access to credit, proximity to AGAK leader, number of productive trees owned, perception of fruit price offered under contract and perception of the ability of contract to offer ready market were found to positively influence the extent of participation in contract farming. The standard errors produced were relatively high and this can be attributed to the low sample size used.

Gender had a significant positive effect on the quantity of fruits sold. The results showed that male headed households sold more fruits than their female counterparts. This could be because avocado farming is a source of cash income and therefore its likely to be male dominated. In Kenya, Women cultivate crops eaten at home while men work in the fields of cash crops (Wane, 2003).

Table 6: Heckman Results for Determinants of Extent of Participation in Contract Farming

Explanatory Variable	Coefficient	Standard error	z
Age	-1072.46	710.09	-1.51
Age squared	7.08	5.20	1.36
Gender	5328.99	1916.38	2.78***
Education	340.76	184.51	1.85*
Household size	1557.00	418.82	3.72***
Agricultural group membership	2725.58	2777.69	0.98
Access to Credit	6896.37	2510.27	2.75***
Proximity to AGAK official	6551.73	3052.11	2.15**
Distance to extension provider	-66.93	235.52	-0.28
Off-farm income sources	2185.23	1632.64	1.34
Farm income sources	-1797.26	2002.00	-0.9
Log of number of avocado trees	4170.08	1172.81	3.56***
Perception of price	7972.65	2835.23	2.81***
Perception of market	10343.69	2835.42	3.65***
Constant	-6787.67	18759.95	-0.36
Number of observations	100.00		
Censored observations	62		
Uncensored	38		
Mills	0.31		
Wald chi2 (14)	53.49		
Prob> chi2	0.000***		

Significance at 1%***, 5%** , 10%*,

Education significantly and positively determined the number of fruits sold by a household. The reason could be that literate farmers were able to conceptualize information which helped them in making economically viable decisions on contract farming markets. The findings were similar to the results of a study by Owuor (2009) where education determined farmers' participation in micro-credit schemes.

Results given in Table 6 further show that household size was highly significant and positively influenced the number of fruits sold by a contract farmer. An increase in household

size led to an increase in the amount of avocado pieces sold. Possible explanations could be that since avocado is among the major sources of income in Kandara; larger households are likely to face increased household needs hence leading to an increase in avocado sales. Ruhangawebare (2010) reported that larger households in Uganda sold more number of cattle in order to meet family needs.

Further, access to credit was also highly significant and positively influenced the number of avocado fruits sold through the contract. This implies that contract farmers who accessed credit sold more produce than those who did not, probably because they could obtain finance for purchasing inputs necessary for increasing production of quality fruits. More often farmers who have access to credit produce best quality fruits therefore few or none of their fruits are rejected by the contract buyer. Oyeyinka and Bolarinwa's (2009) study on the beneficiaries and non-beneficiaries of the Nigeria Agricultural and Cooperative Rural Development Bank smallholder loan scheme in Oyo State, found that farmers who had access to credit realised improved yield hence income.

Proximity to an AGAK leader positively contributed to the farmers' extent of participation in CF. This signifies that a contract farmer who was close to an AGAK leader sold more than the one who was far away maybe because the leader advised farmers on avocado production, harvesting and marketing through contract. Similar results were reported by Nwankwo *et al.* (2009) in their study on whether cooperative membership and participation affects adoption where leaders were ranked as the highest source of agricultural information.

The number of productive avocado trees was transformed into natural logarithms in order to eliminate skewness. The natural log of total number of productive avocado trees was highly significant at 1% level and had a positive effect in determining the number of fruits sold. This clearly depicted that as the farmers increased the number of trees, the total number of avocado fruits sold increased. The finding could be attributed to the theory of economies of scale implying that in this case farmers with more productive trees produced more fruits at a low cost. This low cost of production means increased profit per fruit which might have motivated the farmers to sell more.

Smallholder avocado farmers' perception of fruit price offered under contract was highly significant in determining the extent of their participation in CF. Findings in this study might be explained by the fact that a farmer who expected better fruit prices in CF will not only increase production but will take a step further to sell more of his produce. Further, perception on better prices under contract encourages contract compliance by the farmer who

sells the produce via contract thus reducing cases of side-selling which in turn intensifies farmers' participation in CF. Similarly, Okorley and Ayekpa (2009) found that majority of informants pointed out that upward adjustment of fruit price was likely to encourage farmers to make longterm commitment to the processing industry. Agar and Chilligo's (2008) study on various commodities produced under CF in Malawi indicated that whenever a contract buyer enforced compliance by the farmer to an agreed forward price that subsequently turned out to be below the market price at the time of sale, the contract-buyer risked the crop being side-sold or the farmer refusing to deal with the contract-buyer again.

