

**AN ECONOMIC ASSESSMENT OF THE FACTORS THAT INFLUENCE
SMALLHOLDER FARMER PARTICIPATION IN EXPORT MARKETS AS A CASE
OF HIGH VALUE MANGO MARKETS IN SOUTHERN GHANA**

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DECLARATION

This thesis is my original work and has not been presented for the award of a degree in any other institution.

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DEDICATION

To my mom, Joyce Kumi

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
EDAIF	Export Development and Agricultural Investment Fund
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEPA	Ghana Export Promotion Authority
GIZ	Deutsche Gesellschaft fuer Internationale Zusammenarbeit (German International Development Agency)
GLSS	Ghana Living Standards Survey
GoG	Government of Ghana
GSS	Ghana Statistical Service
ODK	Open Data Kit
RUT	Random Utility Theory
SPSS	Statistical Package for the Social Sciences
USAID	United States Agency for International Development
VIF	Variance Inflation Factor

ABSTRACT

Market participation is critical to the development of smallholder agricultural production because it stimulates increased productivity and enhances poverty alleviation. The levels of access to and participation in high value markets by smallholder mango farmers in Southern Ghana are low. It is not clear what factors influence participation and the level of participation in high value mango markets by smallholder mango farmers in Ghana. Knowledge on these factors would be important when devising and formulating appropriate measures to enhance participation by Ghana's smallholder mango farmers in high value markets. This study analyzed the factors that influence participation and the level of participation of Ghana's smallholder mango farmers in export markets as a case of high value mango markets. The study characterized the mango marketing system in Southern Ghana using descriptive statistics. A triple hurdle model was used in the study to capture a 3-step decision-making process in which a binary probit model was used to assess the factors influencing access to and participation in either low or high value markets in the first stage. In the second stage, a binary probit model was used to assess the factors that influence the choice of a high value market (domestic or export high value market). A tobit model was employed in the final stage to determine the level of market participation in terms of how much is to be sold in the export market. The study was undertaken in Southern Ghana. In this region, the Shai Osudoku, Yilo Krobo and Manya Krobo districts were purposively selected because of their high level of mango production. The multistage sampling technique was used to select 224 mango farmers. Data were collected using a pre-tested semi-structured questionnaire and were captured in SPSS (version 21) software and analyzed with STATA 15. The results from the estimation of the triple-hurdle model showed that participation in high value mango markets was influenced by education, household income, farming experience, ownership of a motorized transport (tricycle), ownership of a radio, trust,

distance to nearest tarmacked road, certification and access to credit. The level of participation in mango export markets as a case of high value markets was determined by household size, household income, farming experience and access to credit. Based on the study findings, it is recommended that institutional support including certification and credit should be provided to smallholder mango farmers. This institutional support should be coupled with practical-based education and training to ensure that the farmers meet the stringent requirements of high value markets and, consequently, increase their participation and the level of participation in high value markets. Also, to ease mango farmers' access to and participation in high value markets, rural infrastructural development should be geared towards improving road networks to mango farms. Further, to ensure market efficiency and enhance smallholder farmer participation in competitive markets, the study recommends the reduction of transaction costs through the provision of equipment, such as motorized transport (tricycles) and radio; and the encouragement of transparency between trading partners to enhance trust between them.

CHAPTER ONE: INTRODUCTION

1.1 Background

Agriculture is a dominant economic activity in Ghana and accounts for 18.7 percent of Ghana's gross domestic product (GDP) (Ghana Statistical Service (GSS), 2018). Horticulture is an important component of agriculture in Ghana as it contributes about 2.2 percent to Ghana's GDP (Adoma & Yeboah, 2017). In 2016, Ghana's horticultural exports earned an estimated US\$ 82 million with a 5.2 percent growth over the 2015 earnings (Ghana Export Promotion Authority, 2017). The fruits and vegetables sector of Ghana provides jobs for many men and women, thereby increasing household income and reducing poverty. Regarding food and nutrition security, the horticultural sector of Ghana increases the availability and utilization of nutritious foods through an increase in production of fruits and vegetables (Joosten et al., 2015).

In Ghana, horticultural products are intensively cultivated for domestic consumption and foreign trade (Agyei-Sasu et al., 2013; Voisard & Jaeger, 2003). According to Agyei-Sasu et al. (2013), the Ghana Export Promotion Authority (GEPA) categorizes the various horticultural products in Ghana under fruits, vegetables, spices, medicinal plants, oil seeds and nuts, and flowers and ornamental plants. The major fruits produced for domestic consumption and export are pineapples, papaya, citrus, mango, and passion (Voisard & Jaeger, 2003). Of these, pineapple is the leading commodity in terms of production and export value. However, mango has a big growth potential considering its local and global demand of 1.37 million tons which rivals that of pineapple (Akurugu, 2016; Danielou & Ravry, 2005; FAOSTAT, 2019; Zakari, 2012).

Ghana's mango subsector has been experiencing a rapid growth after a recent fall in the pineapple subsector due to climate change, inadequate supply of inputs and land inaccessibility (Grumiller et al., 2018). This growth has been fueled by food security and value-chain

development projects which have actively been financed by United States Agency for International Development (USAID), Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) and Export Development and Agricultural Investment Fund (EDAIF) of Ghana. Consequently, the mango subsector is the leading component of the horticultural crops under large-scale production in Ghana (Broek et al., 2016). However, a study done by Micah and Inkoom (2016) found that the expansion of mango production in Ghana is increasingly being threatened by various challenges, including pests and diseases, inadequate input access, lack of skilled labor, inadequate credit access and inadequate extension services. Overcoming these constraints could increase mango production for improved livelihoods and food and nutrition security of smallholder mango farmers in Ghana.

Market participation by smallholder mango farmers can play a vital role in poverty alleviation and rural development and there is the need to make markets become the lifeline of smallholder agriculture production (Ahmed et al., 2016). Barret (2008) argues that policy interventions that are geared towards facilitating smallholder farmer organization, reducing transaction costs and improving access to improved technologies and productive assets by poorer households can stimulate market participation by smallholder farmers and further lead to their escape from semi-subsistence poverty traps. However, there are limited market-oriented policies in favor of smallholder mango farmers in Ghana. Efforts to improve the mango value-chain in Ghana have been limited to the reduction of post-harvest losses through the establishment of storage facilities (Zakari, 2012). Attempts to link farmers to market niches which can improve their welfare have not been made.

Mango farmers in Ghana participate in both local and foreign markets for income generation, with the foreign markets being the most remunerative markets due to the relatively high prices

offered at the foreign markets (Zakari, 2012). Zakari (2012) characterized the mango value-chain of Ghana and found that access to these markets requires the mango farmers in Ghana to meet some product requirements that are apparently not a concern of buyers from local markets. According to Zakari (2012), the stringent requirements of buyers from the foreign markets mainly include quality and certification (GlobalGAP certification) requirements (such as storage pesticides and pesticide residue limits, record keeping of all farm activities, and fertilizer usage and soil fumigation). Further, Grumiller et al. (2017) identified unorganized and poorly developed marketing systems, poor infrastructure, erratic government intervention and institutional failures as some of the challenges in the distribution of mangoes in Ghana. These challenges tend to cause post-harvest losses of between 25 percent and 30 percent which significantly affect the incomes of smallholder farmers.

Considering the important role of market participation in employment and income generation for smallholder mango farmers, there is need for attention from the Government of Ghana (GoG) and development partners alike to put in place measures that can lead to overcoming marketing constraints in the mango subsector of Ghana. This will ensure that mango famers in Southern Ghana will reduce post-harvest losses and maximize benefits from increased participation in remunerative markets.

1.2 Statement of the research problem

Mangoes in Southern Ghana are predominantly marketed domestically owing to the challenges that the smallholder mango farmers face when trying to access foreign markets. Of the 70 percent of mangoes that are marketed in Ghana, about 56 percent ends up in the local markets that offer relatively low prices (Grumiller et al., 2018). The domestic and foreign high value

markets account for about 30 percent and 14 percent of mango sales respectively. While the local low value markets offer Ghana Cedi (GH¢) 0.90 (US\$1 = GH¢ 5) per kg of mangoes, the high value markets (i.e., industrial processors and exporters) offer up to GH¢ 3.0 per kg of mangoes (Baidoo-Williams, 2017). The inability of the majority of smallholder mango farmers in Southern Ghana to access high value markets implies a lost opportunity to maximize income from mango sales and, consequently, household income. With appropriate measures, the capacity of smallholder mango farmers in Ghana could be enhanced to improve their access to high value markets.

From the foregoing account, mango farmers in Southern Ghana have two broad marketing channels to sell their produce through: domestic low value channels which will be referred to as “local traders” in this study, and high value channels. The high value channels include both domestic markets (such as supermarkets and industrial processors) and export markets (Grummiller et al., 2018). Although the high value markets offer relatively higher prices than those offered by the low value ones, smallholder mango farmers’ access to these markets remains low (Grumiller et al., 2018; Zakari, 2012). Yet, participating in high value markets would provide an opportunity for smallholder mango farmers in Southern Ghana to improve their household incomes and hence social welfare.

The studies undertaken on mangoes in Ghana have mainly focused on production issues (Mensah & Brummer, 2016; Micah & Inkoom, 2016) and post-harvest losses (Akurugu et al., 2016). Elsewhere outside Ghana, a number of studies on mangoes have been undertaken. Examples include Gopalakrishnan (2013) on the determinants of smallholder mango farmers’ choice of marketing channels in India, Honja et al. (2017) on a review of mango value-chain in Ethiopia and Maina et al. (2015) and Muthini et al. (2017) on the determinants of smallholder mango

farmers' choice of marketing channels in Kenya. These studies examine some selected demographic, institutional and socio-economic factors that influence the choice of a marketing channel by smallholder farmers under their particular socio-cultural and economic environment. However, the factors that influence participation as well as the level of participation in export markets as a case of high value mango markets by smallholder farmers in Southern Ghana have not been evaluated. The current study was undertaken to fill this knowledge gap.

1.3. Objectives of the Study

The overall objective of this study was to analyze the factors that influence participation and the level of participation of smallholder farmers in Southern Ghana in high value mango markets with export markets as the case in point. The specific objectives were:

1. To characterize the mango marketing system in Southern Ghana.
2. To evaluate the factors that influence smallholder mango farmers' participation as well as the level of participation in export markets as a case of high value markets for Southern Ghana.

1.4. Hypotheses

The following hypotheses were tested in the study:

1. That the smallholder mango farmers' socio-demographic, farm, market and institutional factors, including transaction costs are similar across those who use different marketing channels in Southern Ghana.

2. That socio-demographic, farm, market and institutional factors, taken severally or singly, do not influence participation and the level of participation of smallholder mango farmers in export markets which are a case of high value markets for Southern Ghana.

1.5. Justification

The majority of the Ghana's poor live in the rural areas practicing smallholder agriculture. Increasing farmers' access to high value or niche markets has the potential to reduce poverty and increase farmers' resilience through improved incomes and food security (Markelova et al., 2009). Therefore, an understanding of the factors that influence smallholder farmers' access to high value mango markets is essential not only for devising policies to improve mango farmers' access to high value markets but also for improving their welfare. This study was undertaken to assess the factors influencing participation and the level of participation in export markets as a case of high value markets by smallholder mango farmers in Southern Ghana. The results provide information that policymakers can use to develop market-oriented policies which can improve the mango value-chain and the welfare of mango farmers. At the same time, the findings of this study can be used to inform smallholder mango farmers on what they can do to improve their access to high value mango markets. Other actors in the mango value chain, for example buyers from high value markets, can use the findings to formulate appropriate strategies to assist farmers to meet the mango market demands in terms of both quality and quantity. The findings of the study can inform extension workers about what needs to be done to ensure that the farmers meet the requirements of high value markets to improve their access to these markets. Finally, the findings of this study will contribute to the existing body of knowledge on factors that influence market participation and the level of participation by mango farmers.

CHAPTER TWO: LITERATURE REVIEW

2.1 Trends in mango production and marketing in Ghana

Ghana is the 34th largest producer of mango (*Mangifera indica L.*) in the world (FAOSTAT, 2019). The hot and humid tropical climate coupled with bimodal rainfall and fertile soils are suitable for mango production (Okorley, 2014). The fruit is widely grown in six regions with Eastern Region leading mango production. Six main varieties of mango are produced. Smallholder farmers account for 90 percent of mango production; the rest comes from medium and large scale producers (Van Melle & Buschmann, 2013). Figure 2.1 shows the trends in mango production from 2007 to 2017 in Ghana. The figure shows that there has been a rise in mango production over the past decade.

