FACULTY OF AGRONOMY AND FORESTRY ENGINEERING

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Marketing of Maize and Cowpea amongst Smallholder Farmers in Mozambique: A Market Participation Approach

By

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Declaration

I hereby affirm that this thesis is a presentation of my original research work and has never been presented elsewhere. In this research, every article used were properly cited and referenced.

Linda Chinenyenwa Familusi

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Dedication

I dedicate this study to God Almighty for his protection, guidance and provision.

Acknowledgment

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Acronyms

%	Percentage
AIC	Akaike Information Criterion
APE	Average Partial Effect
BIC	Bayesian Information Criterion
DPCI	Direcção de Planificação e Cooperação Internacional (Directorate of Planning and International Cooperation)
DV	Dependent Variable
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
ha	Hectare
HH	Household Head
IAI	Inquérito Agrícola Integrado (Integrated Agricultural Survey)
MASA	Ministério da Agricultura e Segurança Alimentar (Ministry of Agriculture and Food Security)
MINAG	Ministry of Agriculture
OLS	Ordinary Least Square
TIA	Trabalho de Inquérito Agrícola (National Agricultural Survey)
WFP	World Food Programme
χ^2	Chi-square

Abstract

In Mozambique, agricultural production is dominated by smallholder farmers with cultivation on less than two hectare of land and the use of low inputs with production mostly targeted towards own house consumption with very little for agricultural marketing. This study aim to analyze the trends of market participation of maize and cowpea, examine the socioeconomic characteristics of maize and cowpea farmers affecting market participation and determine the effect of the factors influencing the household decision to participate in maize and cowpeas' market. The t-test and chi-square test is used to examine the socioeconomic characteristics of households affecting market participation and the analysis of factors influencing household decisions to participate in the maize and cowpea markets is achieved using the Cragg's Independent Double Hurdle Model which is estimated using probit model for the first stage (participation decision) and truncated normal for the second stage (quantity to sale decision). This study used 2002-2012 data from Trabalho de Inquérito Agrícola (TIA). The trend analysis result showed that maize market experienced a downward trend while cowpeas' market experienced an upward trend. The results from the t-test and chi-square test on each variables showed that the two groups (participants and non-participants) differ from each other except for few variables – age of household head, household size and the use of manure. The results from the double hurdle model showed that market participation and the quantities sold in the market were positively related to the production quantity, household head being a male and the use of extension services. In addition, market participation and the quantities sold in the market decreased for households who had experienced crop lost. This study concluded that male headed households' had greater opportunity in food-crop markets and that the role of extension services is vital to agricultural market participation and on the quantities sold in the market. Therefore, it was recommended that agricultural programs should focus on male headed households and that extension services coverage should be broaden within each region in the country.

Key words: Double hurdle model, Market participation, and Trend analysis

1.0 Introduction

Agriculture plays a vital role in the economic development of most African economies as it contributes to the income of the farmers, provides employment, and contributes to the Gross Domestic Product (GDP). In 2014, it contributed with about 29% of the GDP of the Mozambican economy (World Bank, 2014). In Mozambique, agriculture is the most important sector since about 80% of its population depend on agriculture as a source of livelihood (Cunguara & Hanlon, 2010) and it provides food which represents two-thirds of the total consumption especially in the rural areas where about 70% of the people live (MASA, 2015).

In 2014, the agricultural sector of the Mozambican economy consist of 4.3 million farms out of which 4.2 (98.92%) million were small farms, 45,320 (1.06 %) were medium farms and 626 (0.02%) were large farms (MASA, 2015). Agricultural production in the country is characterised by very low use of improved inputs such as machinery and credit. This fact has been contributing to low productivity which in turn yields low market participation in the country (World Bank, 2006). In fact, according to the 2014 MASA/DPCI TIA[1] data (for small and medium farms) in Mozambique, only 4.60% of the households used inorganic fertilizers, 48.40% of the households received information on prices, 8.30% of the households received information about extension, 4.70% of the households used pesticides, 3.00% of the households used organic fertilizers, 1.10% of the households received credit, and 9.50% of the households used animal traction. Furthermore, agriculture in Mozambique mostly involves the cultivation of food crops which are targeted for own house consumption with very little for marketing (Siziba et al, 2011).

In the country, food crop production is the most important as it accounts for 80% of the total cultivated area in 2009 (FAO/WFP, 2010). In 2014, more than 85% (5,139,000ha) of the total cultivated lands were used for food production (MASA, 2015). Some of the basic food crop grown in Mozambique includes such crops as cassava, maize, rice, sorghum, millet, rice, common beans, cowpea, pigeon pea, groundnut, and sweet potatoes. Amongst these food

[1] MASA is an acronomy for Ministério da Agricultura e Segurança Alimentar.
DPCI is an acronmomy for Direcção de Planificação e Cooperação Internacional.
TIA is an acronmy for Trabalho de Inquérito Agrícola. Note that starting in 2012 TIA became IAI (Inquérito Agrícola Integrado).

crops, maize and cowpea were selected for this study because they belong to the cereal[2] group which is high in energy and the pulses[3] or leguminous crops which constitute major source of plant protein, respectively.

Additional, the choice of maize and cowpea is also due to its importance in the agricultural sector in Mozambique as they account for the basic food crops grown in the country. Other crops such as cassava and sweet potatoes (orange and non-orange varieties) were initially included for this study but were dropped because of insufficient data to estimate the models.

In Mozambique, maize is the number one basic food crops and it is mostly produced in the northern and central regions because of its favourable climatic condition. It also serves as the most important food crop used as a food reserve during periods of food shortage (Salvucci, 2012). In 2014, about 76.90% of small and medium farms were involved in maize cultivation which was done on 1,703,500 hectares (ha) of land and led to a production of 1,357,220 tons of maize (MASA, 2015). Out of these 76.90% maize farms, only about 12.2 % farms experienced maize crop loss. In agricultural market, maize is either sold fresh, in the cob or as grains.

Cowpea (commonly called *feijão nhemba* in Portuguese) on the other hand, is a drought resistant crop, widely grown in all the regions in Mozambique (ICRISAT, 2013). According to 2014 MASA/DPCI IAI data, 47.30% of small and medium farms grew cowpea on 377,900 ha of land and produced 103,837 tons of cowpea. In agricultural markets, cowpea is either sold fresh, in dry pods or as grains.

Agricultural marketing is the movement from subsistence production in a way that will lead to an increasingly complex production and consumption system that is oriented to market transactions (Goletti, 2005) with the aim to optimize profit. Market participation is a cause of economic development as well as a consequence of economic development and provides households with a chance to enjoy welfare gains (Boughton et al., 2007; Barrett, 2008). Therefore, some of the reasons for participating in agricultural marketing should be to meet the consumption demand for food with the aim of receiving income from transaction which in turn leads to the improvement of households' income and hence economic development.

[2] Maize is a cereal crop alongside rice, sorghum, and millet
[3] Cowpea is a pulse or legume crop alongside common beans, pigeon beans, yoke beans and groundnuts.

The importance of the marketing of agricultural produces cannot be overemphasized and thus the essence of this study. Previous study on market participation includes those done by Walker et al., (2004), Giesbert & Schindler, (2010), Boughton et al. (2006), Heltberg and Tarp (2002), Benfica and Mather (2013), Salvucci, (2012), Benfica and Tschirley (2012), and Boughton et al. (2007). This study differs from these other studies because it takes a next step by dividing the farmers' decision on market participation in Mozambique by regions (north, centre and south regions). This improvement allows accounting for the different geographical features that exist in the country. It should be noted that the biophysical conditions, which affects crop production and consequently market participation vary among the three regions. Also, this study analysed the trend of maize and cowpea from 2002 to 2012 in order to determine the extent by which market participation has declined over the years. Moreover, the methodological approach that was used in this study - the double-hurdle approach, has never been used to study marketing decisions using nationally representative survey data from Mozambique.

1.2 Research problem

In Mozambique, agriculture is mostly practised by the rural households and serves as the main source of food and income for the rural people. Historically however, the marketing of agricultural produce by farmers' in agricultural markets is relatively low (Boughton et.al. 2006, Benfica and Tschirley, 2012, Benfica and Mather, 2013) despite the adoption of market liberalization by the Mozambican government after the war. This is evident in 2008 TIA data as only about 19 % and 8% of the total households participated in maize and cowpea markets respectively.

Previous research has shown that many factors contribute to the decision whether or not a farmer decides to participate in the market. According to data from TIA (2002-2008), some of the factors that were responsible for this poor market participation were low agricultural productivity at house hold level, inadequate market infrastructure and institutions (Benfica and Mather, 2013). Also, Siziba et al. (2011) argued that poor market participation problem manifested as a result of little surplus of agricultural produce for marketing which was largely caused by low product pricing.

Previous studies have also outlined some recommendations that might facilitate in improving market participation. Barrett (2008) argues that for the producers to get the 'right price' for the produces is not enough to improve market participation but also access to adequate technology, private assets, and public infrastructure and service which contribute to the production of marketable surplus. Njuki et al. (2009) suggested that farmers should collectively market their produce in order to reduce transaction costs, which was considered as a barrier to access the market mostly in areas with poor social infrastructures. Also Siziba et al. (2011) suggested that a huge transformation from subsistence farming to commercial agricultural production should be the target of agricultural production.

Despite all these studies, low market participation still poses a challenge in Mozambique. This limited market participation might be associated to lack of information about the factors that influence households' decision to participate in the market. Additionally, households' characteristics might be affecting household participations in marketing of agricultural products. However, there is little information about the key household characteristics that might affect market participation. Mozambique is also a country which is cyclically affected by drought and floods. These weather events affect drastically on agricultural production and consequently agricultural surplus to be marketed. However, the effects of these events in market participation were not extensively studied. Therefore, this study analysed market participation in the three regions (North, Central and South) of the country according to its geographical features.

Given the limitations described above, this study is guided by three major questions: (i) Is the market participation growing over time? (ii) What are the socio-economic characteristics of the smallholder farmers who market their produce compared to those that do not participate in the market? and (iii) What are the factors affecting the household's decision to participate in agricultural market and on the quantity to sales? The answers to these three questions are sure pathway of solving the issue of low market participation and hence, improve farmers' income, reduce poverty and food insecurity in Mozambique.

1.3 Objectives of study

Generally, the study analyse the evolution of the marketing of maize and cowpea amongst smallholder farmers in Mozambique using data from TIA - Trabalho de Inquérito Agrícola. Specifically, the study will

- Analyse the market participation trends of maize and cowpea in Mozambique
- Examine the socio-economic characteristics influencing market participation
- Determine the effects of factors influencing the households' decision to market maize and cowpea, as well as their quantities sold.

1.4 Limitations of the study

Although this study achieved its objectives, there were some inevitable limitations. Firstly, the study was not able to capture both sides (buyer's and seller's side) of households' decision to participate in agricultural market due to the unavailability of the data on the households' decision to participate in the market as buyer. Secondly, on the trend analysis, this study did not take into account the differences in sample size in each year which could probably reflect on the number of market participants. Lastly, as at the time of data collection process, there were no most recent data on household decision to participate in the market. Although 2012 data was available but it had a problem of missing values so the 2008 data was used instead.