The perception of farmers on the ability of contract farming to offer a ready market positively affected their extent of participation. The variable was highly significant at 1 % level meaning that farmers who perceived CF to offer a ready market sold more fruits. The explanation for this could be that there was certainty in the contract market which motivated farmers to increase their production, eventually leading to increased sales. Research on banana contract arrangement in Thailand found that farmers without contracts cultivated smaller areas since they had limited market opportunity to sell produce (Junning, 2008). Sriboonchitta and Wiboonpoongse (2008) revealed that farmers' positive attitude towards market certainty under contracts was a prime reason for farmers' participation in contract farming.

4.4 Effect of Contract Farming Participation on Income

The propensity score matching analysis was done to investigate the causal effect of contract participation on household income. First, propensity scores were estimated using the logit model as shown in Appendix 2. A smaller set of variables was preferred to ensure that the results obtained are robust (Pirracchio *et al.*, 2012) and to reduce the problem of larger variance due to some treated cases being discarded from the analysis or control units being used more than once (Augurzky and Schmidt, 2000). The common support condition was imposed and the balancing property tested and satisfied at 1% significance level (Appendix 3). The balancing test implemented after matching showed that the specification of the propensity was successful in terms of balancing the distribution of covariates between the two groups. This was indicated by the low pseudo R^2 , high total bias reduction and the insignificant p-value of the likelihood ratio test after matching (Appendix 4).

4.4.1 Estimation of Average Treatment Effects

The ATT for Kernel matching method, calliper and nearest neighbour were reported as Kshs.5893, Kshs.4378 and Kshs.5724, respectively. This implies that individuals who

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The household characteristics show that contracting farmers differed statistically from non-contracting farmers in terms of group membership, access to credit, proximity to AGAK leader, education and ownership of Fuerte and Hass productive trees. In terms of the household's decision to participate in CF, several variables were found to significantly influence the farmers' decision. Age negatively influenced farmers' participation in CF. Further, access to credit, membership in agricultural group, proximity to AGAK leader and perception on fruit price offered in contracts had a positive significant influence on households participation in CF.

Factors that influenced contract farmers extent of participation included education, household size, gender, access to credit, proximity to an AGAK leader, number of productive trees owned, perception of fruit price offered under contract and perception of the ability of contract to offer ready market. Education, gender, access to credit, proximity to AGAK leader, number of trees owned, perception of fruit price and ability of market to offer a ready market positively influenced the number of fruits sold by contract farmers. The PSM estimation method revealed that participation in avocado CF had no effect on the household income.

5.2 Recommendations

Access to credit was found to improve farmers' participation in CF and therefore in cases where the contract buyer does not offer credit, the government should be encouraged to participate in providing inputs that are necessary for farmers in avocado contract farming. Number of trees owned positively and significantly affected the quantity of produce sold. This implies that for farmers to increase production and sales, agricultural research institutes should consider providing farmers with certified seedlings at a fair price. Further, it is evident that even though CF did not increase farmers' income, smallholders in CF were found to have more trees of Hass variety implying that they were aware of changes in international market demands. Consequently, CF enabled farmers to access information.

As shown in this study, farmers' age negatively and significantly influenced participation in contract farming. Policy makers should come up with policies that will promote youth involvement in avocado contract farming. Further, agricultural extension officers can carry out community based seminars to increase awareness on the role of youth

in avocado contract farming. The results further suggest that there was gender bias in contract farming participation with more men being involved than women. The government and other stakeholders should tackle the issue of gender bias in the avocado value chain by creating awareness on the role of men and women in farming.

5.3 Further Research

This study focused on the aspect of participation in CF and the effect of contract farming on income. However, there are other aspects of contract farming that need to be researched on. Since the study was conducted in Kandara district, this limited scope implies that further research needs to be undertaken in other areas in order to understand the nature of contractual arrangements in different contexts to bring forth its effects on the household livelihoods, social setting and on the environment. Additionally, though farmers perceived better prices in CF, questions on whether the contract buyers provided more prices than other buyers remains ambiguous since contract farmers' income did not improve. Further research should be done on the pricing mechanism used in the avocado sector.