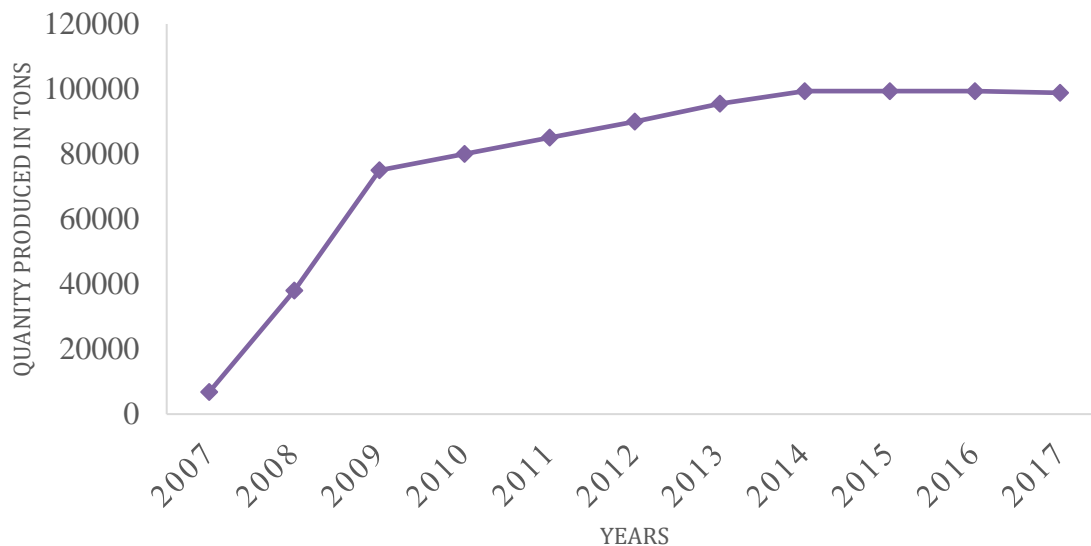


Figure 2. 1: Trends in mango production in Ghana

Source: FAOSTAT (2019)

Mango production in Ghana reached its peak in 2014, with estimated output of 99,358 tons, after which the output remained more or less the same between 2014 and 2017. Studies (such as Micah & Inkoom, 2016) show that Ghana has the potential to produce beyond 98,857 tons of

mango. However, mango production is increasingly being constrained by inadequate access to extension services, the high incidence of pests and diseases, inadequate storage facilities and weak institutional support.

Unlike Northern Ghana, Southern Ghana has two mango harvest or marketing seasons where the main marketing season is March to July while the low season is October to November (Okorley, 2014). In 2017, export earnings from mango amounted to US\$59,326,000 (FAOSTAT 2019) while the mango subsector contributed about 0.3 percent to Ghana's agricultural GDP (Grumiller et al., 2018). Out of the quantity of the mangoes produced in the country in 2017, a third was lost as post-harvest losses while 40.5, 20 and 9.5 percent were, respectively, consumed locally as fresh mangoes, locally processed and exported (Grumiller et al., 2018). The major destination regions or countries include the EU, Lebanon, Israel and the USA. A high proportion of Ghana's mango exports is processed. For example, in 2016, the country exported 845 tons of fresh mangoes, 900 tons of dried mangoes and 1,700 tons of fresh cut mangoes (Grumiller et al., 2018). Ghana has 13 percent share of the United Kingdom mango market with an average annual growth of 41 percent between the period of 2013 to 2017 (GEPA, 2018) and which is ranked 16th globally in terms of mango exports. Figure 2.2 presents trends in mango exports for ten years, and shows that the country's mango exports to the rest of the world have been fluctuating over the past decade. Recent data show that Ghana recorded its highest export in 2017 with volume of 9,352 tons valued at US\$ 59 million.

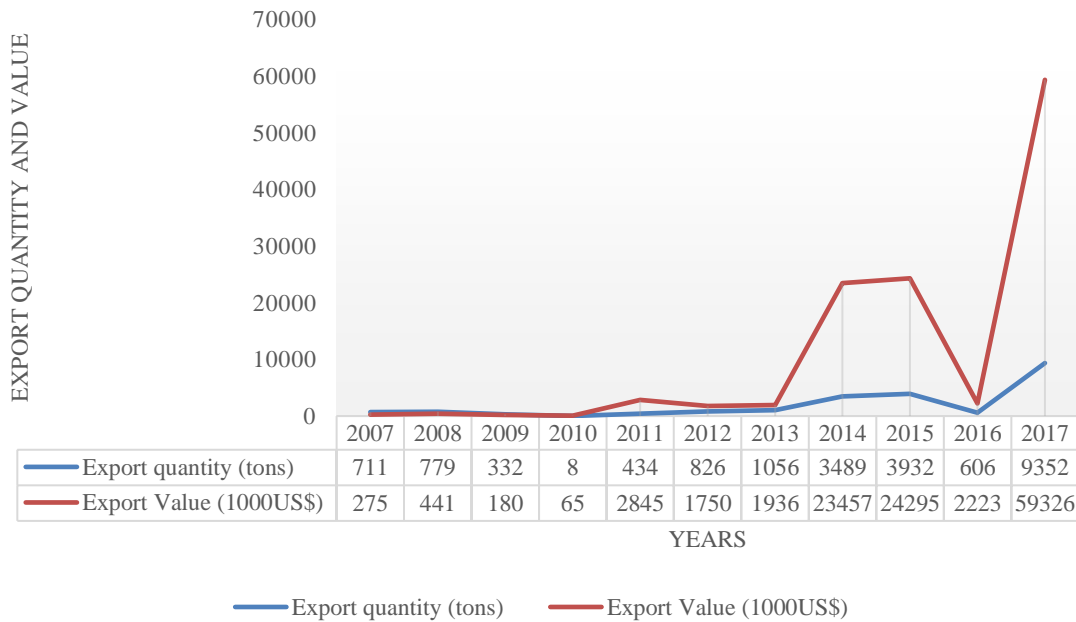


Figure 2. 2: Trends in Ghana’s mango exports

Source: FAOSTAT (2019)

The tremendous increase in the value of Ghana’s mango exports between 2013 and 2015 is attributable to rising but also highly variable mango export prices. In 2016, the mango subsector was hit by the Bacterial Black Spot (BBS) disease which led to a drastic fall in its exports. In 2017, the subsector made a quick recovery which led to an increase in both the quantity and the value of mango exports.

2.2 Review of Theories Underpinning Market Participation

2.2.1 Defining the concept of market participation

Market participation is an important determinant of well-being of smallholder farmers. Output market participation involves a shift from either subsistence farming to semi-subsistence farming (where output surpluses are sold) or to market-oriented farming where production is mainly aimed at commercialization (Barret, 2008). Mango production is highly market-oriented with the

primary goal of income generation and mango marketing is mainly influenced by some socio-demographic, farm, market and institutional factors, including transaction costs.

2.2.2 Theories underpinning the concept of market participation

The main theories that underpin the concept of market participation by agricultural households include the Lancaster Consumer Theory, the Expected Utility Theory, the Random Utility Theory (RUT) and the Household Production Model. However, the most widely used theories in the literature for modelling market participation among agricultural households are the Household Production Model and the Random Utility Theory. According to Jagwe and Machethe (2011), the household production model is used when a household is both a producer and a consumer of what is produced. In this case, the household makes production decisions regarding what to produce, how much to produce and how much of what is produced should be used as inputs. Also, the household makes decisions regarding market participation in terms of how much to purchase and to sell. This model takes into consideration the possibility that a household could be a net buyer or a net seller. According to Key et al. (2000), the household production model incorporates important variables, such as risk and uncertainty and transaction costs that influence household production, consumption and marketing. This incorporation makes the household production model makes it flexible to be adapted for market participation studies. An example of the application of the household production model is Jagwe and Machethe (2011) who used it to assess the effect of transaction costs on market participation by smallholder farmers in banana markets in Burundi, Rwanda and Democratic Republic of Congo.

The random utility theory, on the other hand, assumes that decision-makers choose an alternative from a set of alternatives that maximizes their utility (Greene & Hensher, 2009). In this model, decision-makers have both observable and unobservable characteristics that can influence their

choice of a utility-maximizing alternative (Greene & Hensher, 2009). The observable characteristics include gender, age, education and farm characteristics, while the unobservable ones include intrinsic factors, such as motivation and ability (Greene, 2012). These unobservable characteristics are often unmeasurable and are captured by the error term. Azari et al. (2014) argue that the random utility model is advantageous when compared with the household production model because the former captures the strength of a preference of decision-makers owing to their outcome while the latter does not explicitly capture the strength of a preference of decision-makers.

This study aimed to elucidate the factors influencing farmers' market participation in high value mango markets. Therefore, the best theoretical model underpinning such behavior was considered to be the random utility model as opposed to the agricultural household model. This is because, unlike subsistence crop producers who consume a large portion of their produce, cash crop farmers (mango farmers in this case) do not (Kumba et al., 2015). The major concerns of mango farmers are on production and marketing (selling of mangoes). Thus, they will choose out of a set of marketing channels a channel that maximizes their utility. That is, they will choose a market that offers the households a relatively high profit margin. The random utility theory was applied by Muthini et al. (2017) to assess the determinants of mango farmers' choice of marketing channels in Kenya.

2.2.3 Review of approaches/methods used to model market participation

Several choice-based methods have been suggested in the literature for use to analyze market participation by agricultural households. While the choice of the method to employ largely depends on the objectives of the study, the main criteria of model choice in market participation studies include (i) the sequence of the chooser's market decision (whether it is made in a single,

double or triple steps), (ii) the statistical distribution of the outcome of interest (i.e., the dependent variable), and (iii) the need to control for self-selection bias among the study subjects (i.e., the event where individuals choose to belong to a group or not, based on some comparative advantage rather than a random assignment (Maddala, 1983)). In the case of a single step decision making process leading to a binary outcome without the need for self-selection, a binary choice model (either logit or probit) is sufficient, but if the chooser's decision results in a multiple choice outcome, then a multivariate model (either a multinomial logit or probit) is used.

Where the choice is made in a two-step fashion, then, either a double-hurdle or a Heckman two-step model is the most appropriate, with the latter also controlling for self-selection bias (Heckman, 1979). The two models are used when the factors that influence the participation decision are not the same as the factors that influence the intensity of participation (Wooldridge, 2010). In addition, both models use the probit regression in the first stage. In the second stage, the Heckman uses a multiple regression which includes the inverse Mills ratio as an explanatory variable in the second stage to control for self-selection whereas the double-hurdle model uses a truncated regression in the second stage (Cragg, 1971; Heckman, 1979).

Frequently, agents involved in market participation engage in a three-step decision process in which the first step is to decide whether or not to participate in the market, the second step is to choose which marketing channel to sell through, and the last step is to decide how much to sell, contingent upon the latter two decisions having been made (Burke et al., 2015; Gebremedhin et al., 2017). In such a case, the triple-hurdle model is the most appropriate, as was the case in the present study.

In cases where the majority of the sample are market participants and a few or none of them are non-participants, the Tobit model is used (Aliyi et al., 2018). However, if there is a significant number of non-participants, the model will treat the zeroes as corner solutions, which may yield inconsistent and biased estimates due to the possible presence of sample selection bias. The Tobit model assumes that the factors that determine market participation are the same as the factors that determine the intensity of participation and is appropriate when both the participation and intensity decisions are made concurrently (Omiti et al., 2009).

Since agricultural households in this study faced a three-step decision-making process regarding their participation in mango markets, a triple-hurdle model was used. The first step involved farmer's decision to participate in either low or high value mango markets; the second step entailed deciding in which high value market to sell (i.e., whether domestic or export market), while the third step involved deciding how much to sell in the chosen market. Unlike the Heckman two-stage and the double-hurdle models that have specific types of models to be used in their first and second stages, the triple hurdle model allows different types of models to be used in different stages. For example, Burke et al. (2015) applied the triple-hurdle model to assess farmer participation in production and marketing of dairy products in Kenya. The authors used a probit model in the first stage, an ordered probit in the second stage, and a log-normal regression in the third stage. On the other hand, Okoye et al. (2016) employed a triple-hurdle model to study the effects of transaction costs on market participation among smallholder cassava farmers in central Madagascar using a probit model in the first and second stages, and the Heckman selectivity model in the third stage.

2.3 Review of empirical literature

The importance of market participation has received attention from several researchers. Researchers began with modelling market participation as a single step decision where the binary probit or logit models were used for binary choices and such models as the multinomial logit or probit models were used for a multiple choice outcome. Applying the binary logit model, Sumari et al. (2018) analyzed participation of smallholder vegetable farmers in high value market chains in Tanzania. Findings of the study showed that participation in high value markets in Tanzania was influenced by income, distance from farm to main road, yield, irrigation, access to extension services, access to market information and distance to high value markets. Sumari et al. (2018) informed the current study on institutional factors and transaction costs that influence participation in high value markets. However, unlike Sumari et al. (2018), the current study examined the factors that influence the level of participation in a high value market by smallholder mango farmers in Ghana.

Applying the multivariate probit to model a single step decision with a multiple choice outcome, Honja et al. (2017) analyzed the determinants of the choice of market outlet by smallholder mango producers in Ethiopia. The study found that the choice of market outlet by smallholder mango farmers in Ethiopia was determined by farm size, distance to market, price, mango output and access to off-farm income. The current study drew important variables from Honja et al. (2017). However, the current study differs from Honja et al. (2017) regarding the difference in mango marketing systems in Ethiopia and Ghana because the farmers in the two countries operate in different technical and socio-political environments.

Focusing on high value markets, Ngenoh et al. (2019) used a multivariate probit model to assess the determinants of the competitiveness of smallholder African indigenous vegetable farmers in

high value agro-food chains in Kenya. The study found that the factors that influenced participation in a high value market by smallholder farmers include access to information, location of the farm, the fertility of the soil and the type of irrigation used. Ngenoh et al. (2019) found that through group membership and access to extension services, certification can influence participation in high value markets since being members of farmer based organization and also accessing extension services increases the likelihood of being a certified farmer. The current study benefited from Ngenoh et al. (2019) regarding the application of the certification variable. However, the current study focused on mangoes which are fruits and have high value markets which are different from those of vegetables.

Considering that most agricultural households are faced with a two-step decision regarding market participation, the double-hurdle model and the Heckman two stage model have been frequently used to model this decision making process. Using the double-hurdle model, Muthini et al. (2017) examined the determinants of smallholder farmers' choice of mango marketing channels in Kenya. The study found that distance to tarmac road, number of trees, group membership, access to training services, access to extension services, income, market information access and gender influenced the choice of marketing channels, while only group membership significantly influenced the intensity of participation in the export market. Muthini et al. (2017) concluded that farmers should be supported financially, and with information concerning market and price, to improve their access and participation in markets.