2.0 Literature review

This section encompassed a brief overview of agriculture and the marketing of agricultural products in Mozambique followed by an intensive review of previous studies on market participation both in Mozambique and worldwide.

2.1 Overview of agricultural production and marketing periods in Mozambique

Based on the economic and political environment, the recent Mozambican history can be divided into four periods which are - Before the independence period, from the independence period to the beginning of the structural adjustment program (1975-1987), from the structural adjustment period to the first democratic elections (1988-1994) and the post first elections era (1994 onwards). This section describes the status of agricultural sector in these periods based on the review from Alfieri, Arndt and Cirera (2007).

Before the independence period

At this time, the output from agricultural activities was from plantations, settlers and peasants. Agricultural production was specialized across provinces. For example, the Zambezia province was specialized in tea, copra and sugarcane plantations and the Nampula province was specialised in cashew, cotton, tobacco, and sisal production. Agriculture was regulated with a system of forced labour and the prices of production were fixed by negotiation between the colonial government, concession firms and farmers. The colonial government usually set the price of the producers and consumers as well as the marketing margin gained by all stage of production. The marketing of agricultural produce was done by a parastatal marketing board.

Independence period to the beginning of the structural adjustment program (1975-1987)

In Mozambique, independence was achieved in 1975 and after that, the emigration of settlers resulted to a decrease in agricultural production and marketing. In 1976, the exportation of agricultural crops dropped by 40% in comparison to the export realised in 1973. The emigration of the former colonizer did not result in land reforms but rather the government took over the lands that were abandoned and this led to the foundation of large state farms in the future years. Agricultural food and cash crop production dropped due to the

marginalization of the peasantry and lack of structured state assistance and between 1975 and 1982 the value of agricultural output decreased by nearly 30%.

The agricultural policy in this period was highly regulated given that the economy was already regulated in the previous period. Also private enterprise and a biased policy on large farms were suppressed in terms of prices. Prices were fixed at all phases of the supply chain and the producers prices were set low which were aimed to subsidize for consumers. In the early 1980s, black markets emerged as a result of the compulsory producer prices which were below the market-clearing levels.

The structural adjustment period to the first democratic elections (1988-1994)

During this period, agricultural official no longer fixed agricultural goods prices. This liberalization enabled private traders to enter the marketing which caused an obvious consumer price increase in formal markets[4]. This increase was done in order to support the prices that were previously registered in parallel markets. The on-going war led to the country being destabilized and farmers were secluded from markets particularly in the centre-north regions. Due to these war effects, the production of major food and cash crops decreased. Such crops includes cassava, maize, cotton, peanut and beans.

The post first elections era (1994 onwards)

Mozambique commenced a new historical phase featured with high economic growth (7.8% from 1993 to 2004) following the peace agreement in 1992 and democratic election in 1994. The agricultural sector experienced tremendous growth given that farmers were able to go back to their land and agricultural commercialization was made easier given to the market liberalization. However, the destruction of major transportation means contributed to domestic market segmentation into three discrete geographic regions which are the southern, central and northern Mozambique.

2.2 Previous studies on market participation worldwide

In viewing some of the factors that influence market participation, some literatures have focused on the influence of transaction cost to market participation (Goetz, 1992; Key et al., 2000; Renkow et al., 2004; Alene et.al., 2008; Heltberg and Tarp, 2002). These studies have

[4] About 187 % increase in price in 1987 alone

found that transportation costs and other related costs that is cause by the distance to the market were found to be un-favorably associated to market participation while other factors as assets endowment were found to be positively correlated to market participation. These studies argued that the effect of price policy on market participation are not important for most of the households due to the inability to invest in institutional and other marketing related infrastructure and assets.

The theory of assets has been used to evaluate market participation. Carter and Barrett, (2006) and Boughton, et al., (2007) argued that the lack of assets (land, livestock, labour, equipments) by household maybe the reason why most smallholders are unable to produce surplus in order to participate in the market as a seller. Apart from the assets endowments of the households, an increase in public good-type (such as infrastructure and market information) investments also improves household market participation (Boughton, et al., 2007; Barrett, 2008).

Over the years, different methods have been used to analysis households' market participation of which the double hurdle model has been widely used for production, consumption and labour supply decisions. Regarding consumption decision, Fabiosa (2006) investigated the rising consumption of wheat in Indonesia while Aristei, Perali, and Pieroni, 2007 looked at the consumption of alcohol by Italian households. With reference to labour supply, the effects of volunteering for non-profit organisation on social capital formation was investigated (Isham, Kolodinsky, and Kimberly, 2006). Olwande and Mathenge (2012) examined the market participation of poor rural households in Kenya using a three year panel data (2000, 2004 and 2007) of maize, vegetables, fruits and milk products. The data estimation was done using double hurdle model and results showed that the poor households tend to participate less in the market that the non-poor households and this may be because of some of the characteristics of the poor households such as-low literacy level, small land size, low assets values, low access to credit and low production surplus. The same author noted that the low market participation of the poor households can be improved by increasing the land size and the household becoming a member of farmer organization.

The double hurdle model was used to estimate the factors influencing market participation and the impact on income and poverty among the poor and marginalized households in Kenya in 2000, 2004 and 2007 (Mathenge et al., 2010). The results showed that female headed household, income poor and land poor households have lower market participation

for majority of the enterprise. The market participation for all food crops was low but female headed households have greater likelihood of marketing maize, beans, milk, other cereals and pulses. The author also found that land size and membership of a farmer group increase the likelihood of overall participation in the market and the extent of which the household participates. The membership of farmers group enables farmers to receive agricultural information and increase the probability of accessing credit.

Chilundika (2011) analysed market participation of bean smallholders farmers in Zambia and the results showed that the coefficient of the variables land used, yield, location and age were positively significant in the household decision to participate in the market. The truncated regressions showed that land use, yield, wealth, belonging to an alliance and being a producer from the Northern Province had a positive influence on the quantities of beans sold. Double hurdle regression was used to analysis the factors that influence market participation and sales of potatoes by smallholder farmers in Angola (Reyes, et al., 2012). The result showed that male headed households were more likely to participate in the market as sellers but with no influence on the quantity sold.

Akinbode and Dipeolu (2012) investigated the factors affecting consumption of fresh fish in South-west Nigeria using a single step estimation of the Tobit model, independent double approach and dependent double hurdle model. The results showed that husbands and wife income, expenditure on beef and dependency ratio significantly affects the decision to consume while household size, husbands education, husbands and wife income, expenditure on dry fish and dependency ratio significantly affects the decision on how much to consume. It was recommended that the public should be enlightened on the importance of consuming fresh fish.

Apart from the double hurdle model, other studies had used other forms of estimation. Heckman selection model was used to analyse the dairy market participation with endogenous livestock ownership in Cote d'Ivoire (Balagtas et al., 2007). The results showed that age, television ownership, market price of fresh milk, distance to town, and membership in the Peulh tribe increase the likelihood of owing a livestock. Also increased market price and the number of both local and African cross-bred cows positively increase milk sales. Rios et al. (2009) analyzed the correlation between farm productivity and market participation using a comparable household data from Tanzania, Vietnam and Guatemala and the results showed that the Vietnam and Guatemala households with higher productivity have greater

participation in agricultural markets as compared to households with a small productivity. However, for Tanzania, there was no significant correlation.

Azam et al. (2012) examined the key casual factors behind agricultural supply response and the decision by farmers on market participation using a stylized farm household model in a two step decision making process through the estimation of Heckman regression model. The results showed that risk, technology and rural infrastructure were important determinants of agricultural commercialization in Cambodia.

The logistic regression was also used to model the factors affecting market participation of maize farmers in Limpopo province using a cross sectional data (Hlongwane et al., 2014). Gender, credit access, marital status, market information and infrastructure were found to positively influence market participation. Also, distance to the market and other source of income negatively influence market participation. The study emphasized that government should encourage group market participation, subsidise input cost and organise workshops for farmers.

Demeke and Haji (2014) study on econometric analysis of factors affecting market participation of smallholder farming in Central Ethiopia was aimed to examine the demographic and socioeconomic factors determining market participation of smallholders using the multinomial logistic regression analysis. Results showed that age, male farmers, urea application, labour expenditure and land size were positively related to the probability of being a commercial farmer. It was recommended that technical advice and capacity building training should be provided for farmers accompanied with the allocation of additional funds for research activities and in irrigation projects.

Sebatta et al. (2014) aimed to analyse the factors that influence smallholder farmers' decision to participate in potato market in Uganda and the level of market participation. Heckman model was used for this analysis and results showed that farmers' sex, farmers' age, education, off farm income, extension visit, market price, and nearest to market affects participation decision and non-farm income, farmers' sex, and membership of farmers group affects the level of participation. The study concluded that household characteristics and endowment greatly affect farmer's decisions to participate in the market. It was recommended that policy makers should promote the village market collection centres.

Indexing, tobit and logit models were used to analysis market participation and rural poverty among Taraba state farmers in Nigeria (Gani and Adeoti, 2011). This study used the logit to determine the probability of market participation. The results showed that about 98% of the respondents were market participants and 70%, 10 % and 20% of the produce were sold to trader's on-farm, at home and in the market respectively. Also 25%, 25% and 50% were sold to the consumers on the farm, at home and in the market respectively. But in all, the quantity of agricultural produces consumed by households (46%) is greater than what is being sold (39%). Also, the results showed the market information, family size, and education level influences positively to farmers' market participation.

2.3 Previous studies on market participation in Mozambique

Specifically, in Mozambique, studies analyzing market participation include those done by Heltberg and Tarp (2002), Arndt et al., 2008, Benfica and Mather (2013), Salvucci, (2012), Benfica and Tschirley (2012), Boughton et al. (2007) and Benfica et al. (2015). The study by Heltberg and Tarp (2002) analyzed smallholder market participation for food crops, cash crops, and total value of crop sales in Mozambique using the reduced form equation by applying the Goetz's approach. The results revealed that some factors that affected market participation significantly includes animal traction, size of farm, mean maize yield, climatic risks, age of household head, infrastructure and ownership of means of transport.

Arndt et al., (2008) investigated the consequences of an increase in price of agricultural products. The results of the study showed that the income of households reduced and thus the increase in poverty by 0.5%. Benfica & Mather (2013) examined the market participation and performance of food and cash crops in Mozambique and found that rural road infrastructure, development/dissemination of improved inputs, improving local storage capacity, expansion of the electricity grid and improvement of the spatial coverage and targeting of SIMA price data is apparent to improve the market participation and market performance. Also, they recommended that smallholder inclusion in sugar cane development should be facilitated and the problem of VAT applied to imported agricultural products should be worked on, amongst others.