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APPENDIX 1: Questionnaire

This study is being carried out by a post graduate student from Egerton University in partial fulfilment of a Masters degree in Agricultural and Applied Economics. It intends to assess smallholder avocado farmers' participation in contract farming and its' implications on income in Kandara District. The purpose is purely academic. Your response to the questions will be used to assess the current position and help to formulate workable approaches to these factors which will in turn contribute to increased participation in contract farming, and hence leading to improved production and welfare. The information you provide will be treated as confidential and will be used only for the purpose of this study.

Household Number

HHID _____

Date: (dd /mm /yy)

SURDATE _____

Household Name **HHNAME** _____

Respondent(s) **RESPNAME** _____

MEM _____

(Instruction: Record the member number of the Respondent from the Demography table on page 3 after the survey is completed)

Identifying Variables:

Supervisor: _____

Enumerator: _____

Province: _____

County: _____

District: _____

Division: _____

Location: _____

Sub-Location: _____

Village: _____

SNUM _____

ENUM _____

PROV _____

COUNT _____

DIST _____

DIV _____

LOC _____

SUBLOC _____

VIL _____

Sample : 1=Group member 2=Non- member

SAMPLE _____

Group Name:

Group _____

CROPS PRODUCTION

Q2.1. How many **acres** in **total land holdings** does the household **own**?

TACRES _____

Q2.2.a. Did this household produce avocado during **MAIN/SHORT Crop Season 2011/2012**

(1= Yes No=2) - *If No, go to Q.2.3.*

MAINCROP _____

Q2.2.b. If Q 2.2 a. =Yes (1), go to table below. Otherwise skip to Q 2.2c.

Crop.sav Key Variables: *hhid, season, field, crop:harvest = 1 (MAIN HARVEST)*

Season	Crop/variety code	Field No.	Acres	Is this field 1=owned w/ deed 2=owned w/o deed 3=rented 4=owned by parent/ relative 5=government/ communal/ co-operative	If owned, who owns this field? (use mem numbers from Demog table)	If rented, what is the cost (KES) of rent for the season?	Who is responsible for this crop? (use mem from the Demog table).	Type of system of watering used 1=Rain fed 2=Irrigated	Seed type/Planting material 1=local seedlings/vines 2=improved seedlings/vines	Quantity of seed/seedlings used Cost if purchased this season			Number of productive trees (for avocado)	Harvest -777=not yet harvested	
										Quantity	Unit	Cost per unit (Ksh)		Quantity	Unit
1=Main	1=avocado (fuerte)														
2=Short	2=avocado (hass)														
	3=avocado (local)														
season	crop	field	acres	tenure	memown		memgt	system	sdtype	sqt	unit	cost	ptrees	hvt	hunit

Unit codes:

1=90 kg bag 2=kgs3=50 kg bag 4=crates 5=numbers 6=25kg bag 7=10kg bag 8=tonnes 9=debe 10=grams 11=wheelbarrow 12=cart 13=canter

Input.sav

60

HHID

LANDPREP

0=None 1=Animal traction 2=Tractor 3=Chemicals (herbicides)

Crop labor.sav

[illegible]

ACTIVITY CODES

1=Nursery for seedlings 2=Terracing 3=Slash/burn/bush clearing 4=1st plough 5=2nd plough 6=Ridging 7= Furrowing 8=Planting (include manuring and fertilizing) 9=Mulching
10=Weeding 11=Top dressing 12=Irrigation/watering 13=Pruning 14=Top working 15=Spraying 16=Watchman 17=Harvesting 18=Grading 19=Bagging/Packing
20=other (specify)

PRODUCE MARKETING

Q2.f. Did this household **sell avocado** from the **2011/2012 cropping year**? 1=Yes 2=No; (If No skip to Q 3)

SELLCROP

Crop sale.sav(key variables: hhid, crop)

[illegible]

Unit codes: 1=90kg bag 2=kg 3=50 kg bag 4=litre 5= numbers 6= 25 kg bag 7=10 kg bag 8=tonnes 9=debe 10=grams 11=w/barrow 12=cart 13=canter
14=pickup 15=Extended bag 16=5 kg bag
17=gorogoro

Q2.g. What attributes do buyers of avocado look for in the product?