Also, applying the double-hurdle model, Musara et al. (2018) assessed market participation and marketing channel preferences by small-scale sorghum farmers in semi-arid Zimbabwe. Musara et al. (2018) found that the choice of marketing channels was influenced by market price of sorghum, number of buyers in the market, distance to the market, dependency ratio, and

household income. Musara et al. (2018) concluded that cooperative-based and extension-anchored marketing should be encouraged to reduce marketing risks. However, Musara et al. (2018) did not examine the intensity of participation. Factors affecting intensity of market participation must be ascertained so that the limitations to intensity of participation can be addressed to enhance participation and farm income. The current study examined both participation and the intensity of participation in a high value market by smallholder mango farmers.

The Heckman two stage model was used by Harrizon et al. (2016) to examine the factors that influence the choice of tea marketing channels in Kenya. Harrizon et al. (2016) found that the factors that influenced the choice of a tea marketing channel included age, gender, education, farming experience and the price of tea. The factors that influenced the intensity of participation included tea output, age, farming experience and the price of tea. Harrizon et al. (2016) differs from the current study because the current study considered the three-step decision making process of mango-producing households.

Under some circumstances, agricultural households are faced with a three-step decision making process regarding market participation which thus cannot be modelled with the double-hurdle models. Based on this observation, some researchers have modelled this three-step decision making process with a triple-hurdle model. Applying the triple-hurdle model, Okoye et al. (2016) assessed the effect of transaction costs on market participation among smallholder cassava farmers in central Madagascar. The findings of Okoye et al. (2016) showed that group membership, being a native of the community, good road condition and farming experience positively influenced market participation. Age, distance to the nearest town and distance from farm to market negatively influenced market participation. Okoye et al. (2016) also found that

ownership of means of transportation and marketing experience positively influenced the decision of a farmer to sell off-farm. High cost of transportation, distance to the nearest town, and distance from the farm to the market negatively influenced the decision to sell off-farm.

On intensity, personal means of transportation, good road condition and marketing experience increased the quantity of cassava sold. Distance to the nearest town, distance from farm to the market and high transportation costs decreased the quantity of cassava sold. Okoye et al. (2016) recommended that policymakers should target policies that can reduce transaction costs. The findings of Okoye et al. (2016) informed the current study about important variables that can influence market participation in high value markets and methods that are used to operationalize three-step decisions of farm households. However, Okoye et al. (2016) estimated the coefficients in the various stages of the triple hurdle model separately. Sekyi et al. (2017) noted that separate estimation of models can yield biased estimates. The current study modelled the three-step decision made by mango farmers simultaneously using a maximum likelihood method.

Using a triple hurdle model to analyze small-ruminant production and marketing in Ethiopia, Gebremedhin et al. (2017) found that the factors that determined production of small ruminants in Ethiopia include large-ruminant herd size, small-ruminant flock size, proportion of female animals, number of animals which died and the wage rate. In addition to these factors, the distance to the nearest livestock market, household ownership of a radio and the price of butter influenced market participation. On intensity of market participation, access to extension, average selling price of large ruminants, and the price of butter mainly influenced net sales. The current study benefits from some of the variables and the measurements used by Gebremedhin et al. (2017). However, the current study differs from Gebremedhin et al. (2017) on the basis of the angle from which the triple-hurdle model was conceptualized; that is from production side.

Further, as Gebremedhin et al. (2017) focused on livestock production and marketing, the current study focused on mango marketing which has different production and marketing characteristics from those of livestock production and marketing.

Also on livestock, Burke et al. (2015) used a triple hurdle model to analyze production and market participation in Kenya's dairy market. Burke et al. (2015) found that the factors that influenced dairy production include education, type of trader, rainfall, asset ownership, asset value, household labour, number of cows, use of zero grazing technology, farm size, and the price of maize. Major factors that influenced participation in dairy market include distance to electricity, presence of cooperatives or Kenya Cooperative Creameries in the village, trader type, credit access, asset value, gender, education, number of cows, use of zero grazing technology, price of milk, price of tomatoes, and age. Finally, intensity of participation was influenced by distance from road, rainfall, presence of milk cooperatives, trader type, credit access, health, education, age, use of household labour, and milk prices. Burke et al. (2015), being founded on the application of all the triple-hurdle models, is beneficial to the conceptualization of the current study. However, the current study was conducted in Ghana which is socially, economically and geographically different from Kenya.

2.4 Summary

From the review of related and relevant literature on smallholder market participation, many approaches that include the multinomial logit, the double hurdle and the triple-hurdle models have been used to study smallholder market participation. This review of related literature has revealed some of the determinants of smallholder farmer market participation. However, smallholder mango farmer market participation in Southern Ghana has received little attention

from researchers. Virtually, there is no study that specifically highlights the factors that influence participation as well as the level of participation in export markets as a case of high value mango markets by smallholder mango farmers in the Southern Ghana.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study was undertaken in the major mango production zones in Southern Ghana which cover the Greater Accra Region and the Eastern Region. This area of Southern Ghana is also known as the Southern-Belt regarding mango production. The major mango production zone in the Greater Accra Region is the Shai Osudoku District. The district is the largest in the region with a total land area of 1,442 square kilometers. The district has a warm temperate climate with low annual rainfall, thus making it suitable for mango production. Shai Osudoku District is characterized by savannah grasslands with shrubs and short trees. However, the district has a light forest with tall trees along the foothills of the Akwapim Range, particularly around Agomeda, Ayikuma and Dodowa. Major agricultural activities include tree crop farming (mango farming), maize farming and rice farming. Animal production is on a subsistence level (Akotsen-Mensah et al., 2017).

The Eastern Region of Ghana has a tropical vegetation and the major agricultural activities in this region include tree crop, food crop, and animal production, with the rural parts of the region recording the highest levels of economic activities. These economic activities are in the area of agriculture because agriculture in Ghana is the biggest employer (GSS, 2013). Tree crops in this region are majorly produced in the Yilo and Manya Krobo Districts. The tropical nature of this region allows for mango production. The high level of production of mangoes in the region has led to the establishment of pack houses, in pursuit of the Millennium Development Goals, to serve the mango producers in the region (Zakari, 2012). Figure 3.1 gives the map of the study area, showing Shai Osudoku District in the Greater Accra Region and Yilo and Manya Krobo in the Eastern Region. The study area was deemed to be suitable for the study on the analysis of factors that influence participation in high value markets by smallholder mango farmers.

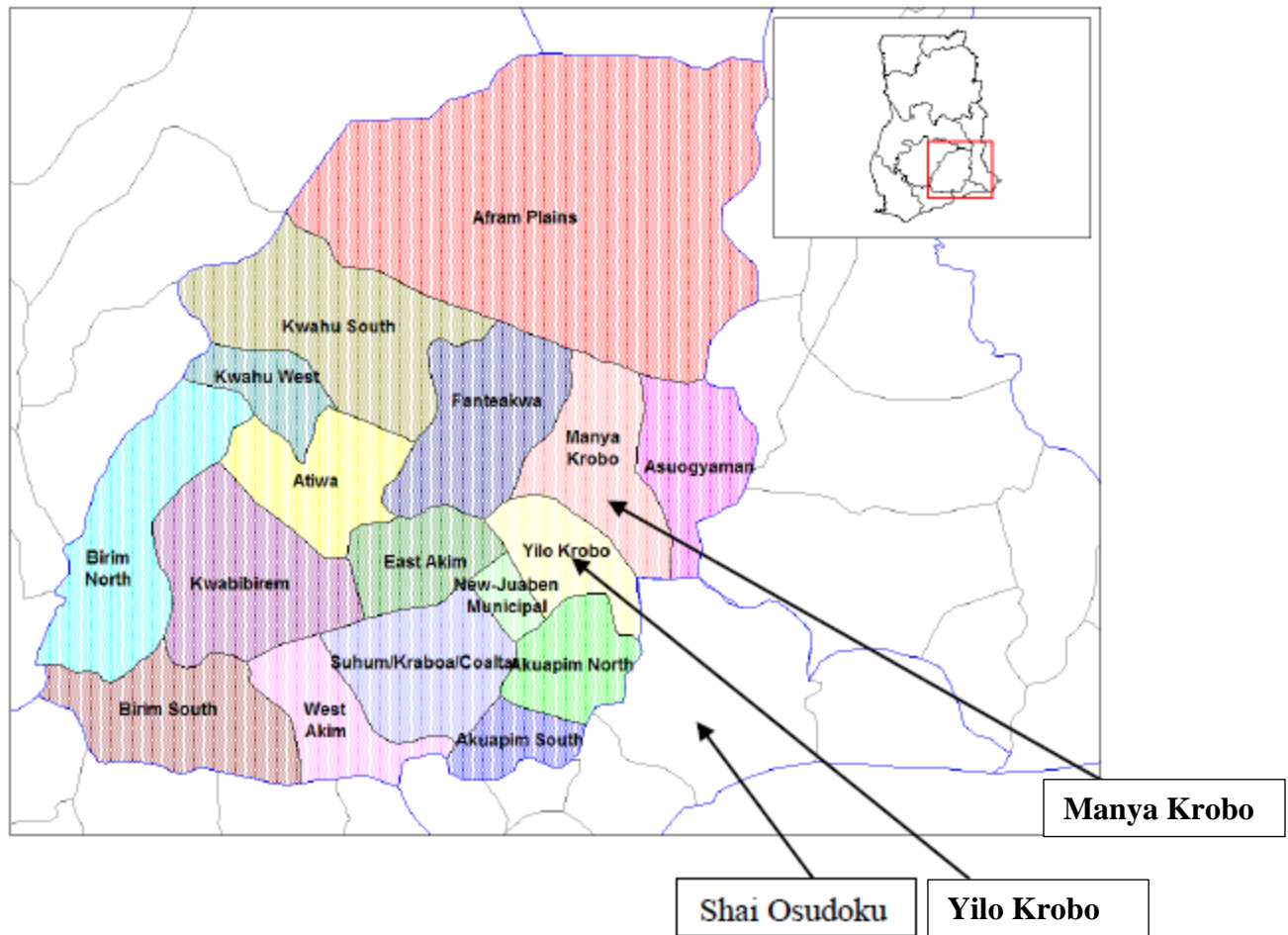


Figure 3. 1: A map of Southern Ghana showing the study area, being the region covered by the Shai Osudoku, Yilo and Manya Krobo Districts

Source: Anderson (2015)

3.2 Theoretical Framework

This study is anchored on the random utility theory. The theory posits that if decision makers are faced with a set of mutually exclusive choices, they will select the alternative that maximizes their utility (Greene, 2012). This utility is unobservable to the analyst; it can only be inferred from observable attributes of the decision maker. In the case of mango marketing, rational farmers will participate in a market outlet that gives them the highest utility, which is derived from the profits obtained from that participation.

Following Greene (2012), the utility, U_{ij} , that the i th mango farmer would obtain from his/her participation in marketing outlet j , can be expressed as a linear sum of two components; a deterministic part V_{ij} that captures the observable components of the utility function, and a random error term ε_{ij} that captures the unobservable components of the function, including measurement errors, that is:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \dots\dots\dots (3.1)$$

For binary choices regarding market participation, equation (3.1) translates to:

$$y_i = x_i'\beta + \varepsilon_i \dots\dots\dots (3.2)$$

where y_i is the market participation decision; X = regressors; β = parameter estimates; ε = stochastic error term which is assumed to be iid (independently and identically distributed) with mean = 0 and variance = δ^2 .

From equation (3.2), one can think of an underlying latent variable y^* with threshold τ below which the market participation decision is not observed and above which the market participation decision is observed, so that:

$$y = 1 \text{ if } y^* > \tau, \text{ and}$$

$$y = 0 \text{ if } y^* < \tau$$

Therefore, a model whose dependent variable is bound between (0, 1) is derived. This model is a binary choice model.

For a probit model, the decision to participate is represented by:

$$Prob(Y_i = 1|x_i) = \Phi(x_i'\beta) \dots\dots\dots (3.3)$$

where Φ represents the cumulative standard normal distribution function. Likewise, its complement is given by:

$$Prob(Y_i = 0|x_i) = 1 - \Phi(x_i'\beta) \dots\dots\dots(3.4)$$

Reformulating equation (3.2) as an index function yields a Tobit model which is used when the dependent variable has a mixture of zero and non-zero observations and is given by:

$$y_i^* = x_i'\beta + \varepsilon_i \dots\dots\dots (3.5)$$

$$y_i = y_i^* \text{ if } y_i^* > 0$$

$$y_i = 0 \text{ if } y_i^* \leq 0$$

where y_i^* is the index variable which defines an underlying observable tendency. Censoring point is assumed to be zero.

The three-stage decision making problem of mango farmers regarding participation in high value markets has three possible outcomes. Not participating in a high value market ($Y_i = 0$); participating in a high value market but not choosing the export market as a high value marketing channel ($E_i = 0|Y_{1i} = 1$); and for those who sell to the export market, intensity or level of participation (Q_i).