The patterns of household agricultural market participation in Mozambique were examined with the main focus on how asset endowment can facilitate market participation (Boughton, et al., 2007). Three different markets were studied-maize, cotton, and tobacco. The Heckman

two-step approach was use for sample selection and the Probit model was first used to analyse household market participation. Then, an OLS regression on the volume of sales conditioned on being a market participant was analysed (Boughton, et al., 2007). The results showed that household asset can cause a barrier for household to enter market. This was true for all three studied markets.

Benfica and Tschirley (2012) examined the dynamics in market participation in the central and Northern Mozambique between 2008 when the prices of many food commodities increased rapidly and 2011. The studied used a panel data for 2008 and 2011 and found that the market participation of almost all major food crops (cassava, maize, sweet potato, sesame, sunflower, soybeans, common beans, pigeon pea, and groundnuts) has increased which may be due to improvement in the access to market information and services from extension agents (Benfica and Tschirley, 2012).

Benfica, et al. (2015) used a two stage least square approach to determine market participation intensity on productivity outcomes and vice versa. The first stage was analysed using a Tobit model while the second stage used OLS model. The result showed that there is a strong positive relationship between market participation intensity and productivity in both directions as increase in productivity increases market participation and vice versa. The study concluded that agricultural market participation intensity progress is small even when the price for output in the market is favourable. Therefore, some needed priorities in order to strengthen agricultural market participation and performance while improving productivity in Mozambique were mentioned and they include investment on road infrastructure, access to market price information, and provision of low cost of storage capacity.

3.0 Methodology

In this section, the methods used in order to achieve the three specific objectives of this study were shown and explained. Such methods include the trend analysis test, t-test, chi-square test and the double hurdle model.

3.1 Trend analysis of maize and cowpea commodities

A Wilcoxon-type test for trends was used to test for the existence of trend across groups of crops over time. It is a non-parametric test used to ascertain if the trend of the number of household participating in agricultural market over the years is statistically significant. The Wilcoxon-type test is an extension of the Wilcoxon rank-sum test and an addition to the Kruskal-Wallis test and was developed by Cuzick (1985). The assumptions for this test are that the data must be at least ordinal and that groups must be in a meaningful order (Cardillo, 2008). The test statistics is calculated as shown below (Cardillo, 2008):

$$\mathbf{T} = \sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{l_i R_i} \quad \textbf{(1)}$$

$$\mathbf{L} = \sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{l_i n_i} \quad \textbf{(2)}$$

$$\mathbf{E(T)} = \frac{\mathbf{L(N+1)}}{\mathbf{2}} \quad \textbf{(3)}$$

$$\mathbf{var(T)} = \frac{\mathbf{N+1}}{\mathbf{12}} \left(\mathbf{N} \sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{l_i^2 n_i} - \mathbf{L^2}\right) \quad \textbf{(4)}$$

$$\mathbf{z} = \frac{\mathbf{T - E(T)}}{\sqrt{\mathbf{var(T)}}} \quad \textbf{(5)}$$

where R_i represents the sum of the ranks for the ith group, l_i represents the scores for the ith group, L represents the weighted sum of all groups score, n_i represents the sample size for the ith group, N represents the total number of observations. As shown below, The null hypothesis states that there are no trend across groups T which will have mean E(T), variance var(T). The hypotheses to be tested are:

H_o: No trend exists in the data and H_1: There is trend existing in the data **(6)**

The null hypothesis is tested using the normalised test statistic z. The probabilities for z are derived from the standard normal distribution table. If the z calculated is greater than the z critical, then the null hypothesis will be rejected. This would imply that there is no trend existing in my data.

If a significant trend exists, the next step is to find the type of trend[5]. The type of trend is found through fitting a linear trend from the graph of the actual data. The linear trend line is the simple linear regression given as:

$$\mathbf{Y = a + bT} \qquad \mathbf{(7)}$$

where Y represents the number of market participants, T represents the trend over the years, a is the intercept and b is the trend coefficient (slope) which indicates the type of trend that exists. If $b > 0$ then it is an upward trend, if $b < 0$ then it is a downward trend and if $b = 0$ then it is sideways trend (that is constant).

3.2 Socio economic factors affecting market participation

The main socio economic characteristics of the households that affect agricultural production and thus market participation will be used to compare the characteristics of both the farmers that participate in the market and those that do not participate in the market. Such characteristics include variables such as sex of household head, age of household head, education level of household head, household size, access to extension services, crops loss (either by drought, floods, cyclone and wild animals), access to temporary jobs, farm size for specific food crops, fertilizer use, pesticides use, quantity produced, type of farm[6](small farm type or medium farm type),and variables such as if the household is a member of association, if the household received price information, if the household utilize manure, if the household had access to credit, if the household rears livestock and if the household received emergency seeds.

For continuous variables such as age of household head, household sizes, education level of household head, quantity produced and farm size used to produce food crops; the means of these variables for the participating and non-participating households were computed and compared to determine if these means are different from each other. These means are compared using t-test to ascertain whether the differences between the two independent groups are statistically significant. This is done by setting a null hypothesis (H_0) which states that the difference in the population mean of the two independent group (participants and

[5] We have an uptrend, downtrend and sideways trend.

[6] MASA (2012-2014) define small farmers as households having ≤10ha of non-irrigated land, ≤ 5ha of irrigated lands, owning ≤ 10 cattle, owning ≤ 50 small animals (such as goats, sheep, pigs etc), and owning ≤ 5,000 poultry birds. Medium farmers are defined as households with production greater than small farms but equal to - 50ha of non-irrigated land, 10ha of irrigated land, 100 cattle, 500 small animals and 20,000 poultry birds. Any production above this limit is a large farm type.

non-participants) is statistically equal to zero and the alternative hypothesis (H_1) states that the difference in the population mean of the two independent group is greater than zero as shown below:

$$\mathbf{H_0: \mu_1 - \mu_2 = 0} \quad \textbf{and} \quad \mathbf{H_1: \mu_1 - \mu_2 > 0} \tag{8}$$

Some assumptions were made on the sample group which includes that the samples are randomly and independently drawn, normally distributed and the population variance are unknown but are assumed equal therefore we will use the two sample standard deviations and pool them to estimate the population standard deviation using a t value with $(n_x + n_y - 2)$ degrees of freedom. The sample variance and the t value are calculated as follows:

$$\mathbf{S_p^2 = \frac{(n_x-1)s_x^2+(n_y-1)s_y^2}{n_x+n_y-2}} \tag{9}$$

$$\mathbf{t = \frac{\overline{X}-\overline{Y}}{\sqrt{S_p^2}\cdot\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}} \tag{10}$$

where S_p^2 is the pooled sample variance, n_y is the sample number of non-participating households, n_x is the sample number of participating households, s_x^2 is the sample variance of participating households, s_y^2 is the sample variance of non-participating households, $\overline{X}$ is the sample mean of the participating households, $\overline{Y}$ is the sample mean of the non-participating households. The t value will be compared with the t critical($t_{n_{x+}n_{y-2,}\alpha}$) from the t distribution table and will be interpreted according to the decision rule as $t_{value} > t_{critical}$ reject the H_0 and $t_{value} < t_{critical}$ fail to reject the H_0. Where α represent the level of significant.

For categorical variables, frequencies will be computed of both the participating and non-participating households. Such variables includes sex of household head, if the household had access to extension services, whether the household lost crops (either by drought, floods, cyclone and wild animals), whether the household had access to temporary jobs, if the household use fertilizer, if the household use pesticides, type of farm, whether the household is a member of association, if the household received price information, whether the household utilize manure, if the household had access to credit, whether the household rear livestock and whether the household received emergency seeds. The frequencies of occurrence for each categorical variable of households will be compared using the chi-square

test to ascertain whether the differences between the two groups are statistically significant. The chi-square test will be done by developing a two by two[7] contingency table which will display the frequency of household responses on each of the categorical variables across each group (participating and non-participating households). This table is illustrated in table 1 below:

Table 1: A two by two contingency table

A typical categorical variable (e.g. sex)	Participating households	Non-participating households	Totals
Response 1 (e.g. yes for female)	R1	R2	R
Response 2 (e.g. no, for male)	N1-R1	N2-R2	N-R
Totals	N1	N2	N

Where: R1 is frequency of the first response of participating households, R2 is frequency of the first response of non-participating households, N1-R1 is frequency of the second response of participating households, N2-R2 is frequency of the second response of non-participating households, R is total number of first response (R1+R2), N-R is total number of second response (N1-R1+ N2-R2), N1 is sample size of participating households. N2 is sample size of non-participating households and N = total sample size (N1+N2).

The aim here is to test whether the characteristics of participating households (π_1) are different from the characteristics of non-participating households (π_2). Therefore this study will test the null hypothesis that there is no difference between the two groups with respect to the specific variable and the alternative hypothesis states that there is a difference between the two groups using as:

$$\mathbf{H_0}: \boldsymbol{\pi_1 = \pi_2} \ \textbf{and} \ \mathbf{H_1}: \boldsymbol{\pi_1 \neq \pi_2} \qquad \textbf{(11)}$$

[7] Two by two contingency table contains two rows and two columns and each cells in the table shows the frequency for each row and column combination

As stated above, the χ^2 test is used to test frequencies and it is equal to the squared difference between the observed frequencies ($f_{o)}$ and the expected frequencies (f_e) all divided by the expected frequency in each cell of the table, which is summed over all cells of the table:

$$\boldsymbol{\chi^2 = \sum_{\text{all cells}} \frac{(f_o - f_e)^2}{f_e}} \quad \textbf{(12)}$$

The test statistics χ^2 approximately follows a chi-square distribution with one degree of freedom which is defined as (the number of rows minus one) multiply by (the number of column minus one). Given that we have two rows and two columns; the degree of freedom is equal to one. In order to calculate the expected frequencies, we will first calculate the estimated overall proportion of response one ($\bar{A}$) of the two groups by dividing the total number of response one by the total sample size. The complement of $\bar{A}$ which is 1- $\bar{A}$ will represent the estimated overall proportion of the second response in the two groups, that is:

$$\boldsymbol{\bar{A} = \frac{R_1 + R_2}{N_1 + N_2} = \frac{R}{N}} \quad \textbf{(13)}$$

After this, the expected frequency (f_e) of each cell will be computed. For the first row, the sample size (column total) pertaining to the first response for each group will be multiplied by $\bar{A}$. In the same way for the second row, the sample size (column total) pertaining to the second response for each group will be multiplied by $1 - \bar{A}$. Then we can fill up the equation for χ^2 test as shown above and use a level of significance (α), to determine whether the null hypothesis is to be rejected or not. In making this decision, we have a rule that says if the calculated χ^2 is greater than the critical χ_c^2 (upper tail critical value from the χ^2distribution table) at one degree of freedom, then reject the null hypothesis, otherwise fail to reject the null hypothesis.