ATTRIBUTE1_____ **ATTRIBUTE2**_____ **ATTRIBUTE3**_____ **ATTRIBUTE4**_____

1=Variety 2=Size 3=Maturity 4=Level of ripening 5=Cleanliness 6=Colour 7=Skin texture
8=Physical wholeness (no spots/bruises) 9=Other (specify)_____

Q2.h. What constraints, if any, do you face in the production of avocado (*Rank in order of importance*)?

PRODCONST1_____ **PRODCONST2**_____ **PRODCONST3**_____ **PRODCONST4**_____

1=Lack of clean planting materials 2=Unfavorable weather 3=Lack of agronomic advice 4=High cost of inputs 5=High incidence of pests
6=High incidence of diseases 7=Lack of agronomic management skills 8=Other (specify)_____

Q2.i. What constraints, if any, do you face in marketing of avocado (*Rank in order of importance*)?

MKTCONST1_____ **MKTCONST2**_____ **MKTCONST3**_____ **MKTCONST4**_____

1=Lack of demand 2=Low prices 3=High cost of transport 4=Unfavorable contractual arrangement 5=Other (specify)_____

PARTICIPATION IN FARMER GROUPS

Q4 a. Do you or **any member** of this household belong to **any group or organization**? 1=Yes 0=No [skip to Q5.a]

GROUP _____

Q4 b. List all the names and ID of members of the household who belong to any group and answer subsequent questions

Group.sav

Name and ID of household member who belongs to a group <i>(May have multiple lines with the same ID number, if that person belongs to multiple groups.)</i>		What type of group is this? 1=agricultural 2=savings and credit 3=education 4=community 5=religious 6=other (specify) <i>(if GRUP is not =1 then skip YRJOIN)</i>	Which activity/enterprise(s) does this group deal with? i.e. Group type		How much (Ksh) is membership fee	What services does the person get from the group? 1=credit/loan 2=marketing 3=input purchases 4=savings 5=joint extension services 6=market information 7=water catchment 6=other (specify)	Are you satisfied with the services received from the group? 1=Satisfied 2=Dissatisfied 3=Indifferent (Neutral)	If you are dissatisfied with the services received from the group why? 1=lack of skilled leadership 2=mismanagement of resources 3=lack of commitment by members 4=lack of democracy 5=Other (specify)_		What benefits does the person derive from participating in the group? 0=None 1=information 2=higher prices 3=credit/loan 4=ready market 5=other (specify)				In your experience, what are the three most important capacity building needs of this group? 0=None 1=record keeping 2=market linkages 3=lobby and advocacy 4=organizational skills 5=group dynamics 6=management skills 7=fundraising skills 8=other specify		
name	mem	grup	grpent1	grpent2	fee	service	stfac	distfc	distfc	befit1	befit2	befit3	befit4	capned1	capned2	capned3

FIANCIAL SERVICES - CREDIT

Q5a. Did any member of this household **apply for credit** (either cash or in kind) between **May2011 and April 2012?**
 1 = yes 2 = no →go to Q5c

CREDTRY _____

Q5b. Complete in the table below details of all credit applied by the household

Credit.sav: Key variables *hhidmemcrsorcecrpurperentp* (Reference period: **May 2011 to April 2012**)

Name of person who applied for the credit	ID of person who applied for the credit (get ID from demograp hy table)	Amount applied for (Ksh) <i>List each credit amount on a separate line.</i>	Form of credit applied for 1= cash 2= in-kind	Person or instituti on applied from? <i>Use codes below.</i>	Main Purpose for which credit was sought 1=agricult ural 2=school fees 3=medical 4=business 5=other household need (Specify)_	If main purpose was agricultur al, specify the enterprise	Was the applicatio n successful ? 1=Yes [skip to <i>amtrec</i>] 0=No	If credit denied , reason for denial 1=no security 2=outstand ing loan 3=don't know 4=Other (specify)	Amount received (Ksh)	Amount to repay includin g interest (Ksh) per month	Repayme nt period in months	Did you provide collatera l? 1=Yes 0=No	If collater al, type	Were you satisfied with the terms and conditions of the loan? 1=Satisfied 2=Dissatisf ied 3=Indiffere nt (Neutral)	If you were not satisfied with the terms and conditions, why? 1=High interest rate 2=Stringent rules 3=Long process 4=Hidden information 5=Other (specify)_____		
name	mem	cramnt	crform	crsorce	crpurp	crentp	suces	crdeny	amtrec	amtrep	period	colat	coltyp	crdsat	crdntsat1	crdntsat2	crdntsat3