Following Gebremedhin et al. (2017), the three decisions that mango farmers face are represented by:

$$Pr(Y_i = 0) = 1 - \Phi(X_{1i}\beta_1) \dots\dots\dots (3.6)$$

$$Pr(E_i = 0|Y_{1i} = 1) = \Phi(X_{1i}\beta_1) - \Phi(X_{1i}\beta_1, X_{2i}\beta_2) \dots\dots\dots (3.7)$$

$$E(Q_i) = E(\text{volume of sales}) = \Phi(X_{1i}\beta_1)\Phi(X_{1i}\beta_1, X_{2i}\beta_2) * \exp(X_{3i}\beta_3 + \delta_3^2/2) \dots\dots\dots (3.8)$$

A likelihood function of the three possible outcomes is given by:

$$\begin{aligned}
l_i(\emptyset) = & 1[Y_i = 0] \log[1 - \Phi(X_{1i}\beta_1)] + 1[Y_i = 1]1[Q_i = 0] \{ \log[\Phi(X_{1i}\beta_1)] - \\
& \log[\Phi(X_{1i}\beta_1, X_{2i}\beta_2)] \} + 1[Y_i = 1]1[E_i = 0] \{ \log[\Phi(X_{1i}\beta_1)] + \log[\Phi(X_{1i}\beta_1, X_{2i}\beta_2)] + \\
& \log \left(\emptyset \left[\frac{\log Q_i - X_{3i}\beta_3}{\delta_3} \right] \right) - \log \delta_3 \} \\
& \dots\dots\dots (3.9)
\end{aligned}$$

where, $\emptyset(\cdot)$ is the standard normal density function, $\Phi(\cdot)$ is standard normal cumulative distribution function, β_1 are the parameters on X_1 in the first stage, β_2 are the second stage parameters on X_2 , and β_3 are the third stage parameters on X_3 . Finally, δ_3 represents the error variance parameter.

3.3 Empirical framework

3.3.1 Characterization of the mango marketing system in Southern Ghana

The characterization of the mango marketing system in Southern Ghana was achieved by using descriptive statistics that involved frequencies and means. Such frequencies and means were generated by analyzing data on some measurable socio-demographic, production, market and institutional factors among smallholder mango farmers in Southern Ghana. Where possible, the means were separated across those who used marketing channels by using the analysis of variance (ANOVA) tests.

3.3.2 Factors that influence participation and the level of participation in export markets as a case of high value mango markets for Southern Ghana

For the purposes of this study, two broad marketing channels were characterized, namely the domestic low value channels, which are referred to as “local traders”, and high value channels which include both domestic markets (such as supermarkets and industrial processors) and

export markets. Participation and the level of participation in high value markets by smallholder mango farmers were estimated in three steps. The first step used a binary probit to assess the factors that influence participation in high value mango markets by smallholder farmers. The second step used a binary probit to assess the factors that influence the choice of the export market by smallholder mango farmers. The third step used a censored regression to estimate the quantity sold to the export market. A graphical representation of the stages in the triple-hurdle model is provided in Appendix V.

Drawing from equation (3.6), the decision to participate in a high value market is given by:

$$P(y_{i1} = 1) = \beta_0 + \beta_1 Education + \beta_2 Hhsize + \beta_3 Income + \beta_4 Experience + \beta_5 Treedensity + \beta_6 OwnTrans + \beta_7 Trust + \beta_8 Distancetoroad + \beta_9 Cert + \beta_{10} Radio + \beta_{11} Region + \varepsilon_i \dots \dots \dots (3.10)$$

Where $y_{i1} = 1$ for participants of high value markets and $y_{i1} = 0$ for participants of low value markets.

Drawing from equation (3.7), the choice of the export market contingent on participating in a high value market is given by:

$$P(y_{i2} = 1) = \beta_0 + \beta_1 Education + \beta_2 Hhsize + \beta_3 Income + \beta_4 Experience + \beta_5 Treedensity + \beta_6 OwnTrans + \beta_7 Trust + \beta_8 Distancetoroad + \beta_9 Credit + \beta_{10} Radio + \beta_{11} Region + \varepsilon_i \dots \dots \dots (3.11)$$

Where $y_{i2} = 1$ for participants in foreign high value markets and $y_{i2} = 0$ for participants in domestic high value markets.

Drawing from equation (3.8), the level of participation in the export market contingent on choosing the export market is given by:

$$y_{i3} = \beta_0 + \beta_1 Education + \beta_2 Hhsiz e + \beta_3 Income + \beta_4 Experience + \beta_5 Treedensity + \beta_6 OwnTrans + \beta_7 Distancetoroad + \beta_8 Credit + \beta_9 Radio + \beta_{10} Region + \varepsilon_i \dots\dots\dots(3.12)$$

Where y_{i3} represents the quantity of mangoes sold to the export market.

Table 3.1 presents the explanatory variables used in the triple-hurdle model, their measurement and expected signs.

Table 3. 1 Explanatory variables and their expected signs

Variable code	Factors	Measurement	Expected sign		
			Hurdle 1	Hurdle 2	Hurdle 3
Education	Education of respondent in years	Continuous	+	+	+
Household size	Number of household members	Continuous	+/-	+/-	+/-
Income	Average monthly income of household in GHS	Continuous	+/-	+	+
Experience	Number of years of farming mango	Continuous	+	+	+
Credit	Access to credit	Dummy: 1= yes 0= no		+	+
Ownership of transport	Ownership of means of transporting mangoes	Dummy: 1= yes 0= no	+	+	+
Distance	Distance to the nearest tarred road in km	Continuous	+/-	+/-	+/-
Tree density	Total number of trees per acre	Continuous	-	-	-
Certification	Certification	Dummy: 1= yes 0= no	+		
Trust	Trust level	Dummy: 1= yes 0= otherwise	+	+	
Region	Location of farmer	Dummy: 1= Eastern 0= Greater Accra	-	-	-

Source: Author, 2019

3.3.3 Justification for inclusion of various regressors in the empirical model

Education

Mutura et al. (2015) found that well-educated farmers do not choose middlemen as their marketing channel but participate in high value markets. This is because education equips farmers with skills that can be used to understand the requirements of buyers from high value markets. This finding corroborates with the finding of Maspaitella (2018) and Muthini et al. (2017). This evidence informed this study's expectation of a positive relationship between education and participation and the level of participation in high value markets by mango farmers.

Household size

For cash crops, household size has been found to positively influence productivity because of availability of farm labour (Mirie & Zemedu, 2018). However, Muriithi and Matz (2014) found that increased household size can negatively influence participation in the export market because a large family size can intensify cultivation of land for food crops, thereby reducing market surplus of cash crops. Based on these findings, this study expected either of the negative and positive relationships between household size and participation and the level of participation in high value mango markets.

Household Income

Household income is an indicator of wealth, and wealthy farmers are more likely to access high value markets than farmers who are not well-endowed (Abu, 2015; Nyaga et al., 2016). However, Aliyi et al. (2018) found that household income reduces the probability of market participation and the intensity of participation. Based on these findings, this study expected

either of the negative and positive relationships between age and participation and the level of participation in high value mango markets.

Farming experience

Sumari et al. (2018) found that experienced farmers had access to production and marketing information and this increased their access to high value markets. This finding is in line with the findings of Daniel et al. (2017) who found that experienced farmers were more likely to participate in the market for Irish potato in Tanzania. On intensity, Abu (2015) found that farming experience increased the volume of groundnuts sold in Northern Ghana. Accordingly, this study expected a positive relationship between farming experience and participation and the level of participation in high value markets by mango farmers.

Ownership of means of transport

Ownership of means of transporting mangoes can enhance access to markets by encouraging farmers' participation in markets such as direct markets and industrial processors and also reducing post-harvest losses due to post-harvest handling (Sigei et al., 2013). Okoye et al. (2016) concluded that ownership of means of transport significantly increases the intensity of market participation by smallholder farmers. This study expected a positive relationship between ownership of transportation and participation and intensity of participation in high value mango markets.

Distance to tarmacked roads

Martey et al. (2012) found a negative relationship between distance to the tarmacked roads and market participation. Sumari et al. (2018) confirm this finding of Martey et al. (2012) by concluding that smallholder farmers who are further away from tarmacked roads could not

access high value markets. However, Maspaittela (2018) and Muthini et al. (2017) found that distance to tarmacked roads positively influenced a smallholder farmer's participation in high value markets. Muthini et al. (2017) found that distance to tarmacked road negatively affects intensity. Based on these findings, this study expected either of the negative and positive relationships between distance to tarmacked roads and participation and the level of participation in high value mango markets.

Certification

Certification has been found to positively influence participation of farmers in high value markets because certification has effects on productivity and quality of products (Murimi et al. 2017). Based on this finding, this study expected a positive relationship between certification and smallholder mango farmers' participation in high value markets.

Access to credit

Sumari et al. (2017) found that access to credit does not significantly influence smallholder farmers' participation in high value markets. However, Abayneh and Tefera (2013) found that access to credit positively influences the level of market participation because farmers are able to buy inputs that are necessary to meet the requirements of high value markets. Based on these findings, this study expected a positive relationship between access to credit and smallholder mango farmers' participation and the level of participation in high value markets.

Trust

A high level of trust reduces transaction costs by way of reducing the time farmers spend to ensure that contracts are enforced with transacting partners (Maina et al., 2015). These authors found that mango farmers in Kenya are more likely to participate in formal markets as opposed

to informal markets such as dealing with the brokers. These findings are supported by Shammah et al. (2017) who found that pineapple farmers were more likely to participate in high value markets because of the trust level of the former in high value markets. This finding informed the expectation of this study that a high trust level positively influenced participation in high value markets.

Region

This study hypothesized a negative relationship between being located in the Eastern Region of Ghana and access to and the level of participation in high value mango markets. This is because the Eastern Region of Ghana is farther from where buyers from high value markets are located.

3.4 Research Design

The cross-sectional research design was employed in this study. This research design focuses on establishing relationships between variables at a point in time (Hall, 2008). The cross-sectional design was used to measure the differences between participant and non-participants of high value mango markets in Southern Ghana. The study employed both qualitative and quantitative approaches to collect and analyze qualitative and quantitative data on the factors that influence participation and the level of participation in export markets as a case of high value mango markets in Southern Ghana. More specifically, a quantitative approach was used to establish relationships between variables in the data collected in Southern Ghana. This included the computation of descriptive statistics that was used to characterize the mango marketing system in Southern Ghana. The triple hurdle model was used to establish relationships between participation in high value market and some socio-economic and institutional factors.

3.5 Data types and sources

The study used both primary and secondary data. Secondary data were obtained through review of related and relevant literature on market participation while primary data were collected from smallholder farmers to capture socioeconomic factors, production factors, institutional factors, market factors, geographical factors, and asset ownership. Primary data were used to analyze the determinants of participation and the level of participation in export markets as a case of high value mango markets by smallholder mango farmers in the study area.

3.5.1 Sampling

3.5.2. Sample size determination

The sample size for the study was determined using the following Cochran (1963) formula for an unknown population size:

$$n = \left[\frac{Z_{\alpha/2} \sigma}{E} \right]^2$$

where n is the sample size; $Z_{\alpha/2}$ is the critical Z -value equal to 1.96 which also reflects an alpha level (α) of 0.05, indicating a 95% confidence level; σ is the population standard deviation; E is the expected margin of error.

The variation among mango farmers in Sothern Ghana was not known, so the study assumed a variance of 0.5. This level of maximum variability produced a more conservative sample size than the mean would calculate (Israel, 1992).

$$n = \left[\frac{(1.96)(0.5)}{0.05} \right]^2 = 384 \text{ respondents}$$

However, only 224 mango farmers agreed to participate in the study.

3.5.3 Sample selection

The study employed a multistage sampling technique to select the respondents. In the first stage, the Eastern Region and the Greater Accra Region which have high levels of mango production and marketing in Southern Ghana were purposively selected. In the second stage, three districts, namely Shai Osudoku District in the Greater Accra Region and the Yilo Krobo and Manya Krobo Districts in the Eastern Region of Ghana, where mango is intensively produced in these regions were purposively selected. With the assistance of extension officers who work as field officers, the villages where mango is predominantly produced were identified. With further assistance of these officers, a list of mango farmers was compiled for each mango-producing village. Random numbers were then assigned to each mango farmer on the list using Microsoft Excel 2016 and the 384 mango farmers were selected. However, as pointed out, only 224 out of the 384 farmers were willing to participate in the study. This procedure constituted the third stage in the sampling.

3.5.4 Data collection

A pre-tested semi-structured questionnaire was used to collect data from the sampled mango farmers. The questionnaire was used to gather information on socio-demographic characteristics, farm characteristics, institutional factors, and marketing characteristics of mango farmers in Southern Ghana. The researcher employed and trained four enumerators in each of the three districts. A pre-test was carried out on thirty mango farmers (ten from each district) using the local dialect (Dangme) in April 2019. The pre-test was aimed at ensuring that the questionnaire would generate the required data to address the research objectives. Therefore, the pre-test data was not used as part of the study. Data were collected from the sampled mango farmers who had

sold mango in the last harvest season. The questionnaire took an average of 50 minutes to be completed.

3.5.5 Data capture and analysis

The questionnaire data were captured in Open Data Kit (ODK) and downloaded in SPSS version 21. They were then analyzed using STATA version 15.0. Both descriptive statistics and econometric analysis were undertaken on the data. The descriptive statistics entailed frequencies, percentages, means, and differences in means. The econometric analysis used key variables that influence participation as well as the level of market participation in export markets as a case of high value markets.

3.6 Diagnostic Tests

3.6.1 Multicollinearity Test

Multicollinearity occurs when there is an exact relationship between some explanatory variables (Gujarati, 2009). The presence of multicollinearity can lead to an increase in the variance of the coefficient estimates and cause the estimates to be sensitive to minor changes in the model. The variance inflation factor (VIF) was used to test for multicollinearity. There was no problem of multicollinearity among the independent variables in the model because all the calculated VIF values were less than 5. A summary of the VIF results is presented in Appendix III. Also, a Pearson correlation matrix for all independent variables included in the models indicated the absence of multicollinearity (see Appendix II).