3.3 Effects of factors affecting marketing participation

Different empirical analysis has been used in the past to determine household participation in agricultural markets. A double hurdle model is popularly used in most literatures (Olwande and Mathenge, 2012; Omiti et al.,2009; Akinbode and Dipeolu, 2012; Mathenge et al., 2010**;** Fabiosa, 2006; Aristei et al., 2007) because of its flexibility, but that of Heckman (1979) deals with the problem of economic hazard of selection bias. In his theory, households were faced with different decisions on market participation-a discrete decision (participating or not decision) and a continuous decision (how much to participate with) which is conditional on the participating in the market. The factors that affect the second decision may affect the first but the factors that affect the first like transportation cost will not affect the second stage. If

the same factors affect both decisions, then the estimate of the regression of the second decision will be biased absent correction for the first decision stage.

In order to avoid this problem in market participation analyses, Goetz (1992) in his study, used a different way by first estimating a reduced form probit model followed by an endogenous switching regression model of either buying or selling behavior by letting the households to choose by themselves into buying or selling states. On the other hand, Key et al. (2000) used a censoring model with an unobserved censoring threshold to estimate the supply and production function. The approaches above gives room for market nonparticipation but do not conflate the participation decision with the level of participation conditional on market participation. The difference between the approaches above is that the decision as to whether or not to participate in the market and the quantity to participate with is done simultaneously or sequentially.

Holloway et al. (2005) used the double hurdle model for estimation but focusing the effect of fixed cost and assumed that the household decisions occurs in a sequential way other than simultaneously. Some studies argued that households' decisions to market participation are made sequentially (Goetz, 1992; Holloway et al., 2005) while other studies argue that they are made simultaneously (Key et al., 2000). A sequential choice means that the households decide on whether or not to participate in the market first before deciding on the amount of goods to sale; depending on the market condition such as price (Salvucci, 2012). On the other hand, a simultaneous decision means that the households decide whether or not to participate in the market and on the quantity to sale at once; depending on traders conditions (Salvucci, 2012). The theory behind the double hurdle model and some empirical evidence are discussed in the next two sections respectively.

3.3.1 Theoretical framework

The theoretical framework presented below is mostly based on the study conducted by Barrett (2008). Therefore, the theoretical keystone as to why households participate in agricultural markets is found in the trade theory as propose by David Ricardo and Adam Smith (Barrett, 2008). The theory assumes that farmers are mostly driven to utility maximization over a bundle of goods for consumption (-produced on the farm or goods that is bought from the market) and this is subject to a constraint in income created by a combination of farm production, sales and off-farm income earnings (Olwande et.al. 2015). Farmers can exploit welfare gains from trading by focusing in the production of goods that

they have comparative advantage on, and exchange for those that they have a comparative disadvantage on. The disadvantage of the trade theory is that it does not comprehensively identify the determinants of market participation but only explains the primary motive for farmers to participate in the market which is to exploit welfare gains.

Barrett (2008) provided a theoretical model that describes the household behaviour to market participation. The theory used a non-separable household model by assuming that the decision on prices is endogenously obtained by observed market prices and by factors manipulating the transaction cost that is related to participating in the markets. When the household engages in production of agricultural products, it decides whether to consume the output of that production or to sell the output, and also the household would decide on the quantities to consume and the quantities to sell. The farmer makes a decision whether or not to participate in the market as a seller or as a buyer. The farmer's decision to participate in the crop market as seller is represented by M^{ss}. If the farmers decide to enter in the market, M^{ss} =1 and if the farmer does not enter in the market M^{ss} =0 at a parametric market price P. In the same way, the household decision to enter the market as a buyer M^{cb} will take the value 1 (M^{cb}=1) if household decides to enter in the market and M^{cb}=0 if household decides not to enter in the market.

For the purpose of this study, we use the household separable model by assuming that the households decisions on production, consumption and marketing are independently (or separately) made as prices are exogenously determined in perfect markets. Therefore, this study focused on the marketing or selling side of the households and not the consumption or buying side due to data limitations[8].

Hence, income is earned by the household from the sales of some or all of the crops produced and from off-farm earning (*W)* and each crop is produced using a given production technology, *f (A, G)* where *A* is the household assets and *G* is public goods. Also the household faces a parametric market price (*P)* and a vector of transaction costs (i.e. commodity and household specific transaction cost) per unit of crop sold. Meanwhile transaction cost depends on the vectors of public goods and services *G* (e.g. radio broadcast, extension service information, etc), household characteristics *Z* (e.g. age, sex, education, etc), and household productive assets *A* (e.g. land, labour, livestock, machinery).

[8] There is no data on farmer's decision to enter in the market as a buyer

The transaction costs are in two layers which are (*i*) household-specific and commodity-and-location specific, and *(ii*) the linkages between the local, regional and the international markets. The transaction cost involved in the market participation generate a kinked price schedule that reflects the price band defined by market prices plus or minus those costs, that reflects the net prices from buyers and sellers, respectively. Therefore in order to directly affect the producer's behaviour, welfare and market participation, these transactions cost should be taken into account.

Barrett (2008) has shown that the decision whether or not to participate in agricultural commodity market can be represented in the reduced form as a function of exogenous variables as shown below;

$$\mathbf{M_i^{ss} = f\ (P,\ Z,\ A,\ G,\ W)} \qquad \mathbf{(14)}$$

where $\mathbf{M_i^{ss}}$ is the decision to enter the market which takes the value 1 if households are market participants and 0 otherwise, $\boldsymbol{P}$ is the vector of observed market prices, the rest refers to the determinants of transaction costs τ^c(Z,A,G,W) where, $\boldsymbol{Z}$ is the vector of the household characteristics, $\boldsymbol{A}$ is the vector of the household assets, $\boldsymbol{G}$ is the vector of public goods, and $\boldsymbol{W}$ is the vector of the off-farm earnings of the household

Also a reduced form of the factors that influence the decision on the quantity sold in the market can be stated as:

$$\mathbf{M_i^{sc} = f(k, P, Z, A, G, W)} \qquad \mathbf{(15)}$$

where $\boldsymbol{M_i^{sc}}$ is the vector of the commodity quantities sold by household *i*, and $\boldsymbol{k}$ is the vector of the decision to enter the market. The other variables were defined above.

3.3.2 Empirical framework

The decision whether or not to market agricultural products (first hurdle) and the decision on the quantity to market (second hurdle) can be modelled using the Double Hurdle Model which was originally proposed by Cragg (1971) in two sequential steps (Holloway and Ehui, 2002; Smith, 1998; Mathenge et.al., 2010; Omiti et.al., 2009; and Olwande and Mathenge, 2012). The Cragg's independent double-hurdle model is an improvement of the Tobit model and it assumes that the household shocks to the participation process and the household shock to the production process are independent. The standard tobit model which was originally

formulated by Tobin (1958) deals with data that have a lot of zeros that yields a censored dependent variable. The models allow the inclusion of all observations including those censored at zero without considering the sources of the zeros.

Hence, Heckman (1979) proposes a model which tackles the problem that are associated with the zero observations that is generated by non-participation decisions and argued that an estimation on a selected subsample leads to sample selection bias which can be overcomed in a two-step estimation procedure known as heckit (Wodjao, 2007). Heckman's model regarded the zero observations to arise mostly from respondent's self-selection or choice (Wodjao, 2007; Azam et al., 2012).The difference between the heckit and the Tobit is that- the heckit observes the process in a two- step or stage decision and then it allows the use of different sets of explanatory variables in both stages of estimations where as the tobit uses a one-step procedure and assumes that the factors (i.e. explanatory variables) affecting the decision to participate in the market and on quantity level to sale are the same. Thus, the heckit is viewed as a 'generalized version of the Tobit model' (Wodjao, 2007).

Also, a modification of the tobit model was done by Cragg (1971) in order to remove the restrictive assumptions in this model by assuming that the "double-hurdle" model will solve the problem of significant number of zeros in the data and give special treatment to the participation decision (Wodjao, 2007). The double hurdle model assumes that two hurdles have to be overcomed in order to observe positive values. As originally stated in terms of demand of durable goods (Cragg, 1971), households has to desire positive amount first and then secondly, the factors to achieve these positive expenditure has to be favourable. But for this study, the decision whether or not to participate in the market through sales is the first hurdle and the second hurdle lies on the decision on the amount to sell.

Nevertheless, the heckit and the double-hurdle models have some similarities in that they both have rules that preside over the discrete outcomes both zero and positive (Wodjao, 2007) which are determined by the participation and level of participation decisions. Both models also allows for the possibilities of the explanatory variable used in the different stages to vary. Although the heckit as oppose to the double hurdle assumes that in the second stage, there will be no zero observations once the first stage is passed, whereas the double hurdle still considers that there might be a possibility of a zero observation which may arise from the individual's choice or random circumstances.

Illustrating this in the present study implies that, even after the households have decided to participate in the market as seller which is the first stage, some may not encounter any sale of their product as a result of the buyer's deliberate choice or random circumstances. While the heckit model argues that, as far as the households have decided to participate in the market, they must have a positive sale. This marks the difference between the heckits model and the double-hurdle model. With this explanation, the double-hurdle model can be considered as an improvement of both the standard Tobit model and the Heckit model (generalized Tobit model). The Akaike (1974) Information Criterion (AIC) and the Schwarz's (1978) Bayesian Information Criterion (BIC) were used to access which model best fits the data between the Tobit and the Double hurdle models. The model with a smaller value of the information criterion (AIC and BIC)[9] was chosen for this study. AIC and BIC are defined as:

$$\mathbf{AIC = -2lnL + 2\,k} \qquad \mathbf{(16)}$$

$$\mathbf{BIC = -2lnL + k\,lnN} \qquad \mathbf{(17)}$$

where lnL is the maximized log-likelihood of the model, k is the number of parameters estimated and N is the sample size. The result from the Information criterion estimation showed that the double hurdle model best fits the data as compares to the Tobit model. The double hurdle model had a smaller value of AIC (1st stage = 2488699 and 790020.70 for maize and cowpea respectively, 2nd stage = -344748.40 and -578310.50 for maize and cowpea respectively) and BIC (1st stage = 2488848 and 790158.2 for maize and cowpea respectively 2nd stage = -344633.7 and-578228 for maize and cowpea respectively) compared to the AIC (1st stage = 4305016 and 939978.7 for maize and cowpea respectively, 2nd stage = -325828.3 and -577739.4 for maize and cowpea respectively) and BIC (1st stage = 4305172 and 940122.2 for maize and cowpea respectively, 2nd stage = -325713.6 and -577656.9 for maize and cowpea respectively) for the Tobit model.