Source of credit codes 1=Family member/relative 2=Friend 3=Employer				4=Commercial bank 5=SACCO 6=Group (Registered) 7=Group (Unregistered)				8=MF1 9=Money lender 10=KTDA 11=Coffee coop				12=KFA 13=Other Coop 14=Other, (Specify)				COLTYP 1=Title deed 2=Shares 3=Household Asset 4=Other Specify_____			
---	--	--	--	--	--	--	--	--	--	--	--	---	--	--	--	--	--	--	--

Q5c. If **Q5a= No**, why did **you or any member of your household** not apply for credit in the last 12 months?

NOCRED _____

*1=No security/collateral 2=Had outstanding loan 3= Credit received in kind 4= Don't Know 5=Did not need credit 6=Credit services unavailable
7= Other (specify) _____*

Q5d. In **your opinion**, how would you rate the following attributes of credit to farmers in this area?

i. Availability of credit services *1=unavailable 2=available but few 3=adequately available*

CRAVAIL _____

ii. Interest rate charged on credit *1=exorbitant 2=reasonable 3=too low*

CRINTERST _____

iii. Application process/procedure for credit *1=too long 2=reasonable 3=too short*

CRAPROCESS

iv. Information on terms and conditions of credit *1= not clear 2=inadequate 3= clear*

CRINFO _____

v. Stringency of terms and conditions of credit *1=very stringent 2=favorable 3=not stringent*

CRCOND _____

Q5e. What **constraints**, if any, have you faced in accessing credit?

CRCONST1 _____ **RCONST2** _____ **CRCONST3** _____ **CRCONST4** _____ **CRCONST5** _____

1=few credit services 2=lack of collateral/security 3=exorbitant interest rates 4=tedious application procedure 5=stringent terms and conditions

FIANCIAL SERVICES – SAVINGS

Q5f. Does any member of this household have a savings/current account? (*Enumerator: Probe for all savings accounts including those in cooperatives, ROSCAs e.t.c*) 1=Yes 2=No (*Skip to Q5h*)

SHACCNT _____

Q5g. Complete the table below with details about the savings/current accounts held. (*Enumerator to probe for all savings accounts including those in cooperatives, ROSCAs e.t.c*)

Savings.sav (key variables: hhid, mem, wrsave, distbank)

Name of person with account	ID number of the person (From the demog table).	Where is the savings account? (<i>see codes</i>) 1=Post Bank 2=SACCO 3=Commercial Bank 4=MFI 5=Groups (ROSCAs) 6=Village bank 7=Mobile money/account 7= Other (<i>specify</i>)	What is the distance to this banking institution? (kilometres)
name	mem	wrsave	distbank

Q5h. If no member in the household does not have a savings/current account, why?

NACCNT _____

1=No money to save
bank charges

2=No nearby financial institution

3= Ignorance/illiteracy

4=Ready money (convenience)

5= High

6=Other (*specify*) _____

ACCESS TO AGRICULTURAL INFORMATION

Q6a. What are your main sources of **information on agricultural production and marketing**? FINFO1 _____ FINFO2 _____ FINFO3 _____

1=Government organizations
 2=Non-governmental extension agents
 3=Other farmers
 4=Farmers organizations / Cooperatives
 5=Radio
 6=Mobile phone

7=Newspapers
 8=Farmers' magazines /newsletters
 9=Input dealers
 10=Field days /demonstrations
 11=Extension leaflets
 12=Agricultural shows (ASK)

13=Internet
 14=Private service providers
 15=Research institutions
 16=Commodity traders
 17=Other (specify) _____

Q6b. Which methods/media do you find **most effective and convenient** for dissemination of agricultural information to farmers? (*Select from the list in column 1*)