3.6.2 Heteroscedasticity

Heteroscedasticity occurs when the variance of the error term is not constant (Wooldridge, 2010). The presence of heteroscedasticity causes the least square estimator to be inefficient and the variance estimates to be biased (Maddala, 2005). The Breusch-Pagan test was used to detect heteroscedasticity under the null hypothesis that the error term variances are equal against the alternative hypothesis that they are not. The resulting F-statistic was not statistically significant. Hence, the study failed to reject the null hypothesis that the error term variances are equal (see Appendix 1V).

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Characterization of the mango marketing system in Southern Ghana

4.1.1 Distribution of farmers according to the marketing channels used

Table 4.1 presents the main marketing channels used by the sample mango farmers in Southern Ghana. The table shows that there are three main marketing channels, namely the local traders, industrial processors and the export market. A substantial proportion (46%) of mango farmers in the study area used local traders as their main marketing channel. Industrial processors were used by 32 percent of the farmers while the export channel had the lowest number of participants. The results suggest that access to the export market by mango farmers in Southern Ghana is rather low compared with the other two channels. The results are consistent with those of Van Melle and Buschman (2013) who established that mango farmers use three main marketing channels, i.e., local traders, industrial processors and the export market. The local traders deal in both wholesale and retail businesses in mangoes. These traders are predominantly women and are mostly called “market queens”. The industrial processors buy mangoes for value addition to produce juice which domestically is in high demand. They also process mangoes into dried products. The major mango processors in Southern Ghana are Blue Skies Ltd and Hans Peter Werder (HPW) Fresh and Dry Ltd. The main actors in the export market include large scale farmers who are exporters and some independent export companies.

As shown in Table 4.1, the majority of the sample farmers participated in the domestic markets (i.e., industrial processors 32% and local traders (46%)). Access to or participation in the three main mango marketing channels in Ghana varies according to the level of requirements. Broek et al. (2016) argue that local mango markets do not have stringent requirements regarding quality standards, whereas the export markets and the industrial processors have stringent requirements.

Table 4. 1: Distribution of smallholder mango farmers in Southern Ghana according to the main marketing channels used by these farmers

Marketing Channel	Number of Farmers	Percentage of Farmers
Local traders	102	46
Processors	72	32
Export	50	22

Source: Survey data (2019)

4.1.2 Socio-demographic characteristics of mango farmers in Southern Ghana

Table 4.2(a) presents socio-demographic characteristics of the sample mango farmers who used the different marketing channels in Southern Ghana. Majority (95%) of the mango farmers were male. Even though there is a significant representation of women in mango marketing, the fruit is produced as part of agroforestry, which Okorley (2014) found to be male-dominated in Ghana. Further, Grabowski et al. (2017) argued that men in Ghana dominate agricultural production of export crops while the women mostly engage in vegetable and legume production targeted to the domestic market. Across the three marketing channels, most of the sellers were male; 93 percent for the suppliers of the local traders, 99 percent for the suppliers of the industrial processors, and 92 percent for the suppliers of the export market traders. However, these numbers were not statistically different.

Most of the mango farmers in Southern Ghana (81%) had received formal education, indicating a relatively high level of literacy. This finding is consistent with the Ghana Statistical Service's Living Standards Survey (GLSS 6) Report that found about 81 percent of Ghanaian population to be literate (GSS, 2014). Across the three marketing channels, the participants in the export market accounted for the most educated group. Given that the industrial processors and the export market are high value markets, this finding is in line with the findings of Neven et al.

(2009) who conducted a study on Kenyan supermarkets and emerging middle-class horticultural farmers and found that most of the participants in high value markets had formal education. The differences in the level of education of the farmers who used the different marketing channels were found to be statistically significant at 1 percent level.

Table 4.2(b) presents the major sources of income of smallholder mango farmers who used different marketing channels in Southern Ghana. The results show that most of the sample farmers (82%) derived their income from mango sales, while 18 percent derived their income from the sale of other crops, and from both formal and informal sector employment and pension benefits. These findings are consistent with those of Okorley (2014) who found that mango production is the main economic activity in in Southern Ghana. Regarding the farmers who sold to the local traders, the results show that the sale of mango was their major source of income. On the other hand, almost all farmers who sold to industrial processors (93 percent) and the export market (94 percent) derived their income primarily from mango sales. Differences in sources of income across marketing channels were statistically significant at 1 percent level.

Table 4. 2 (a) Socio-demographic characteristics of smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by these farmers, where n = Number of Farmers Involved

Narrative Characteristic (Variable)	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana								Chi ²
	Local traders Channel n= 102		Industrial Processors Channel n = 72		Exporters Channel n = 50		The Channels Pooled n= 224		
		Percent		Percent		Percent		Percent	
Gender									
Male	95	93	71	99	46	92	212	95	0.184
Female	7	7	1	1	4	8	12	5	
Marital Status									
Single	9	9	5	7	8	16	22	10	0.547
Married	86	84	66	92	40	80	192	86	
Divorced	2	2	0		1	2	3	1	
Widowed	1	1	0		1	2	2	1	
Separated	4	4	1	1	0		5	2	
Educational level									
None	23	23	19	26	0		42	18.75	0.004***
Primary	7	7	2	3	1	2	10	4.64	
Junior secondary	32	31	21	29	18	36	71	31.70	
Senior secondary	26	25	20	28	27	54	73	32.59	
O level	6	6	5	7	0		11	4.91	
A level	1	1	0		0		1	0.45	
Tertiary	7	7	5	7	4	8	16	7.14	

Note: *** indicates 1% significance level

Source: Author's work (2019)

Table 4.2(b) Frequencies of income sources of smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by these farmers, where n = Number of Farmers Involved

Narrative Characteristic (Variable)	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana								Chi ²
	Local traders Channel n= 102		Industrial Processors Channel n = 72		Exporters Channel n = 50		The Channels Pooled n= 224		
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
Mango sales	70	68.627	67	93.06	47	94	184	82.14	0.000***
Crop sales	11	10.784	1	1.39	1	2	13	5.80	
Employment	3	2.941	1	1.39	0		4	1.79	
Wage	18	17.647	3	4.17	1	2	22	9.82	
employment									
Pension	0		0		1	2	1	0.45	

Note: *** indicates 1% significance level

Source: Author's work (2019)

Table 4.3 presents the means of socio-demographic characteristics of mango farmers who used different marketing channels in Southern Ghana. On average, mango farmers in Southern Ghana were 48 years of age, which is close to the mean of 46 years reported by Eghan (2017) for the mango farmers in Lower Manya Krobo District of Ghana. The mean age of farmers was not statistically different across the three marketing channels.

The average number of years of formal education was 8.8. The farmers who participated in the export market had attained the highest level of formal education, with an average of 11 schooling years relative to those who supplied to processors and traders who had mean schooling years of 8.4 and 7.9 respectively. The mean number of years of formal education was statistically different among participants in the three marketing channels.

The average household size for the sample mango farmers was 5, which tallies with the finding of Mensah and Brummer (2016). This is higher than the national average by 1 person (GSS, 2014). The farmers who sold to local traders had the highest mean household size of 5.6 members. The household size was not statistically different across mango farmers who used the three marketing channels.

Table 4. 3: Means of socio-demographic characteristics of smallholder mango farmers in Southern Ghana on the basis of the marketing channels use by these farmers, where n = Number of farmers Involved

Narrative	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana				Anova Test
	Local Traders Channel n = 102	Industrial Processors Channel n = 72	Exporters Channel n = 50	The Channels Pooled n = 224	
Age	47.9 (14.49)	48.7 (10.66)	45.4 (10.52)	47.6 (12.53)	0.3338
Schooling years	8.4 ^{b***} (5.23)	7.9 (5.25)	11.1 ^{c***} (2.05)	8.8 (4.85)	0.0007 ^{***}
Household size	5.6 ^{a**} (2.42)	4.8 (1.92)	5.2 (2.22)	5.2 (2.23)	0.1231
Total annual income	8235.8 ^{a***} (8577.216)	13037.2 ^{c*} (13376.92)	17146.6 ^{b***} (16272.23)	11768.1 (12695.97)	0.0001 ^{***}
Mango sales	5165.7 ^{a***} (5428.51)	10491.8 ^{c***} (7480.09)	13918.6 ^{b***} (11218.25)	8831.4 (8464.80)	0.0000 ^{***}
Non-mango income	3070.1 (6939.46)	2545.5 (8374.64)	3228 (8470.98)	2936.7 (7744.96)	0.8684
Farming experience	10 ^{a*} (5.56)	8.6 (3.44)	8.5 ^{b*} (4.42)	9.2 (4.75)	0.0753 [*]
Marketing experience	7.4 (5.61)	6.4 (3.63)	5.1 ^{b***} (3.67)	6.5 (4.71)	0.0200 ^{**}

NOTE: US\$1 = GH¢ 5 and *, ** and *** indicate 10%, 5% and 1% significance levels respectively

Numbers in brackets show standard deviations

a = processors vs traders; b = export vs traders; c = export vs processors.

Source: Author's work (2019)

The average non-mango income was GH¢ 2,937, but the participants in the export market had the highest (GH¢ 3,228), even though the difference was not statistically significant. Sellers to local traders had a relatively higher non-mango income (GH¢ 3,070) than sellers to industrial processors (GH¢ 2,546). This high non-mango income for the farmers who sold to local traders was due to the engagement of the famers in other livelihood activities including crop sales,

salaried employment, and wage employment. In general, the relatively high mango incomes when compared to the non-mango incomes for the mango farmers in Southern Ghana shows that mango farming was the main economic activity in Southern Ghana.

On farming and marketing experience, the average numbers of years a farmer was involved in mango production and marketing in Southern Ghana were 9 and 7 years respectively, and this is close to Eghan (2017) findings at 9.9 years. Mango farmers who sold to local traders had produced and marketed mangoes for a longer period (10 and 7 years respectively) than those who sold to industrial processors and the export market. The average number of years of experience was significantly different across those who used the three marketing channels.

4.1.3 Household mango production characteristics

Table 4.4 presents the major farm and production characteristics among mango farmers who used different marketing channels in Southern Ghana. The average size of mango farms was 5 acres (2 hectares). This is in line with the findings of Van Melle and Buschmann (2013) who studied mango value chains in Benin, Burkina Faso and Ghana and found that the majority of mango farmers in Ghana were small-scale producers. This study found that the average number of mango trees per acre was 39 trees. However, this number was not statistically different across those who used the three marketing channels.

Table 4. 4: Summary statistics of farm and production characteristics among smallholder mango farmers in Southern Ghana across the marketing channels used by these farmers, where n = Number of Farmers Involved

Narrative		Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana				Anova Test
		Local Traders Channel n = 102	Industrial Processors Channel n = 72	Exporters Channel n = 50	The Channels Pooled n = 224	
Mango land size		3.9 ^{a*} (4.07)	5.3 ^{c***} (4.72)	6.9 ^{b***} (6.26)	5.0 (4.96)	0.0018 ^{***}
Mango Trees		160.8 (250.03)	205.5 (223.04)	279.2 ^{b***} (297.266)	201.6 (256.29)	0.0268 ^{**}
Trees/Acre		39.1 (11.74)	38.4 (11.28)	39.5 (7.99)	39.0 (10.83)	0.8354

NOTE: ** and *** indicate 5% and 1% significance levels respectively. Numbers in brackets represent standard deviations

a = processors vs traders b = export vs traders c = export vs processors

Source: Author's work (2019)

Table 4.5 presents the frequencies of production characteristics for the mango farmers who used different marketing channels in Southern Ghana. The results show that only 12 percent of the farmers used purely household labour, while 42 percent of the farmers used only hired labour. Thus, 46 percent of the households used both household and hired labour. Out of 28 farmers who used only family labour in mango production, most (96.4%) of them sold their mangoes to the local traders. Only one (1) participant of the export market used household labour only, and none of the farmers who sold to industrial process used household labour only. The differences in labour use across those who used different marketing channels were statistically significant at 1 percent level.

Regarding land tenure, majority (96%) of mango farmers in Southern Ghana owned the land under mango production.

The main mango varieties produced in the study area were Keitt, Kent, Palmer and Haden. Of these, the Kent variety was the most (89%) commonly produced. A few farmers (10%) produced the Keitt variety while the production of the Palmer and Hayden varieties was by only one percent of the farmers. According to Broek et al. (2016), Kent and Keitt are the most preferred mango varieties by the processors and exporters, but local traders tend to deal in all mango varieties.

Table 4. 5: Frequencies of farm and production characteristics of smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by the farmers, where n = Number of Farmers Involved

Narrative Characteristic (Variable)	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana								Chi ²
	Local traders Channel n= 102		Industrial Processors Channel n = 72		Exporters Channel n = 50		The Channels Pooled n= 224		
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
Labour source:									
Family	27	27	0		1	2	28	12	0.000***
Hired	31	30	27	37	36	72	94	42	
Both	44	43	45	63	13	26	102	46	
Land tenure:									
Own land	100	98	70	97	46	92	216	96	0.154
Leased	2	2	2	2	4	8	8	4	
Mango varieties:									
Keitt	15	15	6	8	1	2	22	10	0.088*
Kent	86	84	66	92	48	96	200	89	
Palmer	1	1	0		0		1	0.5	
Hayden	0		0		1	2	1	0.5	

Note: * and *** indicate 10% and 1% significance levels respectively

Source: Author's work (2019)

4.1.4 Household mango marketing characteristics

Table 4.6 presents marketing characteristics of farmers who used different marketing channels in Southern Ghana. On average, 4.5 tons of mango were marketed per channel. However, the means were not statistically different across the three channels.