Therefore, this study applies the Double hurdle model to determine the household market participation decisions and the level of participation for both maize and cowpea crops in Mozambique. The double hurdle provides a more flexible framework to model the households observed behaviour as a joint choice of two decisions instead of a single decision (Akinbode & Dipeolu, 2012). Previous empirical studies about market participation applied the reduced form of Barrett (2008) model which suggested that market participation decision

[9] The result of the AIC and BIC is found in the result and result discussion section

should be modelled as an entry decision (k) and a quantity decision (M^{sc}). The double model allows different mechanism to determine the discrete probability of participating in the market (k=1, 0) which requires a probit estimation and the quantity sold at the market M^{sc} (Olwande et.al., 2015). The second stage is commonly defined by a truncated normal distribution or lognormal distribution conditional on a positive outcome in the first stage. The reason behind the use of a truncated normal distribution is that it has an advantage over the lognormal distribution in that it nests the standard Tobit model. This method is similar to the method used by Olwande et al., (2015); Mathenge et al. (2010) and Olwande and Mathenge (2012) and therefore this study follow the same procedure.

The regression equations to be estimated will be in the following forms:

First stage: market entry/participation stage $\mathbf{P(M_i^{ss}=1) = X \propto + \varepsilon}$ **(18)**

Second stage: Quantity sold $\mathbf{M_i^{sc} = Z\beta + \mu}$ **(19)**

Equation (18) defines the model on whether the households decide to enter the market or not ($\boldsymbol{M_i^{ss}}$) which takes the value one if a household decides to enter in the market and zero otherwise and this equation will be estimated using the Probit model. Equation (19) defines the model on the quantity of maize and cowpeas ($\boldsymbol{M_i^{sc}}$) sold in the market and will be estimated using the truncated normal distribution. The variables $\boldsymbol{X}$ and $\boldsymbol{Z}$ define the factors that affect the discrete probability decision of participating in the market and the quantity sold respectively[10]. These explanatory variables include such variables as extracted from the theory of market participation, thus the reduced form in equation (14) and (15) is used.

After the probit and the truncated estimation, bootstrapping was done to re-estimate the model in order to obtain better estimates of the standard errors. The bootstrap method deals with the estimation of a model lot of times[11] (MacKinnon, 2006). Bootstrapping will be done in three (3) stages. The first stage is estimated using the probit model, the second stage is the truncated stage but conditioned for those who had positive sales and the third stage is also the truncated stage but unconditioned for all households (both those that had positive and zero

[10]The factors affecting the discrete probability decision of participating in the market and the quantity sold, may or may not be the same thus the use of double hurdle model because of its flexibility to this condition.
[11] For this study- 550 times.

sales). The results [12] from this analysis are used to make inferences on the data (MacKinnon, 2006).

3.4 Variables definition and expected signs

The binary dependent variable for the first stage of analysis which is the probit stage of the double hurdle model for each food crop (maize and cowpea) is equal to one if the household participates in the market and 0 otherwise. In the second stage, the dependent variable represents the quantity sold at the market and this represents the total sales in ton of maize and cowpea in 2008.

The choice of explanatory variables used in this study is based on the theory and previous studies such as those conducted by Enete and Igbokwe (2009), Salvucci (2012), Hlongwane et al. (2014), Boughton et al. (2007), Alene et al. (2008), Demeke and Haji (2014), Omiti et al. (2009), Siziba et al. (2011), Chilundika (2011) and Gani and Adeoti (2011). These variables include the market price information of maize and cowpea, the household characteristics, the commodity characteristics and the location characteristics that determines market participation. These household characteristics are the ownership of private assets (land, livestock) and household socioeconomic characteristics (age, sex, education level, household size, temporary jobs, membership of farmers association, use of credit, etc.). Sex will be represented as a dummy to clearly distinguish the household participation of both male headed household and female headed household

The commodity characteristics includes those factors influencing productivity of the commodities which depends on the type of technology used and includes such variables as the use of emergency seeds, fertilizer use, pesticides used, manure used and the type of farm. For the location specific transaction costs is based on the characteristics of climatic condition of the location or province given that some areas are prone to flooding and drought, so information on crop losses due to drought, flood, fire and wild animals will be captured. Therefore, the double hurdle analysis for maize crop was analyzed and differentiated into three regions in Mozambique[13] as:

[12] Such as the Average Partial Effect (APE), P-values and the bootstrap standard errors.
[13] The map of Mozambique is attached in annex one.

- Northern region which comprises of the following provinces - Niassa, Cabo Delgado, Nampula and Zambezia[14] provinces.
- Central region which comprises of the following provinces - Tete, Manica, and Sofala provinces.
- Southern region which comprises of the following provinces - Inhambane, Gaza and Maputo provinces.

Boughton et al. (2007) acknowledged that the northern and the central region of Mozambique are those regions where more basic food crops (especially maize) are produced. Furthermore, this differentiation was done because of the following reasons;

- The number of maize participants were very high compared to the other food crops therefore in order to better analysis the factors the affect the participation in maize market as a seller, it is better to analyze these different regions.
- Also the climatic condition of these different regions' is distinct from each other as the northern and the central regions experience higher rainfall than the southern region. The Southern regions are mostly prone to drought which may lead to low agricultural productivity.

The same was not done for cowpea because of the poor market participation (230) relative to maize market participation (946). The table 2 below shows the variables that are used for estimation and their expected signs in the two-stages (1st and 2nd stages) of analysis.

[14] Although from the administrative division of Mozambique, Zambezia is considered central part of the country. In this study it was included in the Northern region.

Table 2: Variable definition and expected signs on market participation

Variable name	Description	Maize		Cowpea	
		1st	2nd	1st	2nd
		Expected sign			
1.vendeu[a]	Dummy variable equal to 1 if the household participated in the market and 0 otherwise				
2.qntvnkg[b]	Quantity of crops sold in tons (t)				
3.qntkg1	Maize quantity produced in tons	+	+	+	+
4.qntkg8	Cowpea quantity produced in tons	+	+	+	+
5.tipoexp	Type of the farm being equal to 1 for small and 0 for medium	+	+	+	+
6.chefsexo	Sex of household head being equal to 1 for male and 0 for female	+	+	+	+
7.chefidad	Age of household head in years	-	-	-	-
8.chefeduc	Education level of household head in class level	+	+	+	+
9.haslvstk	If household rears livestock being equal to 1 if yes and 0 if no	+	+	+	+
10.extensao	If any member of the household received extension service being equal to 1 if yes and 0 if no	+	+	+	+
11.assoc	If any member of the household belongs to any agricultural association being equal to 1 if yes and 0 if no	+	+	+	+
12.precos	If any household member received any information on price in the last 12 months being equal to 1 if yes and 0 if no	+	+	+	+
13.perda	If the household lost significant part of the crops in the last 3 years being equal to 1 if yes and 0 if= no	-	-	-	-
14.sememerg	If household received emergency seeds in the last season being equal to 1 if yes and 0 if no	+	+	+	+
15.trabtemp	If the household has a temporary employment being equal to 1 if yes and 0 if no	-	-	-	-
16.fert	If the household used fertilizer in the last 12 months being equal to 1 if yes and 0 if no	+	+	+	+
17.estrume	If the household used manure in the last 12 months being equal to 1 if yes and 0 if no	+	+	+	+
18.pest	If the household used pesticides in the last 12 months being equal to 1 if yes and 0 if no	+	+	+	+
19.credito	If the household received credit being equal to 1 if yes and 0 if no	+	+	+	+
20.hhsize	Number of members (size) of the household	+	+	+	+
21.hhareacr	Size of farm of the household in hectare (ha)	+	+	+	+

Note: a: is the dependent variable for the first (1st) stage.

b: is the dependent variables for the second (2nd) stage. The rest are the independent variables.

From the table above, it is expected that an increase in the household size and the area cultivated will increase the production of each crops and thus market participation. In the same way, an increase in the type of farm, fertilizer use, pesticide use and manure use is expected to reflect positively on market participation. Age of the household is expected to reflect unfavourably to market participation because as one grows old, they tend to be less active in production activities. Also for household with higher education level, market participation is expected to increase because they better understand the need for extension services, and will be more receptive to technology use. Households' that experienced crop loss and have temporary jobs are expected to reflect negatively on market participation.

Also if the households are members of agricultural association, have access to credits, use emergency seeds, rears animals and have information on price, the market participation is expected to be affected positively. It is expected that male headed households are more likely to improved market participation than their female counterpart because male headed household tends to have orientation in generating financial resources for the family than female headed households.

3.5 Methods of data collection

Data from the National Directorate of Planning and International Cooperation (DPCI) at the Ministry of Agriculture and Food Security (MASA), Mozambique - known by its Portuguese acronym as TIA (presently called IAI) - was used for this study. For the trend analysis, the data covered the period from 2002 to 2012 and for market participation analysis, 2008 data was used. Missing data in other years was the factor which made the analysis of market participation to be concentrated in 2008 data. The instrument (questionnaire) used for the survey required detailed information on all different sources of income from both farm and off farm activities, different food crops produced, technology used, assets endowment, climatic hazards, different agricultural practices used, access to services, market participation including the household level of engagement in marketing agricultural commodities as well as households socioeconomics characteristics. Detail of the questionnaire and data can be found at Mozambican Ministry of Agriculture and Food Security (MASA), Directorate of Planning and International Cooperation (DPCI). The sample size from each province is presented in the table 3 below.

Table 3: The sample size differentiated by province in the diferent years

Province	2002	2003	2005	2006	2007	2008	2012	Total
Niassa	277	263	337	342	353	472	497	2,541
Cabo Delgado	500	458	591	621	568	556	578	3,872
Nampula	604	569	785	845	795	794	896	5,288
Zambezia	724	682	781	824	781	743	910	5,445
Tete	587	664	721	686	693	680	673	4,704
Manica	478	532	505	544	547	526	584	3,716
Sofala	416	436	531	534	541	494	563	3,515
Inhambane	426	413	586	596	590	534	838	3,983
Gaza	552	602	865	815	788	631	665	4,918
Maputo	344	316	447	441	419	538	540	3,045
Total	4,908	4,935	6,149	6,248	6,075	5,968	6,744	41,027

Source: MINAG, 2002-2012

4.0 Results and result discussion

This section covers all the results of the three specific objectives for household market participation in maize and cowpea in Mozambique. The results include trend analysis, descriptive statistics, student's t-test, Pearson's chi-square distribution test and Cragg's Independent double hurdle model.