Information.sav

Method	List the methods /media that you prefer	What two attributes makes you prefer this particular method/media?	
MEDIA	METHOD	RPREF1	RPREF2
1=Radio			
2=Newspapers			
3=Tours			
4=Field days/demonstrations			
5=Television			
6=Group discussions			
7=Short courses			
8=Group meetings (Barazas)			
9=Extension leaflets			
10=Newsletters /bulletins			
11=Internet			
12=Telephony			
13=Face to face contact			
14=Farm Visits			
15=Mobile phone			
15=Other specify _____			
		Reason codes 1=practical 2=cost effective 3=materials can be used for further reference 4=reliability and accessibility 6=Other specify _____	

HOUSEHOLD INCOME

Crop income

Q7a. How much income did the household receive from **crop** enterprises in the 2011/2012 cropping year? (**Enumerator: Fill in either quantity and prices or approximate value of production**)

Enterprise		Quantity produced and unit		Price for largest sale/Prevailing price	Approximate value of production
		PRODQTY	UNIT	CPRICE	PRODVAL
Cereals					
Maize	1				
Wheat	2				
Rice	3				
Other cereals	6				
Pulses and oil crops					
Beans	7				
Cowpeas	8				
Green grams	9				
Pigeon peas	10				
Ground nuts	11				
Other pulses and oil crops	12				
Roots and tubers					
Irish potatoes	13				
Sweet potatoes	14				
Cassava	15				
Other roots and tubers	17				
Vegetables					
Sukuma wiki	18				
Tomatoes	19				
Cabbages	20				
Other vegetables	21				
Fruits					
Bananas	22				
Avocado	23				
Mango	24				
Passion fruit	25				
Other fruits	26				
Cash crops					
Tea	27				
Coffee	28				
Sugarcane	29				
Other cash crops	30				

Unit codes: 1=90kg bag 2=kg 3=crate 5=number 6=bunches 9=gogoro 10=ton 11=50kg bag 12=debe

Livestock income

Q7b. How much income did the household receive from **sales of livestock** between May 2011 and April 2012? (**Enumerator: Fill in either number and average price or total revenue**)

Livestock sales.sav

Livestock species		Number sold and average price per animal price		Total revenue (Ksh)
		NSOLD	ANIMPRICE	LSTREV
Cattle	1			
Goats	2			
Sheep	3			
Chicken - Indigenous	4			
Chicken – Improved	5			
Other livestock	6			

Q7c. How much income did the household receive from **livestock products** between May 2011 and April 2012? (**Enumerator: Fill in either quantity and prices or approximate value of production**)

Livestock products.sav

Enterprise		Quantity produced and unit		Price for largest sale/Prevailing price	Approximate value of production
		LPRODQTY	LUNIT	LPRICE	LPRODVAL
Cow milk	1				
Goat milk	2				
Eggs	3				
Honey	4				
Fish	5				
Other products	6				

Off-farm income

Q7d. List all off-farm income (including remittances, dividends and pension) earned by all household members May 2011 and April 2012.

Off farm income.sav

Person name (<i>As in demography table</i>)	Person ID (<i>As in demography table</i>)	Which Income earning activity(ies)? (<i>See activity codes below</i>)	Months involved in the activity in the last 12 months	What was the monthly estimate of income (Kshs) from this activity
NAME	MEM	ACTIVITY	ACTMONTH	INCMONTH

INFRASTRUCTURE (*Measures of market access*)

Q8. Distances (km) from your homestead (*-7=service not available*).

- a. What is the distance from your homestead to the **nearest agricultural extension service provider?** DEXTN_____
- b. What is the distance from your homestead to the **nearest animal health service provider?** DVET_____
- c. What is the distance from your homestead to the **nearest market place for farm produce?** MKTKM_____
- d. What is the **type of the road** from your homestead to the **nearest farm produce market?** RDAGMKT_____ (*use codes below*)
- e. What is the distance from your homestead to the **nearest livestock market place?** ANIMKT_____
- f. What is the **type of the road** from your homestead to the **nearest livestock market place?** RDLSTMKT_____ (*use codes below*)

Road type codes: 1=murum /all weather 2=tarmac 3=dry weather 4=foot path.