Table 4. 6: Means of various marketing characteristics of smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by the farmers, where n = Number of Farmers Involved

Narrative	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana				
	Local Traders Channel n = 102	Industrial Processors Channel n = 72	Exporters Channel n = 50	The Channels Pooled n =224	ANOVA Test
Quantity sold (tons)	4.0 (3.91)	5.1 (6.57)	4.7 (8.91)	4.5 (6.19)	0.4981
Price per kg	1.1 ^{a***} (0.27)	2.0 (0.84)	2.1 ^{b***} (0.43)	1.6 (0.74)	0.0000 ^{***}
Airtime spent (GH¢)	16.5 ^{a***} (9.58)	22.0 (10.19)	22.9 ^{b***} (10.17)	19.7 (10.30)	0.0001 ^{***}
Contract (days)	2.9 ^{a***} (1.83)	4.9 (3.63)	5.0 ^{b***} (3.76)	4.0 (3.14)	0.0000 ^{***}
Negotiation time (hours)	0.8 ^{b***} (0.30)	0.7 (0.43)	0.1 ^{c***} (0.28)	0.6 (0.43)	0.0000 ^{***}
Distance to road (km)	9.6 (12.02)	10.9 (11.42)	8.5 (7.34)	9.8 (10.93)	0.4914

Note: ** and *** indicate 5% and 1% significance levels.

Numbers in brackets represent standard deviations

a = processors vs traders; b = export vs traders; c = export vs processors

US\$1 = GH¢ 5

Source: Author's work (2019)

The above finding is consistent with that of Grumiller et al. (2018) who reported that about 70 percent of marketed mangoes end up in the domestic market and 30 percent is exported.

The farmers who sold their mangoes to the local traders received the lowest price (GH¢ 1.08 per kg), while those who sold to exporters obtained the highest price (GH¢ 2.1per kg). The price offered by industrial processors was slightly lower that the one offered by the exporters. However, the difference was not statistically significant. However, the prices offered were significantly different across the three marketing channels. The higher prices offered by the exporters have led to recent increased focus on this market by Ghanaian mango farmers (Van Melle & Buschman, 2013).

Mango farmers incur such transaction costs as contract enforcement costs, communication costs, trust, and negotiation costs while marketing their mangoes (Maina et al., 2015). In this study, contract enforcement cost was measured by the number of days spent in ensuring that a mango buyer honours a contract while communication cost was measured by the amount of airtime spent in communicating with buyers. Negotiation cost was measured in terms of the hours spent before agreeing on a price. The farmers used a significantly higher amount of airtime to talk to industrial processors and exporters (GH¢ 22 and GH¢ 23 respectively) than when talking to local traders (GH¢ 16.5). This could be due to the fact that local traders move from farm to farm looking for mangoes to buy, which implies less market search cost for the farmer. On the other hand, both the industrial processors and mango exporters are often contacted in advance by the farmers when their mangoes are ready for sale. As noted earlier, farmers look for mango processors and exporters because they offer relatively higher prices than those offered by the local traders.

On average, a mango sale contract took four days to enforce with those between the farmer and both industrial processors and exporters taking significantly longer than those between the farmer and local traders (Table 4.6). In Kenya, Maina et al. (2015) found that it took longer to

enforce formal contracts (contracts between farmers and both industrial processors and exporters) than informal contracts because the former were mainly enforced through the farmer groups.

On the average, mango farmers took 35 minutes to negotiate prices (Table 4.6). It took significantly longer to bargain with local traders (45 minutes) and industrial processors (42 minutes) than with exporters (3 minutes). This is in line with the findings of Maina et al. (2015) who reported that mango farmers in Kenya took longer to bargain with local traders for better prices than with buyers from other marketing channels (brokers and marketing groups). In the case of Ghana, exporters bought mangoes at fixed prices because they (exporters) were more organized and used more accurate tools to weigh mangoes than the local traders. Industrial processors and the local traders bought mangoes in wooden crates whose measure varied widely by weight. Accordingly, farmers had to bargain for the best price, which definitely took time.

The average distance from farm to the tarmacked road was 9.8 km. The farmers who sold to the industrial processors were furthest (11 km) from the tarmacked road as compared with those who sold to the local traders (10 km) and the export market (9 km). However, distance to tarmacked road was not statistically different across those who used the three marketing channels.

4.1.5 Household access to institutional and support services

Table 4.7 presents access to institutional and support services by mango farmers who used the different marketing channels in Southern Ghana. Most (82%) of farmers who sold to local traders did not belong to any farmer-based organization. However, majority of farmers who sold to the industrial processors (71 percent) and the export market (66 percent) were members of farmer-based organizations. The main groups in the study area included the Yilo Krobo Mango

Farmers Association, Dangbe-West Mango Farmers Association and the Lower Manya Mango Farmers Association.

Storage facilities are vital in mango marketing due to their ability to reduce post-harvest losses. Most farmers who sold to local traders (95%) and industrial processors (64 percent) did not have access to storage facilities (Table 4.7). In contrast, a high proportion of those who sold to the export market (58%) had access to storage facilities. Overall, 73 percent did not have access to storage facilities. This could be attributed to the fact that the majority of mango buyers came with their labour to harvest the quantity of mangoes they wanted to buy. Storage was only needed in instances where farmers had to wait for the buyers after they had already harvested the mangoes.

Majority of mango farmers (84%) had access to mango market information. Even though some of the farmers who sold to the local traders and the industrial processors (21 percent) could not access such information, all those who sold to exporters had access to mango market information. The differences in access to mango market information were statistically significant at 1% level across those who used the three marketing channels.

Access to extension services in Southern Ghana was low. In fact, only 26 percent of the sample mango farmers in the study area had access to extension services (Table 4.7). Of these, 56.9 percent sold their mangoes to local traders while 36.2 percent and 6.9 percent sold to industrial processors and exporters respectively.

Only 36 percent of the farmers had access to credit facilities. This finding is comparable to that of Sekyi et al. (2017) who noted that only 30 percent of smallholder farmers in Ghana have access to credit. Across those who used the three marketing channels, 51 percent of farmers who

sold to industrial processors and 74 percent of those who sold to the exporters had access to credit. Only 8 percent of those who sold to local traders had access to credit. The differences in credit access was statistically significant at 1% level across those who used the three marketing channels.

The GlobalGAP standard, which gives rise to GlobalGAP certification, is the most important standard in the export of horticultural products to the international market (Kleeman et al., 2014). Compliance with this standard gives farmers access to the export market and also to domestic high value markets, such as the supermarkets and industrial processors. Half of all the study farmers were certified (Table 4.7). Across those who used different marketing channels, only 16 percent of the farmers who sold to the local traders were certified. This was expected because local traders do not have stringent quality requirements. As expected, GlobalGAP certification was found to be common among the farmers who sold to the exporters and industrial processors (74 percent and 81 percent respectively). This is because access to these markets requires the farmers to meet the stringent quality requirements (Grumiller et al., 2018).

Table 4. 7: Frequencies of the access to institutional and support services by smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by the farmers, where n = Number of Farmers Involved

Narrative	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana								Chi ²
	Local Traders		Industrial Processors Channel		Exporters Channel		All the Channels Pooled		
Variable	n = 102	Percent	n = 72	Percent	n = 50	Percent	n = 224	Percent	
Group membership (Yes)	18	18	51	71	33	66	102	46	0.000***
Storage (Yes)	5	5	26	36	29	58	164	73	0.000***
Market information access (Yes)	81	79	57	79	50	100	188	84	0.002***
extension access (Yes)	33	32	21	29	4	8	58	26	0.004***
Credit access (Yes)	8	8	35	51	37	74	80	36	0.000***
Certification (Yes)	16	16	58	81	37	74	111	49.5	0.000***
Trust level (High)	44	43	49	68	46	92	139	62	0.000***

Note: *** indicate 1% significance level

Source: Author's work (2019)

4.1.6 Household asset ownership

Table 4.8 presents the assets owned by the mango farmers who used the different marketing channels in Southern Ghana. Most (92%) of the mango farmers owned the land under mango production. In addition, most (94%) of the farmers owned a cellphone. Radio and television were owned by 86 and 90 percent of mango farmers respectively. Regarding the means of transportation, about 19, 16, and 36 percent of the mango farmers owned a vehicle, motorcycle and a bicycle respectively. Farm transport was available for 84 and 27 percent of the mango farmers in the form of a tricycle and a wheelbarrow respectively. In Southern Ghana, the tricycle is the most widely used mode of farm transport.

Table 4. 8: Frequencies of household assets owned by smallholder mango farmers in Southern Ghana on the basis of the marketing channels used by the farmers, where n = Number of Farmers Involved

Narrative Variable	Types of Marketing Channels used by the Smallholder Mango Farmers in Southern Ghana								Chi ²
	Local Traders Channel n= 102		Industrial Processors Channel n = 72		Exporters Channel n = 50		The Channels Pooled n=224		
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
Land	90	88	67	93	48	96	205	92	0.231
Cellphone	94	92	69	96	47	94	210	94	0.612
Radio	91	89	58	81	44	88	193	86	0.242
Tv	88	86	65	90	50	100	203	90	0.024**
Vehicle	11	11	12	17	7	14	42	19	0.527
Tricycle	5	5	14	19	12	24	35	84	0.001***
Bicycle	36	35	35	49	9	18	80	36	0.002***
Motorcycle	12	12	15	21	8	16	35	16	0.267
Wheelbarrow	25	25	28	39	8	16	61	27	0.014***

Note: ** and *** indicate 5% and 1% significance levels respectively

Source: Author's work (2019)

4.2 Factors that influence participation and the level of participation in export markets as a case of high value mango markets in Southern Ghana

The triple-hurdle model (equations 3.6 to 3.8) was used to assess the factors that influence participation and the level of participation by smallholder mango farmers in export markets as a case of high value mango markets in southern Ghana. The results of the model estimates are given in tables 4.9 to 4.11. The goodness-of-fit test (the pseudo R^2) showed that 42%, 35% and 41% of the variations in the dependent variables in hurdles 1, 2 and 3 respectively are explained by the independent variables used in the models which suggests a strong explanatory power. Table 4.9 presents the results of the factors that influence participation in high value mango markets by smallholder farmers in Southern Ghana (hurdle 1).

Table 4. 9: Factors that influence participation in high value mango markets by smallholder mango farmers in Southern Ghana (hurdle 1)

Variable	Coefficient	Standard error	Marginal effects	p-value
Years of schooling	-0.0101	0.0240	-0.0022	0.673
Household size	0.00795	0.0497	0.0018	0.873
Household income	0.384	0.149	0.0854	0.010***
Farming experience	-0.0723	0.0273	-0.0161	0.008***
Tree density	-0.000487	0.0102	-0.0001	0.962
Tricycle (Yes)	0.920	0.385	0.2048	0.017**
Trust level (High)	0.300	0.250	0.0667	0.231
Distance to road	0.0314	0.0106	0.0070	0.003***
Certification (Yes)	1.972	0.274	0.4390	0.000***
Radio (Yes)	-0.243	0.352	0.0541	0.489
Region (Eastern)	-0.557	0.318	0.1240	0.080*
Constant	-3.435	1.338		0.010***
Model diagnostics				
Pseudo R^2	0.4171			
Prob > χ^2	0.0000			
LR χ^2	128.78			
Log likelihood	-89.9805			
Observations	224			

Note: *, ** and *** represent 10%, 5% and 1% significance levels respectively

Source: Author's work (2019)

As expected, household income positively influenced participation in high value markets ($p = 0.010$). Wealthy farmers can afford farm inputs to enable them meet the quality requirements of their produce buyers (Nyaga et al., 2016). This study shows that a GH¢ 1 increase in household income would increase the probability of participating in a high value market by 8.5 percent. To a large extent, access to or participation in high value markets requires the farmers to use approved chemicals and possibly hired labour for purposes of ensuring good agricultural practices (Kleeman et al., 2014). These inputs are expensive and wealthy farmers are more likely to afford them. Hence, wealthier mango farmers had an increased probability of participating in high value mango markets.

Contrary to expectation, farming experience was found to negatively and significantly influence participation in high value markets ($p = 0.008$). A decrease in farming experience by one year increased the probability that a farmer will have access to or participate in a high value market by 1.6 percent. This finding could be attributed to the fact that mango farming for export markets is a recent phenomenon in Ghana and so is the cultivation of varieties that are preferred by high value markets (Okorley et al., 2014). Older farmers are more likely to have established relationships with local traders and since they are more risk averse (Martey et al., 2012), they are less likely to shift from the low value markets to the high value ones. Further, older farmers are less likely to adopt technologies that can enhance their access to or participation in high value markets (Martey et al., 2012). Hence, they are less likely to participate in high value mango markets.

As expected, ownership of a motorized transport (tricycle) significantly and positively influenced participation of mango farmers in Southern Ghana in high value ($p = 0.017$). Ownership of a tricycle increased the probability of accessing a high value market by 20 percent. This is because

ownership of means of transport reduces variable transaction costs and encourages market participation (Key, 2000). Thus, the farmers who own tricycles can easily transport mangoes to the bulking points and even to storage facilities in cases where contracts take long to be enforced and when farmers are required to transport mangoes to high value markets, especially in the case of the industrial processors. This finding is in line with the findings of Muthini (2015) who found that the ownership of means of transport enhances participation in the direct market which is the most remunerative mango market in Kenya.

Contrary to expectation, distance to the nearest tarmacked road positively influenced participation in high value markets ($p= 0.003$). An increase in distance to tarmacked road increased the probability of participation in a high value market by 0.7 percent. A plausible explanation is that the buyers for the high value markets available to the farmers have better means of transport and can thus reach farmers who are far away from the roads as they search for quality mangoes. Also, according to Muthini et al. (2017), buyers from high value markets prefer large farms and these farms tend to be mostly situated farther away from the main roads.