4.1 Trend analysis of maize and cowpea over years

This section is based on TIA data from 2002 to 2012. The result from the Wilcoxon-type test for the trend analysis showed that maize and cowpea had a p-value of 0.00 each. This p-value is statistically significant at 1% significance level. Therefore, we reject the null hypothesis of no trend and conclude that indeed there is a trend presence in the data. Furthermore, the result to determine the type of trends for maize, cowpea and a summation of the number of maize and cowpea participants represented as 'total' are presented in figure 1 below:

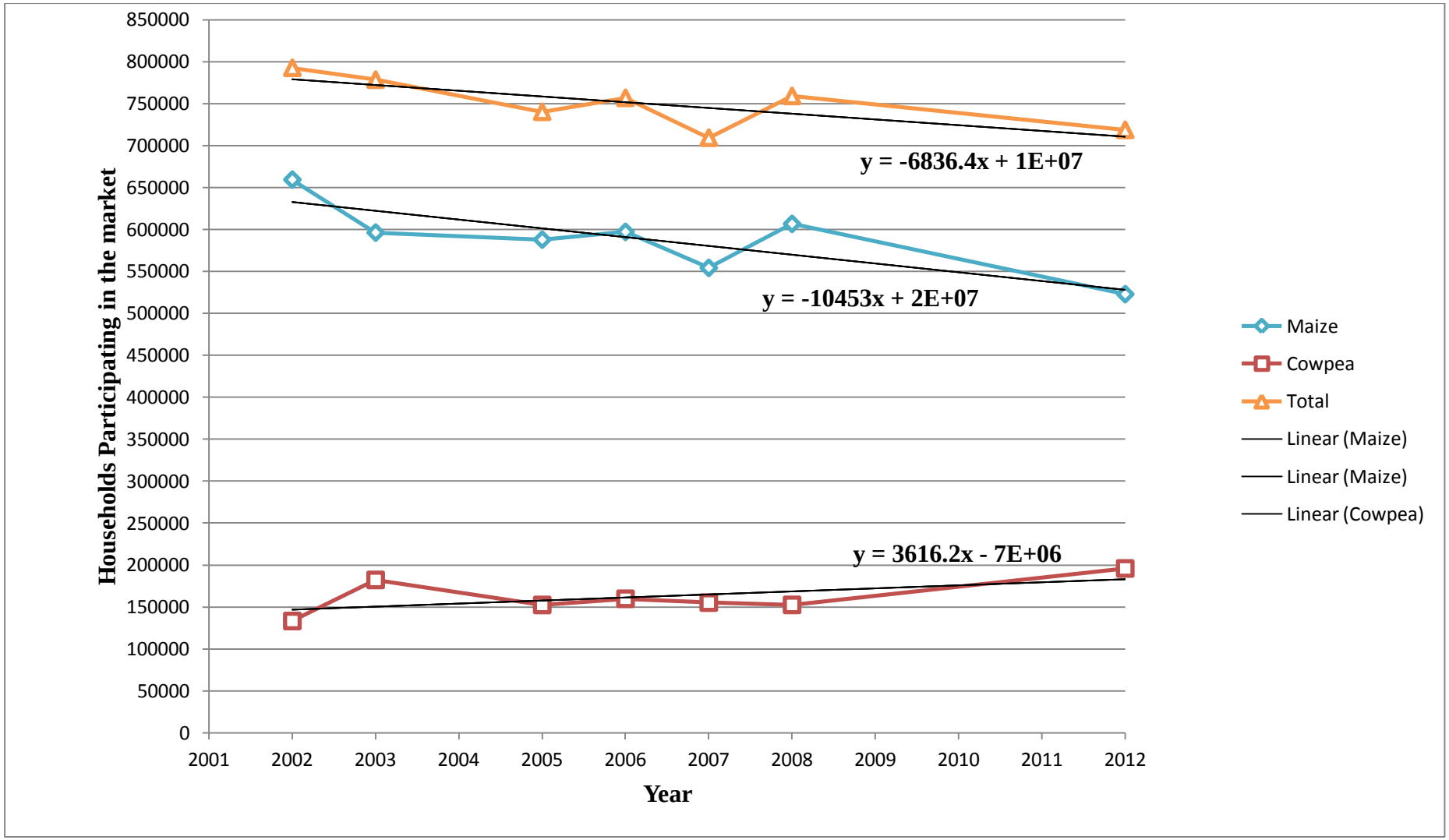

Figure 1: Trend of market participation of maize and cowpea over time

Trend coefficient from the linear regression showed that maize trend is downward (-10453), cowpea is upward (3616.23) and their total trend is downward (-6836.41). From the line graph above, the maize market participation of households as a seller showed a downward trend. In order words, maize market participation decreased through the years except in2006 and 2008. In 2008, it increased with about 9 %. After that, it decreased with about 14% from 2008 to 2012. This decrease in maize market participation could be as a result of continued small quantity production which is mostly geared towards household consumption with low marketable surplus. It could also be as a result of farmers diversifying into the cultivation of emerging crops such as sesame, soybean, sisal and pigeon pea.

On the other hand, cowpea market participation showed an upward trend. In other words, cowpea market participation increased with about 29% from 2008 to 2012. Before that time, cowpea's market participation was somewhat constant from 2005 to 2008. This increase in cowpea market participation could be as a result of an increased health awareness of the importance of consuming food with high protein content as a meets of living healthy. It could also reflect increase in the cost of living as witnessed by lack of poverty reduction from 2002/03 to 2008/09. That is, if meat, fish and chicken becomes more expensive, farmers cultivate more cowpea as the leaves as well as the seeds can be cooked and eaten with maize meal or with rice. In general, the total market participation of maize and cowpea households as a seller showed a downtrend (decreases by 5.3% from 2008 to 2012) and thus, the need for improved.

4.2 Socioeconomic factors affecting agricultural market participants

This section is based on data from TIA 2008 and will involve some testing to show whether the two groups (participants and non-participants) are significantly different from each other based on their socio-economic characteristics.

4.2.1 Maize farmers

The difference between the maize farmer's market participants and non-participants were analysed. The continuous variables such as the age of HH[15], education level of HH, household size, and area of land (in hectares) were analysed using the students t-test while categorical variables were analysed by using the Pearson's chi-square distribution test. The

[15] HH means household head

null hypothesis for these tests states that there are no differences between participants and non-participants differentiate by their various characteristics while the alternative hypothesis states otherwise.

Table 4: T-test of maize farmers' in 2008

Group	Age of HH Mean	Education of HH Mean	Household size mean	Quantity produced(tons) mean	Farm size (ha) mean
Participants	40.68	3.00	5.33	1.15	2.72
Non-participants	44.99	2.84	5.62	0.37	1.87
Differences	-4.31	0.17	-0.29	0.78	0.85
T statistics	-8.43	1.51	-2.62	17.51	13.08
P value	1.00	0.07*	1.00	0.00***	0.00***

*, ** and ***denotes statistical significance at 10%, 5% and 1% respectively

The results of the t-test in table 4 above shows that the difference in the average age of HH between maize market participants and non-participants are statistically equal to zero. Therefore we conclude that there are no age difference between participant's HH and non-participant's HH. Also, from the results of the t-test table 4 above, we reject the null hypothesis about the equal level of education of HH the participating and non-participating households at 10% level of significance. Therefore, we conclude that the level of education of HH for maize market participants is greater compared to the non-participants. It could be because education presents the head of the households with adequate information and skills in order to be able to thrive in agricultural production and marketing.

The results of the t-test in table 4 above shows that the difference in the average household size between maize market participants and non-participants are statistically equal to zero. Therefore we conclude that the household size of maize market participant's and non-participant's HH is the same. This result was in line with Enete and Igbokwe (2009) as household size did not significantly determine market participation as sellers in Ivory Coast, Ghana, Nigeria, Tanzania and Uganda.

Given the result from the table 4 above, maize market participants produce more than the non-participants at 1% level of significance. The result shows that those who participate in

the market produce in average about 0.8 tons more than those who do not participate. This was expected given the bulky nature of maize output and its high perishable nature. Therefore, if a farmer produces more, it is expected that the farmer would want to sell off some of its output to avoid spoilage given the low storage facilities that prevails amongst smallholder farmers.

The result in table 4 above shows that maize market participants used a greater area of land for the production of maize than the non-participants. Also, market participants used on average about 0.9 hectares of land more for maize cultivation. This could explain why their outputs were reported more than the non-participating group of households. This was in line with Salvucci (2012) who reported positive relationship between market participation and farm size.

Table 5 below show the results of χ-square test of maize farmers by comparing the characteristics in terms of categorical variables of participating and not participating households.

Table 5: Chi square test of maize farmers' in 2008

Variables	Number of observation	Pearson chi square	Probability
1= male Headed Household	5029	79.82	0.00***
1= small farms	5029	0.02	0.90
1=household received extension services	5029	16.59	0.00***
1=household is a member of an agricultural association	5029	4.95	0.03**
1=household received price information	5029	41.71	0.00***
1= household experienced crop loss	5029	65.76	0.00***
1= household received emergency seed	5029	0.51	0.47
1=household utilized fertilizer	5029	5.07	0.02**
1=household utilized manure	5029	0.12	0.73
1=household utilized pesticides	5029	7.31	0.01**
1=household received credit	5029	5.78	0.02**
1=household head had temporary job	5029	73.52	0.00***
1=household owned livestock	5029	12.80	0.00***

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively

The result reveals that the sex of household head, if households had access to extension services, if households are membership of an agricultural association, whether households had access to price information, whether households experienced maize loss, if households utilized fertilizer, if households utilized pesticides, whether households had access to credits, whether households had temporary jobs and if households own livestock are all significantly associated to maize market participation. The extent of this importance will be discussed in the Double hurdle models.

This goes to imply that, access to public services (such as extension services, association, credit facilities, and access to information), ownership of assets (such as livestock), households demographic factors (such as sex and off-farm income) and production characteristics (such as crop losses, fertilizer use and pesticides use) are all important factors in determining household market participation.

4.2.2 Cowpea farmers

The difference between the cowpea farmer's market participants and non-participants were analysed. Table 6 presents the results of comparison made using t-test.

Table 6: T-test of cowpea farmers in 2008

Group	Age of HH Mean	Education of HH mean	HH size mean	Quantity produced (tons) mean	Farm size (ha) mean
Participants	40.64	3.01	5.10	0.12	2.32
Non-participants	45.45	2.80	5.69	0.03	1.96
Differences	-4.81	0.21	-0.59	0.09	0.36
T statistics	-4.90	1.04	-2.66	16.85	2.97
P value	1.00	0.15	1.00	0.00***	0.00***

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively. Degree of freedom is 2919 for each variable.

The results of the t-test in table 6 above shows that the difference in the average age of HH between cowpea market participants and non-participants are statistically equal to zero. Therefore we conclude that there are no age difference between participant's HH and non-participant's HH. This was similar to the result from maize t-test presented above. From the results of the t-test table 6 above, we fail to reject the null hypothesis of equal level of HH education between participating and non-participating group. We conclude that there is no difference between the two groups in terms of education level of HH. The results of the t-test in table 6 above shows that the difference in the average household size between cowpea market participants and non-participants are statistically equal to zero. Therefore we conclude that the household size of cowpea market participant's and non-participant's HH is the same. This was similar to the result from maize t-test presented above.

Given the result from table 6 above, cowpea market participants produced more compared to the non-participants at 1% significant level. The result shows that the mean difference between both groups is about 0.09 tons with the participating group producing more. This is expected because an increase in the quantity produced, increase the probability of having marketable surplus. This is also similar to the t-test for maize presented above. The result in

table 6 above also shows that the farm size of cowpea market participants is greater compared to the non-participants at 1% significant level. Therefore, cowpea market participants used on average about 2.3 hectares more for cowpea cultivation compared to the non-participating group. This is again similar to the result of the t-test of maize presented above.