Contract Farming

HHID

Do you have experience with CF 0=No 1=Yes (If No, go to next table last row)	Are you currently engaged in CF? 0=No 1=Yes	If Yes, please specify								
		How many years have you been involved in CF (Indicate)	Type of contract 0=Formal 1=Informal	Does the contract specify condition for exit/termination of either party? 0=No 1=Yes	Are there clear rules to prevent breach? 0=No 1=Yes	Is an arbitrator specified 0=No 1=Yes	Did you participate in formulating terms and conditions 0=No 1=Yes	If No, do you know the terms and conditions for the contract 0=No 1=Yes	Name of the contractor (Indicate)	Which market does he sell to? 1=Export 2=Local 3=Both

What do you get from Contract Farming (<i>Three main</i>)	1.
	2.
	3.
Challenges faced in producing under contract (<i>Three main</i>)	1.
	2.
	3.
How does marketing under contract compare to traditional marketing (<i>Brokers/spot markets</i>)	
If No, what are the reasons for not participating in contract	1.
	2.
	3.

PRODUCTION FOR 2012

HHID _____

Variety 1=Fuerte 2=Hass 3=Local	Grade 1=Grade 1 2=Grade 2	Quantity sold	Unit (Use codes below)	Mode of sale 1=Through farmer group 2=Individually	Buyer (Use codes below)	Transport cost (Kshs)

Unit codes: 1=90kg bag 2=kg 3=50 kg bag 4=litre 5= numbers 6= 25 kg bag 7=10 kg bag 8=tonnes 9=debe 10=grams 11=w/barrow 12=cart 13=canter 14=pickup 15=Extended bag 16=5 kg bags 17=gorogoro

Buyer type codes: 1=Small trader 2=Large trader 3=Exporter 4=Processor 5=Supermarket 6=NGO 7=Consumer 8=Broker 9=Other (specify)

RISKS

Do you face and marketing risks 0=No 1=Yes	If Yes, what kind of risks do you face (e.g Bad Weather, Pests, Diseases, Poor quality fruits, price fluctuation, unavailability of market)	Who compensates for production losses due to risks 1=None 2=Buyer 3=Insurance company 4=Government	Who compensates for post-harvest losses due to risks 1=None 2=Buyer 3=Insurance company 4=Government	Are you trained on EUREPGAP 0=No 1=Yes
	1.			
	2.			
	3.			

MARKETING

Do you have access to buyer/market 0=No 1=Yes	How accessible is the buyer/market 1=Accessible 2=Moderately accessible 3=Inaccessible	Who pays for transport 1=Farmer 2=Buyer	To whom do the crates belong to 1=Farmer 2=Buyer	Are there documents which have to accompany the produce (traceability) 0=No 1=Yes	How does the price paid by the buyer you sell most to compare to other markets you might supply (Indicate)	After how long are you paid for your produce (Indicate)	How satisfied are you with the time taken 1=Satisfied 2=Indifferent 3=Dissatisfied
How is the payment made 1=To individual directly 2=Through the group	What is the mode of payment 1=Cheque 2=Money transfer 3=Cash	How satisfied are you with this mode of payment 1=Satisfied 2=Indifferent 3=Dissatisfied	How variable are the prices that you receive in the market you sell most to 1=Variable 2=Moderately variable 3=Invariable	What percentage of your produce was able to meet quality requirements of the buyer in the period of 1=<20% 2=About 50% 3=>50%			
				2011		2012	

ECONOMIC CHARACTERISTICS

What kind of investments have you made since you started contract farming	1.	4.
	2.	5.
	3.	
Which basic needs are you able to meet (school fee, health expenses, education, sufficient food, clothing, others)	Currently	Before starting contract farming
	1.	1.
	2.	2.
	3.	3.

ASSETS

Asset	No. of assets	Value, KSHs	Ownership 1= Husband; 2 =Wife; 3= Joint ownership	When was asset acquired? 1=One year ago; 2=Two years ago; 3=Three years ago; 4=> Three years ago
Non-Agricultural Assets				
Bicycles				
Motor cycle				
Mobile phone				
Others				
Agricultural Assets				
Wheel barrows				
Irrigation equipment				
Spraying pump				
Livestock				
Tractor				
Others (specify)				