As expected, certification significantly and directly influenced access to or participation in high value markets by small-scale mango farmers in Southern Ghana ($p = 0.000$). Moving from “not being certified” to “being certified” increased the probability that a farmer will access a high value market by up to 44 percent. Certification is an important determinant of access to high value markets. High value markets prefer certified farmers because, as found by Lee et al. (2012), certified farmers employ good agricultural practices which positively influence their productivity and the quality of mangoes produced. This finding is in line with the findings of Ngenoh et al. (2019) who found that certified farmers have greater access to high value markets because of greater productivity, high quality products and better bargaining power which can

give them secure or direct linkages with buyers.

As expected, the location of a farmer negatively influenced participation in high value markets by smallholder mango farmers in Southern Ghana ($p = 0.080$). Being in the Eastern Region of Ghana reduces the probability of participating in a high value market by 12 percent. This is because, high value markets such as the industrial processors, do not exist in this region (Zakari, 2012).

Contingent on decision to participate in a high value market, a mango farmer then decides to choose a high value market in which to participate. Table 4.10 presents the drivers of the choice of the export market by smallholder mango farmers in Southern Ghana as the high value market in which to participate (hurdle 2).

Table 4. 10: Factors that influence the choice of the export market as a high value marketing channel by smallholder mango farmers in Southern Ghana (hurdle 2)

Variable	Coefficient	Standard error	Marginal effects	p-value
Years of schooling	0.134	0.0657	0.0274	0.042**
Household size	0.103	0.0901	0.0210	0.254
Household income	0.153	0.204	0.0313	0.453
Farming experience	0.00217	0.0486	0.0004	0.964
Tree density	-0.0103	0.0142	-0.0021	0.468
Tricycle (Yes)	0.0535	0.333	0.0109	0.873
Trust level (High)	1.552	0.602	0.3171	0.010***
Distance to road	0.00498	0.0230	0.0010	0.829
Access to credit (Yes)	1.523	0.463	0.3114	0.001***
Radio (Yes)	0.676	0.366	0.1382	0.065*
Region (Eastern)	-2.815	0.970	-0.5755	0.004***
Constant	-3.756	2.442		0.124
Model diagnostics				
Pseudo R ²	0.3512			
Prob > Chi ²	0.0000			
LR Chi ²	57.99			
Log likelihood	-53.5723			
Observations	122			

Note: *,** and *** represent 10%, 5% and 1% significance levels respectively

Source: Author's work (2019)

As expected, education positively and significantly influenced the choice of the export market by a mango farmer over the domestic high value market (industrial processors) ($p= 0.042$). The results show that a one year increase in the years of schooling would increase the probability of participation in the export market by 2.74 percent. This could be because more educated farmers are more likely to understand and meet the stringent requirements of the export market (Kleeman et al., 2014). This finding is consistent with Rao and Qaim (2011) who reported that education increases the propensity of farmers to participate in remunerative market channels. More educated farmers are more likely to have more access to market information and be able to understand and take advantage of new market opportunities as they arise (Kyaw et al., 2018).

As expected, trust level significantly and positively influenced a mango farmer to choose the export market ($p = 0.010$). Transitioning from a low level of trust to a high level of trust in the export market increased participation in the export market by 32 percent. According to Maina et al. (2015), high levels of trust reduce transaction costs because farmers spend less time in ensuring that contracts are honoured by buyers, mostly regarding timely payments. In addition to the transaction cost-reducing function of trust, it facilitates the circulation of reliable information about technology and market opportunities and also enhances the exclusion of unreliable agents for farmers (Lu et al., 2008). Considering that the export market is the most organized market, the agents are trustworthy and there is a relatively higher level of transparency in their dealings with the farmers. Transparency being a positive signal increases the trust level of farmers (Granja & Wollni, 2019). This finding is in line with Shammah et al. (2017) who found that small-scale pineapple farmers in Uganda who had high trust in their agents were more likely to participate in the export market.

As expected, household ownership of a working radio increased the probability of smallholder

mango farmers in Southern Ghana choosing to participate in the export market ($p = 0.065$). Accordingly, owning a radio would increase participation in the export market by mango farmers in Southern Ghana by up to 14 percent. Moreover, owning a working radio increases access to formal information and reduces transaction costs (Maina et al., 2015). Thus, farmers who have a working radio are likely to have access to information about the requirements of the export market and are more likely to participate in this market. This finding is consistent with Mtega (2018) who found that farmers in Tanzania considered the radio as a credible source of agricultural information which can be used to enhance agricultural production and marketing.

Access to credit positively influenced choosing the export market as a high value marketing channel over the domestic high value market ($p = 0.001$). Access to credit increased the probability that a farmer will participate in the export market by 31 percent. This is because accessing credit can play a major role in acquiring the variable farm inputs that can contribute to meeting the requirements of the export market and thus be able to get certification (Ngenoh et al., 2019). This finding is in line with the findings of Muriithi and Matz (2014) who found that credit positively influences a smallholder horticultural farmer's decision to commercialize in the export market.

Being located in the Eastern Region of Ghana reduced the probability of choosing the export market as a high value market by mango farmers in Southern Ghana ($p = 0.004$). Farmers in the Eastern Region of Ghana are far from the mango-exporting companies, thereby limiting their chances of selling to exporters (Zakari, 2012).

Finally, contingent upon choosing to participate in the export market, a mango farmer makes the quantity decision regarding how much to sell to the export market. Table 4.11 presents the

results on the factors that influence the level of participation in terms of the quantity sold in the export market (hurdle 3).

Table 4. 11: Factors that influence the level of participation in export market by smallholder mango farmers in Southern Ghana (hurdle 3)

Variable	Coefficient	Standard error	Marginal effects	p-value
Years of schooling	-0.0575	0.0376	-0.0078	0.126
Household size	-0.102	0.0325	-01.386	0.002***
Household income	0.199	0.0925	0.0210	0.032**
Farming experience	0.0598	0.0161	0.0081	0.000***
Tree density	-5.10e-05	0.00824	-6.93e-06	0.995
Tricycle (Yes)	0.217	0.147	0.0295	0.141
Distance to road	0.0137	0.00887	0.0019	0.122
Access to credit (Yes)	-1.019	0.328	-0.1384	0.002***
Radio (Yes)	-0.135	0.208	0.0183	0.517
Region (Eastern)	0.642	0.339	0.0872	0.058*
Constant	0.170	1.198		0.887
Model diagnostics				
Pseudo R ²	0.4089			
Prob > Chi ²	0.0000			
LR Chi ²	43.05			
Log likelihood	-31.1142			
Observations	50			

Note: *, ** and *** represent 10%, 5% and 1% significance levels respectively

Source: Author's work (2019)

Contrary to a priori expectation, household size negatively and significantly influenced the level of participation in the export market ($p = 0.002$). An increase in household size by one person reduced the volumes sold to the export market by 14 percent. A feasible explanation is that an increase in household size can lead to an increased focus on the production of food crops rather than cash crop and this can lead to a decrease in the quantity of cash crops (mango in this case) available for sale. This finding is in line with Muriithi and Matz (2014) who found that increases in household size decreased volumes of French beans that are sold to the export market because household size increases pressure on land which further leads to a reduction in the land set aside for cash crops and hence reduction in the volume of marketable surpluses.

As expected, household income positively and significantly influenced the level of participation in the export market ($p = 0.032$). This finding is intuitive because wealthy farmers are able to afford to cultivate large land sizes and also purchase inputs that enhance productivity, thereby increasing the quality and the quantity of output (Abu, 2015). This study found that an increase in household income by GH¢ 1 increased the level of participation in the export market by 2.1 percent. This finding is in line with Muriithi and Matz (2014) who found that wealth enables the scaling up of production because farmers are able to purchase inputs such as fertilizers. This encourages a larger extent of commercialization conditional on participating in the export market.

As expected, farming experience positively influenced the level of participation in the export market ($p = 0.000$). Older farmers are more likely to have more contacts with trading partners and this reduces their transaction costs relative to those younger farmers (Martey et al., 2012). Also, with experience, older farmers have a good understanding of market dynamics, thereby improving their decisions about the amount to be sold (Makhura et al., 2001). This study found that an increase in farming experience by one year increased the volumes sold to the export market by 0.81 percent. This finding is consistent with Abu et al. (2015) who found that more experienced farmers in Ghana sold more groundnuts than younger farmers.

Contrary to expectation, access to credit negatively influenced the level of participation in the export market ($p = 0.002$). Accordingly, a transition from not accessing credit to accessing credit decreased the level of participation in the export market by a smallholder mango farmer in Southern Ghana by 14 percent. According to Omobolanle (2010), access to credit can lead to a reduction in productivity, especially when credit is diverted to meet other household needs, and this possibility could explain the unexpected finding of this study.

Being in the Eastern Region of Ghana was found to positively influence the level of participation in the export market by smallholder mango farmers in Southern Ghana ($p = 0.058$). The level of participation in the export market increased by 9 percent for farmers who are located in the Eastern Region of Ghana. This is because farms in the Eastern Region are larger than those in the Greater Accra Region (Okorley, 2014) and this could lead to an increase in marketable surpluses for farmers in the former. Thus, the farmers in the Eastern Region are more likely to supply more to the export market than those in the Greater Accra Region.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Mangoes in Southern Ghana are predominantly marketed in domestic low value markets, with the export market having the least number of participants and volume of sales. This is despite the fact that high value markets (industrial processors and export markets) offer the highest prices which can lead to increased incomes for smallholder mango farmers. Thus, identifying the factors that influence participation in high value mango markets by smallholder farmers in Southern Ghana is important. This is because that information can help policymakers when formulating appropriate policies regarding the institutions and infrastructure that can help improve participation and the level of participation of smallholder mango farmers in high value mango markets with the export markets being the case in point. In view of this, the study was undertaken to analyze the factors that influence participation as well as the level of participation of smallholder mango farmers in Southern Ghana in high value mango markets. The study had two objectives: (a) to characterize the mango marketing system in Southern Ghana and (b) to evaluate factors that influence participation and the level of participation of smallholder mango farmers in Southern Ghana in export markets as a case of high value mango markets.

The multistage sampling technique was used to select 224 mango farmers for the study. Descriptive statistics were used to characterize the mango farmers' socio-economic and demographic profiles. The triple-hurdle model was employed to assess the factors that influence farmers' participation and the level of participation in export markets as a case of high value mango markets.

The results of the study revealed that mango farmers in Southern Ghana actively participate in three mango marketing channels namely, local traders, industrial processors and export channels.

For example, mango sales to local traders, industrial processors and exporters accounted for 46, 32 and 22 percent of the total sales by the sample farmers. Industrial processors and mango exporters constituted the high value markets and offered higher prices than the ones offered the local traders. However, the majority of the mango farmers sold their produce to the local traders because of their inability to access the high value markets. Participation in high value mango markets was found to be influenced by farmer characteristics (including income), institutional factors (including certification), marketing factors (including distance to tarmacked road) and ownership of transaction cost-reducing assets (including a motorized transport (tricycle)). A key challenge to participation in high value markets was the possibility that experienced farmers maintained long-term relationships with local traders. The choice of the export market as high value mango market by mango farmers in Southern Ghana was influenced by education, a high trust level, ownership of information-and-communication technology (radio) and institutional factors, such access to credit.

The level of participation in export markets as a case of high value mango markets in Southern Ghana was influenced by farmer characteristics, such as household income and years of mango farming experience, but it was challenged by large family size and access to credit, possibly due to the misallocation of the latter.

5.2 Policy recommendations

Based on the findings of the study, the following recommendations were made:

1. Given that certification is an important determinant of participation in high value mango markets in Southern Ghana, the Government of Ghana (GoG) and other mango sector development partners should equip farmers with the necessary knowledge and skills

required to meet certification standards. These can be provided through regular agronomic trainings, frequent extension visits and media advertisements.

2. Considering that access to credit is critical to farmers' choice to participate in the export market, financial institutions and stakeholders in agribusiness should make credit (both in-cash and in-kind) more accessible to farmers. This will increase their access to inputs and other farm equipment like the motorized transport that are key to improving their participation in high value markets.
3. The unintended effect of decreasing the level of participation in export markets owing to low productivity attributable to possible diversion of credit can be addressed through the provision of trainings on financial literacy and management to mango farmers in Southern Ghana. This can reduce the diversion of credit to other uses and encourage the use of credit on mango production to increase productivity, and hence enhance the level of participation in high value markets.
4. Education was found to positively influence Southern Ghana mango farmers' choice to participate in the export markets. The GoG and other development partners should offer capacity building of mango farmers through practical-based training, such as farm management training to improve their managerial skills to enhance their participation in high value markets.
5. Farming experience was found to influence participation and the level of participation in high value markets. Therefore, there is the need for agronomic training and encouragement of older farmers to adopt improved agricultural practices. Such a move will help them meet the requirements of the high value markets, thereby increasing their access to and the level of participation in high value markets. Further, older farmers who

do not participate in high value markets should be trained on the benefits of participating in these markets.

6. Household income was found to positively influence participation and level of participation in high value mango markets. Therefore, government policies and efforts should target activities that can improve household income. This will capacitate smallholder mango farmers to be able afford buying improved inputs that will increase the productivity and the quality of mangoes produced to enhance their participation and the level of participation in high value mango markets.
7. Given that distance to tarmacked roads influences mango farmers' decision to participate in high value markets, the Government of Ghana should target rural infrastructural development at improving road networks to mango farms in Southern Ghana. This move will ease mango farmers' access to markets by enabling all buyers to access mango farms.
8. A high level of trust creates an enabling environment for smallholder mango farmers to participate in competitive markets. Therefore, agents should ensure an utmost level of transparency in their transactions with each other. This will enhance trust, thereby creating a more level playing field to encourage participation in high value markets by smallholder mango farmers.