Table 7 below presents the results of the χ-square test for the analyzed categorical variables

Table 7: Chi square test of cowpea farmers in 2008

Variables	Number of observation	Pearson chi square	Probability
1= male Headed Household	2921	16.53	0.00***
1= small farms	2921	10.35	0.00***
1=household received extension services	2921	1.22	0.27
1=household is a member of an agricultural association	2921	0.05	0.82
1=household received price information	2921	22.09	0.00***
1= household experienced crop loss	2921	52.08	0.00***
1= household received emergency seed	2921	3.83	0.05*
1=household utilized fertilizer	2921	9.19	0.00***
1=household utilized manure	2921	0.85	0.36
1=household utilized pesticides	2921	22.92	0.00***
1=household received credit	2921	5.11	0.02**
1=household head had temporary job	2921	12.69	0.00***
1=household owned livestock	2921	1.45	0.23

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Similar to maize market, the sex of household head, the farm type, whether households had access to price information, whether households experienced cowpea loss, if households received an emergency seed, if households utilized fertilizer, whether households utilized pesticides, whether households had access to credits, and whether households had temporary jobs are key factors in determining household participation in cowpea market. The extent of this importance will be discussed in the Double hurdle models.

4.3 Effects of factors affecting market participation for maize

The number of maize farmers and maize market participation in each region are listed in the table 8 below:

Table 8: The number of maize farmers in each region

Regions in Mozambique	Number of Maize farmers	Market participation of Maize	
		Yes	No
Northern region	2,565	556	1,352
Central region	1,700	296	1,306
Southern region	1,703	94	1,425
Total	5,968	946	4,083

Source: MINAG, 2008

From the table 8 above, maize market participation is relatively higher for the Northern and the Central regions than in the Southern region because the northern and the central regions have relatively higher rainfall compared to the southern[16] regions which is mostly susceptible to drought.

The result of the double hurdle model for maize in the northern, central and southern regions are shown in table 9, 10 and 11 below, respectively. The first stage was estimated using probit model and the second stage was done in two phases: firstly, it was done using the truncated normal but conditioned on the household having positive sales and the second phase of the second stage was unconditional on whether the household had positive or zero sales.

[16] For the Southern region, households that produced less than three (3) tons of maize where used for the Double hurdle analysis. This was done because there were very few cases of households producing more than 3 tons of maize. Therefore, in order to cut outliers, we have to use households with maize production of 3 tons or less. This same will be done for maize double hurdle analysis for Mozambique as a whole.

Table 9: Double hurdle model for Maize in the Northern Region in 2008

Explanatory variables	Probit DV=1 if HH sold maize		Truncated Normal (conditional model)		Probit+Truncated Normal (unconditional model)	
					DV = Quantity sold in tons	
	APE	P-value	APE	P-value	APE	P-value
1=household is a member of an agricultural association	0.04	0.53	-0.01	0.83	0.00	0.87
Education of Household Head	0.01	0.92	0.00	0.94	0.00	0.95
Age of Household Head	0.00	0.93	0.00	0.93	0.00	0.92
1= male Headed Household	0.05***	0.00	0.09***	0.00	0.04***	0.00
1=household received credit	0.06	0.50	0.08	0.18	0.04	0.17
1=household utilized manure	-0.07	0.56	-0.04	0.92	-0.02	0.52
1=household received extension services	0.05***	0.00	-0.03***	0.00	-0.01***	0.00
1=household utilized fertilizer	-0.16***	0.00	0.01	0.94	-0.03	0.14
1=household owned livestock	0.06**	0.01	0.02	0.27	0.02*	0.06
Farm size (ha)	0.02	0.47	0.02	0.14	0.01	0.22
Household size	-0.01	0.72	0.00	0.81	0.00	0.68
1= household experienced crop loss	0.01	0.28	0.00	0.91	0.00	0.49
1=household utilized pesticide	0.05	0.40	-0.03	0.40	0.00	0.83
1=household received price information	0.04	0.23	0.01	0.73	0.01	0.39
Quantity produced (tons)	0.23***	0.00	0.06***	0.00	0.06***	0.00
1= household received emergency seed	0.02	0.78	0.01	0.79	0.01	0.72
1= small type farms	0.19**	0.01	0.08	0.37	0.05*	0.06
1=household head had temporary job	0.02**	0.01	0.01**	0.01	0.01***	0.00

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Notes: DV means Dependent Variable and APE means Average Partial Effect

In the northern region, the probability of households to participate in maize market is higher for the male headed household compared to female headed household. This implies that male headed households have more opportunity in participating in the marketing of agricultural products compared to their female counterpart. This result is in line with Hlongwane et al. (2014) who found that male headed households have some preferences to market participation compared to female headed households. Also, male headed households tend to sale more quantities of maize (in tones) than female headed households for both the conditional and the unconditional models. This shows that men headed households are more actively involved in maize marketing. This result is also in concordance with the results reported by Boughton et al., (2007) and Salvucci (2012). Salvucci (2012) revealed that female headed households negatively influence the quantities of maize sold. The results suggests that female headed households have less opportunity in generating income from selling agricultural products compared to male headed households.

The probability of participating in maize market as a seller is higher for those households who received extension services. This result was also found by Alene et al. (2008)who reported that extension services had a positive effect on market participation. It was suggested in their study that extension services showed a critical role on technology and support services in the promotion of market participation amongst smallholders. However, households benefiting from extension services tend to market lower quantities of maize compared to those not benefiting from extension services. This result is contrary to what was initially expected. It was expected that the use of extension services would have a positive effect on the quantity of maize sold with the assumption that extension services motivates the farmers to produce more, therefore it should influence positively on the quantity sold. This unexpected result could be that maize is not a target crop for extension workers and they may be focused on other crop type like cash crops or tree crops.

The probability of households to participate in maize markets as a seller is higher for households who rear animals. This result suggests that asset endowment is a key factor that determines market participation. Similar result was found by Boughton et al. (2007) who reported an increase in market participation of agricultural products for households having animals. For the unconditional model, households who own farm animals tend to sale more

compared to those who do not. However, this effect was insignificant for the conditional model.

The probability of participating in maize market decreases for households using fertilizers. This was in accordance with Demeke and Haji (2014) result. In their study, they implied that fertilizer use could be an indicator for input market integration. This outcome might be due to high cost of purchasing fertilizers for maize production and therefore, farmers now use less or no fertilizer for the production of maize. However, for those households using fertilizer, we were expecting positive relationship as fertilizer boost yield.

The quantity produced of maize is related to the probability of participating in maize market. As expected, the higher the quantity produced of maize, the higher is the household probability of participating in maize market. This result is expected since marketable maize surplus increases with an increase in the quantity of produced maize. Also, an increase in the quantity produced causes an increase in sales of maize in both models (conditional and unconditional model). This result was also found by Omiti et al. (2009) who reported positive relationship between quantity sold and quantity produced.

Households owing small farms tend to participate more in the market. This result seems to be unexpected as small farms tends to produce less compared to medium farms. The dominance of small farms might be behind the result of this study. However, the effect of the farm type variable was insignificant for the quantities of maize sold for the conditional but positively significant for the unconditional model.

Also, the probability of participating in maize market increases for household with household head with temporary jobs and the effect of this variable was also positive and statistically significant in the two stages of estimation. This result was also found by Alene et al. (2008), Siziba et al. (2011) and Salvucci (2012). Alene et al. (2008) and Salvucci (2012) found that market participation increases for farmers with off farm income compared to farmers with non off-farm income. Siziba et al. (2011) also found a positive relationship between the quantities sold of agricultural products and household with off-farm incomes and implied that farmers with more liquid were able to finance agricultural production and are able to produce more marketable surplus. Therefore, these results imply that households head with temporary jobs are endowed with financial resources which can be used for financing agricultural marketing such as transportation cost.

Table 10: Double hurdle for maize in the Central region in 2008

Explanatory variables	Probit DV=1 if HH sold maize		Truncated Normal (conditional model) DV = Quantity sold in tons		Probit+Truncated Normal (unconditional model) DV = Quantity sold in tons	
	APE	P-value	APE	P-value	APE	P-value
1=household is a member of an agricultural association	0.07	0.14	-0.06	0.34	0.00	0.91
Education of Household Head	-0.01	0.87	0.02	0.79	0.00	0.86
Age of Household Head	0.00	0.87	0.00	0.98	0.00	0.93
1= male Headed Household	0.04***	0.00	0.05***	0.00	0.03***	0.00
1=household received credit	0.04	0.43	-0.04	0.73	0.00	0.96
1=household utilized manure	0.03	0.37	0.00	1.00	0.01	0.70
1=household received extension services	-0.01***	0.00	0.04***	0.00	0.01***	0.00
1=household utilized fertilizer	-0.05**	0.04	0.06	0.56	0.00	0.93
1=household owned livestock	0.02	0.44	0.15*	0.05	0.06**	0.03
Farm size (ha)	0.02	0.54	0.03	0.50	0.02	0.38
Household size	0.00	0.83	-0.02	0.74	-0.01	0.67
1= household experienced crop loss	0.02***	0.00	0.07***	0.00	0.03***	0.00
1=household utilized pesticide	0.02	0.77	-0.08	0.34	-0.02	0.48
1=household received price information	0.03	0.23	0.06	0.55	0.03	0.34
Quantity produced (tons)	0.11***	0.00	0.07***	0.00	0.06***	0.00
1= household received emergency seed	0.04	0.27	-0.09	0.13	-0.02	0.36
1= small type farms	0.05	0.17	0.03	0.77	0.02	0.40
1=household head had temporary job	0.04***	0.00	0.01	0.31	0.02***	0.00

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Notes: DV means Dependent Variable and APE means Average Partial Effect

In the central region, the probability of households to participate in maize market as a seller is higher for male headed household. Also, male headed household tends to significantly sales more than the female headed households in both the conditioned and unconditioned model. It is important to stress that the same result was true for the northern region. This means that male headed household generally has an upper hand when it comes to maize market participation and maize sales and therefore male headed household have a greater opportunity to invest in maize production and sales as an enterprise.

Different from our expectation, the probability of participating in maize market as a seller decreases for household receiving extension services. However, in the second stage, the use of extension services is positively related to the quantity of maize sold. This result reveals that even though benefiting from extension services does not favour maize market participation, it has positive effect on maize sales. This was in concordance with Siziba et al. (2011) as household who received extension services had a positive association with the cereal sales volume and it was implied that public services promotes the household participation in agricultural markets.

The probability of participating in maize market decreases for household using fertilizers. This result was also found in Northern region as reported presented above. The probability of participating in maize market as a seller increases with the quantity produced of maize and the tendency is observed for the conditional and unconditional models. Similar result was also found for the northern region.

The probability to participate in maize market increases for household that have lost their maize crop either by fire, drought, flood and theft. However, this result was not expected as the probability of participating in maize market as a seller for household who experience crop loss should decrease as these households will experience maize shortage which may not likely be enough even for household consumption. On the quantity of maize sold, the effect of the variable crop loss is also unexpectedly positive on both the conditional and unconditional models.