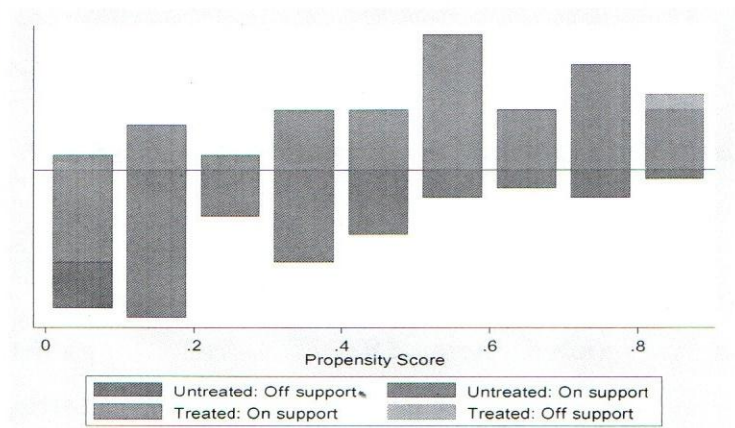
HHID _____

APPENDIX 2: Estimation of Propensity Scores

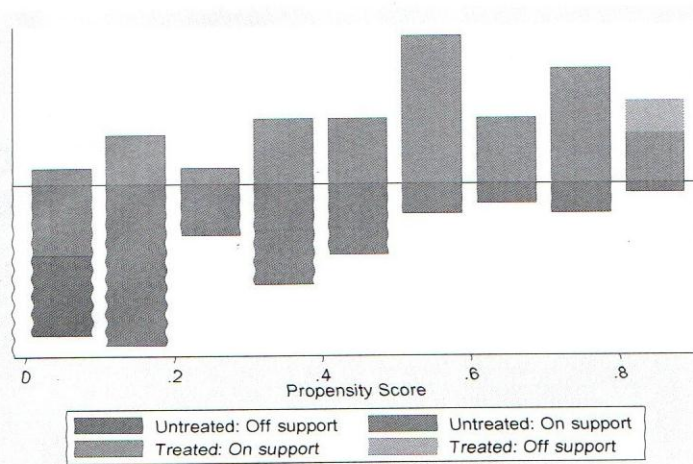
	Marginal Effect	Standard Error	z
Age	0.00	0.01	-0.60
Marital status	0.19	0.15	1.25
Access to credit	0.22	0.09	2.33**
Log of Number of trees	0.08	0.07	1.22
Agricultural group membership	0.35	0.08	4.28***
Gender	0.15	0.18	0.86
Distance to extension	-0.01	0.01	-1.05
Education	0.02	0.01	1.57
Log of asset	0.02	0.01	1.57
Road status	0.15	0.10	1.45
Log of farm size	-0.09	0.06	-1.43
Household Asset	0.00	0.00	0.16
Number of observations	100.00		
LR chi2(8)	30.57		
Prob> chi2	0.002***		
Pseudo R2	0.23		

Significance at: 1%***, 5%** , 10%*

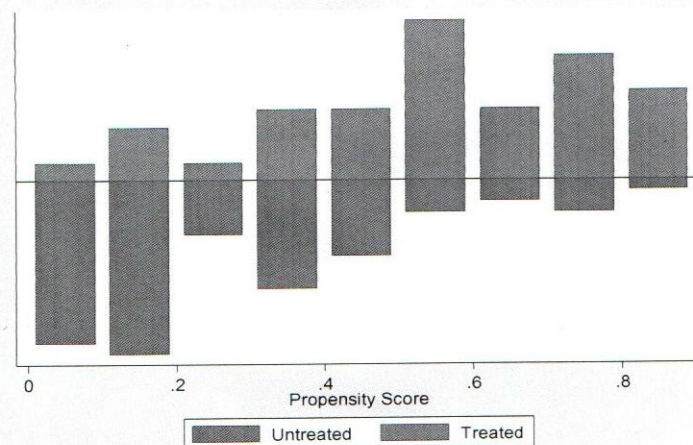
APPENDIX 3: Histograms of estimated propensity scores



Kernel matching



Calliper matching



Nearest neighbour matching

APPENDIX 4: Propensity Score Matching Quality Indicators

	Pseudo R2	Pseudo	LR	Chi2	LR	Chi2	Mean	std	Mean	std	Total	%
Matching	before	R2	after	before	after		bias	before	bias	after	bias	
Algorithm	Matching	Matching	Matching	Matching	Matching		matching		matching		reduction	
Kernel Based	0.23	0.19	24.66	18.29	26.51		8.1				69.40	
Calliper	0.23	0.17	30.78	21.35	26.5		8.5				67.92	
Nearest												
Neighbour	0.23	0.19	30.78	26.29	26.51		9.59				63.82	