5.3 Recommendations for further research

The main aim of the study was to assess the factors that influence participation and the level of participation in export markets as a case of high value mango markets in Southern Ghana. This objective has largely been achieved. However, the study proposes further research to

assess the constraints in the compliance of farmers with certification standards because it would be important to know why some mango farmers have not been certified.

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APPENDICES

Appendix 1: Questionnaire

QUESTIONNAIRE

ANALYSIS OF THE FACTORS THAT INFLUENCE PARTICPATION AND THE LEVEL OF PARTICIPATION IN EXPORT MARKETS AS A CASE OF HIGH-VALUE MANGO MARKETS IN SOUTHERN GHANA

This survey questionnaire is being used to ascertain information on factors that influence your access to high-value mango markets. The information you will give us will be treated confidentially and will be used for only academic purposes. Your names and contact details will not be published in any document. This interview will take not more than an hour.

Thank You.

District name

Village name.....

Enumerator’s name

Date of interview.....

Name of Household Head.....

Phone number of respondent

Relationship with household head

(1= Spouse 2= Father/Mother 3= Sibling 4= Uncle/Aunty)

SECTION A: HOUSEHOLD SOCIODEMOGRAPHIC CHARACTERISTICS

1) Name of Respondent (if different from household head)

2) Sex of Respondent

(1= Male 0= Female)

3) Age of Respondent years

4) Marital status of respondent

(1 = Single/Never married 2 = Married 3 = Divorced 4= Widowed/Widower 5 = separated)

5) Highest level of education of respondent

(1= None 2= Primary 3= Secondary 4= Tertiary)

6) Number of years spent in school years

Primary 1 = 1	Primary 6 = 6	SSS/TVET 2 = 11
Primary 2 = 2	JSS 1 = 7	SSS/TVET 3 = 12
Primary 3 = 3	JSS 2 = 8	Diploma = 14
Primary 4 = 4	JSS 3 = 9	Polytechnic = 15
Primary 5 = 5	SSS/TVET 1 = 10	University degree = 16

7) Number of household members

8) What is the total average monthly income of household head GHS

9) Is farming your main activity?

(1= Yes 0= No)

10) If No, what other activity/activities do you rely on as a source of income?

(Salaried employee 2 = Business man/woman 3 = Casual laborer 4 = Motorcycle operator
5 = Fishing 7 = Mining 8= Other (Specify))

11) What is the average total monthly income generated from these activities GHS?

SECTION B: HOUSEHOLD PRODUCTION CHARACTERISTICS

1) Did you produce mangoes during the last season?

(1= yes 0= No)

2) What size of land did you use to plant mango in the last season? hectares

3) Who owns the land?

(1= Own land 2= Leased)

4) What variety of mango do you produce?

(1= Kent 2= Keitt 3= Palmer 4= Alphonso 5= Haden 6=Jaffina)

5) How many mangoes did you harvest in the last season?..... mangoes

6) Which inputs did you use in your production?

Input	Quantity in the last season	Average cost per input (GHS)
Hoes		
Machinery		
Labour		
Seedlings		
Fertilizer		
Pesticides/insecticides		
Others (Specify)		

7) How do you access your inputs?

(1= Agro-vet store 2= Local kiosk 3= Farmer group 4= Extension officers 5= Government suppliers 6= other

(specify).....)

8) What kind of labour do you employ?

(1= Household labour 2= Hired labour 3= Both household and hired 4= other

(specify).....)

9) What is your source(s) of irrigation?

Water Source	Distance (Km)
Rain water	
Lake	
River	
Borehole	
Other (Specify).....	

10) Do you get any financial support for your production?

(1= yes 0= No)

11) If yes, how much did you receive GHS

12) If yes, what is your source of support?

(1= Government grant 2= Rural banks 3= Farmer groups 4= Own savings 5= Handouts from neighbours/relatives/ friends 6= NGOs 7= other specify.....)

13) Did you receive any training on production of mangoes?

(1= Yes 0= No)

14) What challenges do you face in production of mango?

(1= Irrigation water 2= Access to seedlings 3= Access to fertilizer 4= Access to credit 5= Access to pesticides/insecticides 6= Mechanization 7= Extension support 8= Training 9= Information on farm practices 9= other

(Specify).....)

15) What would be the best way to improve your production?

.....

SECTION C: HOUSEHOLD MARKETING CHARACTERISTICS

1) Did you sell mangoes in the last season?

(1= Yes 0= No)

- 2) For how long have you been selling mangoes years
- 3) Do you normally sell to the following outlets?

Outlet	1= yes 0=no	How frequently do you sell to the outlet? 1= daily 2= once a week 3= twice a week 4= monthly 5= yearly	Quantity sold	Price sold at (GHS)	Distance to outlet (KM)	Transport cost (GHS)
Local community markets						
Central markets						
Roadside retailer						
Wholesaler						
Supermarket						
Export buyers						
Export market						
Industrial Processors						
Farmer group						
Market women						
Middlemen						
Organizations						

- 4) Is there a reason you prefer selling to the outlet in question 3 above?

Outlet	1= offer higher prices 2= regular buyer 3= High trust level 4= proximity 5= contracts are easily enforced 6= offers technical support 7= other specify
Local community markets	
Central markets	
Roadside retailer	
Wholesaler	
Supermarket	
Export buyers	
Export market	
Industrial Processors	
Farmer group	

Market women	
Middlemen	
Organizations	

5) Buyer Requirements

Outlet	Regular supply required ? 1= Yes 0=No	Minimum quantity required	Strict physical quality required ? 1=Yes 0= No	Specific varieties required ? 1= Yes 0= NO	Variety Required ?	Strict chemical quality required ? 1= Yes 0= No	Certification required? 1= Yes 0= No
Local community markets							
Central markets							
Roadside retailer							
Wholesaler							
Supermarket							
Export buyers							
Export market							
Industrial Processors							
Farmer group							
Market women							
Middlemen							
organizations							

Variety Coding

(1= Keitt 2= Kent 3= Palmer 4= Alphonso 5= Haden 6= Jaffina)

6) Difficulties in meeting the requirements

It is difficult to meet the requirements of	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Regular supply					
Minimum quantity					
Physical quality					
Chemical quality					
Certification					
Variety					
Size					

7) At what point did you sell your mango?

(1=farm gate 2= by the road side 3= local assembly markets 4= central markets 5= other (specify).....)

8) What price do you get for your mango when you sell as an individual GHS?

9) Did some mangoes lose physical qualities after harvest or in transit to the point of sale?

(1= Yes 0= No)

10) If yes, how many

11) Do you have access to storage facilities?

(1= Yes 0= No)

12) If yes, what storage facility do you access?

(1= Cold storage 2= Crates 3= Boxes 4= Other (specify).....)

13) What is the major cost you incurred in the sale of mango?

Activity	Costs per season (GHS)
Storage	
Accommodation	
Communication (airtime)	
Losses to negotiation	
Transportation	
Monitoring costs	
Market search costs	

Other (Specify).....	
----------------------	--

- 14) What is the distance from your farm to the nearest tarmac road? Km
- 15) how much do you pay as transport fare to the nearest market? GHS
- 16) How much do you make from the sale of mangoes per season? GHS
- 17) How long does it take to find a buyer? hours
- 18) What challenges do you encounter in marketing your mango?

(1= Market information 2= High transportation costs 3= Competition from large/medium scale producers 4= Price exploitation 5= Poor infrastructure (roads) 6 =Perish ability due to poor storage 7=Other (specify).....)

- 19) What would be the best way to improve your participation in high-value markets.....

SECTION D: SOURCES OF MARKETING INFORMATION

- 1) Was there available information on price?
(1= Yes 0= No)
- 2) If yes, what was your source of information?
(1= Neighbor 2 = Television 3=Radio 4 = Internet 5 = Newspapers/magazines 6= Buyers 7 = NGO’S 8=Extension officers 9 = Other (Specify))
- 3) Who sets the prices of the vegetables?
(1= Buyers 2 = Farmer group 3 = Farmer negotiates 4= Government standard price 5 = Other (Specify))

SECTION E: ACCESS TO EXTNSION SERVICES

- 1) Have you got assistance from extension officers regarding production decisions over the past 12 months?
(1= Yes 0= No)
- 2) If yes, how frequently did you get the assistance?
(1= Daily 2= Once a week 3= Twice a week 4= Once a month 5= Once every planting season 6= Once in a year)
- 3) Where do you get information on production practices?

(1= Fellow farmer 2= Radio 3= Books/brochures 4= Field visit 5= Government extension officers 6= Private extension officers 7= Other (specify).....)

4) What type of extension did you receive?

Type	1=Yes 0= No	Provider
Field layout		
Planting date		
Irrigation		
Fertilizer application		
Post-harvest handling		
Other(specify).....		

5) Did the household apply the information acquired?

(1= yes 0= No)

6) Was there any improvement after acquiring the information?

(1= Yes 0= No)

7) If No, why?

SECTION F: HOUSEHOLD ASSET OWNERSHIP

1) Does the household own a cellphone?

(1= Yes 0= No)

2) Have you used the cellphone to get information on mango marketing?

(1= yes 0= No)

3) Where do you charge your phone?

(1= Own place 2= Information center 3= Friends/family's house 4= Charging centers 5= other (Specify).....)

4) How many kilometers is the charging point away..... km

5) Do you own a TV or a Radio?

(1= Yes 0= No)

6) Do you watch or listen to agricultural programmes on the TV/Radio?

(1= Yes 0= No)

7) If yes, to which programmes do you watch or listen.....

8) Transportation Assets

Asset Type	1= Yes 0= No	Number	Use for mango transportation
Vehicle			

Motorcycle			
Bicycle			
Tricycle ("Aboboyaa")			

9) Does the household own land?

(1= Yes 0= No)

10) If yes, what is the size of the land..... (hectares)

11) Is the land a communal land?

(1= Yes 0= No)

12) If no, do you have a title deed

(1= Yes 0= No)

SECTION G: ACCESS TO CREDIT

1) Did the household access credit in the last 12 months?

(1= Yes 0= No)

2) If yes, what was the source of credit

(1= Neighbours 2= NGOs 3= Rural banks 4= Microfinance institutions 5= Farmer groups
6= other (specify)

3) In what form was the credit provided?

(1= Inputs 2= Cash)

4) If inputs, please specify the quantity for each

- a) Seedling
- b) Fertilizer..... kgs
- c) Pesticide/insecticide Litre

SECTION K: GROUP MEMBERSHIP

1) Do you belong to any farmer group?

(1= yes 0= No)

2) If No, what is your reason?

(1= There are no groups 2 = I don't have time for groups 3 = I am not aware of any group
4 = Groups are costly 5 = Groups are not beneficial 6 = Other (Specify)

3) For how long have you been in the group months Years?

4) Does your group help you sell your mangoes? (1 = Yes 0 = No)

- 5) If Yes, to which of these markets do they take your mangoes?
 (1= Supermarkets 2 = export buyers 3 = industrial processors 4= export market 5= open air markets 6= Wholesalers 7= Retailers 8= Brokers 9= Other (specify))
- 6) What is the price you get for your mango if you sell with the group? GHS
- 7) What other services does the farmer group offer?
 (1= Access to credit 2= mango marketing 3= Products bulking 4= input acquisition 5= extension services 6= training services)

SECTION L: PUBLIC GOODS PROVISION

- 1) What is the state of the nearest road to town?
 (1= Good 2= Bad)
- 2) What is the distance to the nearest town km
- 3) Has the road been resurfaced before?
 (1= Yes 0= Bad)
- 4) If yes, when was it last resurfaced?..... years
- 5) Distance to selected infrastructure

Infrastructure	Distance (km)
Tarmac Road	
Hospitals/clinic	
Schools	
Bank	
Agricultural offices	
Borehole	
Market place where you sell	
Storage facilities	
Point of sale to private buyer	

Thank you very much for your time!!!

Appendix II: Pairwise correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) education	1.000											
(2) hhsize	0.073	1.000										
(3) logincome	0.282	0.044	1.000									
(4) farmingexp	0.016	0.226	0.162	1.000								
(5) treedensity	0.214	0.019	0.183	0.034	1.000							
(6) owntricycle	0.122	0.056	0.199	-0.006	-0.015	1.000						
(7) trustlevel	0.259	0.061	0.319	-0.141	-0.046	0.210	1.000					
(8) distance	-0.339	0.011	-0.224	-0.079	-0.127	-0.088	-0.218	1.000				
(9) certification	0.097	-0.168	0.351	0.021	-0.066	0.237	0.407	-0.180	1.000			
(10) radio	-0.161	0.076	-0.127	0.015	-0.066	-0.006	0.033	0.098	-0.068	1.000		
(11) creditaccess	0.247	-0.120	0.191	-0.352	0.049	0.295	0.410	-0.073	0.510	-0.214	1.000	
(12) region	-0.174	-0.007	0.220	0.051	-0.307	0.165	0.199	0.038	0.408	-0.116	0.293	1.000

Appendix III: Variance inflation factor (VIF)

Variable	VIF	1/VIF
Certification	2.617	.382
Age	2.596	.385
Region	2.581	.387
Household size	2.318	.431
Farming experience	1.829	.547
Trust level	1.557	.642
Storage	1.435	.697
Education	1.418	.705
Tree density	1.391	.719
Logincome	1.375	.727
Distance to road	1.252	.799
Radio	1.238	.808
Tricycle	1.211	.826
Mean VIF	1.755	.

Appendix IV: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Homoskedasticity

Ha: Heteroskedasticity

$\chi^2(1) = 0.53$

Prob > $\chi^2 = 0.4679$

Appendix V: The triple-hurdle model