Also, the probability of participating in maize market increases for households led by an individual with temporary job. Although, the effects of households who has temporary jobs had an insignificant positive effects on the quantity sold in the market for the conditional

model, it is however significant with positive effect for the unconditional model. The results imply that households with temporary jobs are endowed with financial resources which can be used for financing agricultural production and probably in the market.

The probability of participating in maize market for households rearing livestock increases but the estimated coefficient is not statistically significant. However, the effect of households who rear livestock on the quantity sold was significant both in the conditional and the unconditional models. This implies that those households who rear animals tend to sale more than those who do not rear animals. This result was not in line with Alene et al. (2008) findings as livestock ownership by households was positively related to the quantities of agricultural products sold in the market.

The result of the Double hurdle estimation for the Southern region is shown in table 11 below:

Table 11: Double hurdle of maize in Southern region in 2008

Explanatory variables	Probit DV=1 if HHsold maize		Truncated Normal (conditional model) DV=Quantity sold in tons			
	APE	P-value	APE	P-value	APE	P-value
1=household is a member of an agricultural association	-0.01	0.58	-0.01	0.80	0.00	0.50
Education of Household Head	0.00	0.99	0.00	0.95	0.00	0.96
Age of Household Head	0.00	0.99	0.00	0.97	0.00	0.98
1= male Headed Household	0.01	0.36	-0.04***	0.00	-0.01***	0.00
1=household received credit	0.07	0.25	0.31	0.26	0.06	0.14
1=household utilized manure	0.05**	0.04	0.00	0.99	0.01	0.39
1=household received extension services	0.07***	0.00	0.04***	0.00	0.02***	0.00
1=household utilized fertilizer	-0.02	0.19	0.00	0.99	0.00	0.47
1=household owned livestock	0.03**	0.02	0.01	0.82	0.01	0.12
Farm size (ha)	0.01	0.39	0.01	0.81	0.00	0.49
Household size	-0.01	0.89	-0.01	0.93	0.00	0.90
1= household experienced crop loss	-0.08***	0.00	-0.01**	0.04	-0.01***	0.00
1=household utilized pesticide	-0.01	0.63	0.15	0.45	0.01	0.34
1=household received price information	0.03**	0.02	0.01	0.70	0.01	0.12
Quantity produced (tons)	0.09***	0.00	0.06**	0.03	0.02***	0.00
1= household received emergency seed	0.00	0.97	-0.03	0.68	0.00	0.54
1= small type farms	0.01	0.38	0.02	0.80	0.00	0.43
1=household head had temporary job	0.03***	0.00	0.05***	0.00	0.01***	0.00

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Notes: DV means Dependent Variable and APE means Average Partial Effect

In the southern region, the probability to participate in agricultural market as a seller based on the sex of the HH is insignificant. However, female headed household tend to sale more quantities of maize (in tons) compared to male headed households for both models (conditional and unconditional models). In other words, female headed household have more opportunity in the marketing of maize in the southern region than in other regions. This could be as a result of numerous non-agricultural activities and jobs that predominates the southern regions such as Maputo. Such non-agricultural activities may include the dominate presents of financial institutes (commercial banks), gas sector, teaching, and other non-agricultural businesses.

The probability of participating in maize market as a seller increases for households who utilized farm manure in the production of maize. However, this effect is insignificant for the second stage (i.e. quantity sold). This result imply that using farm manure helps to increase agricultural production thereby increasing marketable surplus and thus improving the number of household that participate in maize market.

The probability of participating in maize market as a seller increases for households who utilized extension service. This result is similar for the northern region. In the second stage, the use of extension services influences positively on the quantity of maize sold. This result is in accordance as the result of the Central region and same implication is assumed also. The probability of participating in maize market as a seller increases for households who rear animals but insignificant for the second stage. This result is also similar to that of the Northern region.

The probability to participate in maize market decreases for household that have lost their maize crop. This result is as expected as households with crop loss will experience production shortage and thus is more likely to participate less in the market. This result is also in concordance with Boughton et al., (2007) as households with crop lost participated less in agricultural market. The effect of those who lost crop is negatively related to the quantity of maize sold and therefore, causes the quantity sold to decrease as shown in both models (conditional and unconditional models). This result was expected because the more the farmer experiences lost of crop either by fire, flood, theft or drought the smaller the production and thus the smaller the quantity sold in the market. This crop lost effect is adverse on economic development.

Also, the probability to participate in maize market increases for households with household head with temporary jobs and the effect of this variable was positive and statistically significant on the quantity sold in the market. Similar result was found for the Northern and central regions. The probability of households to participate in maize market increases with the increase in the quantity produced of maize. This effect is also positive for the quantities sold in the market. Similar result was found for the Northern region.

The probability of participating in maize market increases for households receiving price information. This result is also in line with the result reported by Siziba et al. (2011) and Omiti et al. (2009). Siziba et al. (2011) reported that access to information reduces risk perceptions. However, access to price information has an insignificant effect on the second stage. It is suggested that having knowledge of market price gives the sellers an advantage in determining the quantity of crops to sale in agricultural markets.

Table 12 below shows the double hurdle model for maize in all the regions.

Table 12: Double hurdle of maize for all regions in 2008

Explanatory variables	Probit DV=1 if HH sold maize		Truncated Normal (conditional model) DV = Quantity sold in tons		Probit+Truncated Normal (unconditional model) DV = Quantity sold in tons	
	APE	P-value	APE	P-value	APE	P-value
1=household is a member of an agricultural association	0.05	0.14	-0.01	0.79	0.01	0.44
Education of Household Head	0.00	0.94	0.00	0.96	0.00	0.96
Age of Household Head	0.00	0.86	0.00	0.87	0.00	0.79
1= male Headed Household	0.07***	0.00	0.06***	0.00	0.03***	0.00
1=household received credit	0.03	0.56	0.02	0.63	0.01	0.47
1=household utilized manure	-0.03	0.31	-0.01	0.56	-0.01	0.27
1=household received extension services	0.04***	0.00	0.01***	0.00	0.01***	0.00
1=household utilized fertilizer	-0.12***	0.00	0.01	0.81	-0.02***	0.00
1=household owned livestock	0.03	0.10	0.01	0.42	0.01	0.10
Farm size (ha)	0.02	0.20	0.01	0.28	0.01	0.14
Household size	-0.01	0.44	0.00	0.85	0.00	0.50
1= household experienced crop loss	-0.03***	0.00	0.00**	0.02	-0.00***	0.00
1=household utilized pesticide	0.05	0.20	-0.03*	0.06	0.00	0.62
1=household received price information	0.03*	0.09	0.01	0.53	0.01	0.10
Quantity produced (tons)	0.19***	0.00	0.12***	0.00	0.07***	0.00
1= household received emergency seed	0.00	0.99	-0.02	0.20	-0.01	0.38
1= small type farms	0.09***	0.00	0.00	1.00	0.02**	0.04
1=household head had temporary job	0.02***	0.00	0.01***	0.00	0.01***	0.00

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Notes: DV means Dependent Variable and APE means Average Partial Effect

In Mozambique as a whole, the probability of households participating in maize market as a seller is higher for male headed households compared to female household. In the second stage, male headed household tends to significantly sales more than the female headed households in both models (conditional and unconditional models). These results were true for the northern and central regions. The probability of households participating in maize market as a seller is higher for households who received extension services. This was true for the southern and northern regions. In the second stage, households benefitting from extension services tend to market higher quantities of maize compared to those not benefitting from extension. This same result was true for the central and the southern regions.

The probability of participating in maize market as a seller decreases for households using fertilizers. This result was also similar to the northern and central regions. The probability of participating in maize market as a seller decreases for households that have lost their maize crop either by fire, drought, flood and theft. This was true for the southern region. In the second stage, the effect of maize crop loss is positive for the conditional model and negative for the unconditional model. The effect on the conditional model was similar to the central region while the effect on the unconditional model was similar to the southern region.

The probability of participating in maize market for households using pesticides is insignificant. However, the use of pesticides tends to decrease maize quantities sold in the market for the conditional model but insignificant for the unconditional model. Also, the probability of participating in maize market increases with household that received price information. However, this variable effect is insignificant for the second stage. Similar results were found for the southern region.

The probability of participating in maize market as a seller increase with the quantity produced of maize and the same tendency is observed for the conditional and unconditional models. This result was also similar to all regions (northern, central and southern regions). Households owing small farms tend to participate more in maize market as seller compared to those owing medium farms. This result was also true for the northern region. However, the effect of small type farm on the quantity sold for the conditional model is insignificant but positively significant for the unconditional model. Also, the probability of participating in maize market increases for households with household head with temporary jobs and the

effect of this variable was also positively and statistically significant in the second stage of estimation. A similar result was discovered for all regions.

4.4 Effects of factors affecting market participation for cowpea

Details of the cowpea farmers' participation in agricultural market in each region is presented in table 13 below:

Table 13: The number of cowpea farmers in each region

Regions in Mozambique	Number of cowpea farmers	Market participation of cowpea	
		Yes	No
Northern region	2,565	147	861
Central region	1,700	63	692
Southern region	1,703	20	1,138
Total	5,968	230	2,691

Source: MINAG, 2008

The number of households producing cowpea farmers in 2008 was 5,968 and the double hurdle analysis was based on these households but 230 participated in cowpeas' market as a seller while 2,691 did not participate. Given the limited number of households producing cowpeas participating in agricultural markets, the analysis of market participation using double hurdle technique was performed for all regions. Table 14 below presents the results of factors determining households' participation in cowpea market in Mozambique.

Table 14: Double hurdle of Cowpea in 2008

Explanatory variables	Probit DV=1 if HH sold cowpea		Truncated Normal (conditional model) DV = Quantity sold in tons		Probit+Truncated Normal (unconditional model) DV = Quantity sold in tons	
	APE	P-value	APE	P-value	APE	P-value
1=household is a member of an agricultural association	-0.01	0.64	0.01	0.47	0.00	0.85
Education of Household Head	0.00	0.98	0.00	0.93	0.00	0.99
Age of Household Head	0.00	0.95	0.00	0.99	0.00	0.97
1= male Headed Household	0.00	0.84	0.01***	0.00	0.00*	0.07
1=household received credit	0.03	0.56	0.00	0.99	0.00	0.75
1=household utilized manure	0.01	0.69	0.00	0.95	0.00	0.79
1=household received extension services	0.02***	0.00	0.01***	0.00	0.00***	0.00
1=household utilized fertilizer	-0.01	0.67	-0.01	0.24	0.00	0.49
1=household owned livestock	-0.01	0.55	0.00	0.38	0.00	0.52
Farm size (ha)	0.01	0.46	0.00	0.32	0.00	0.49
Household size	0.00	0.79	0.00	0.93	0.00	0.87
1= household experienced crop loss	-0.01***	0.00	-0.00*	0.09	-0.00***	0.00
1=household utilized pesticide	0.03	0.43	0.00	0.88	0.00	0.62
1=household received price information	0.05**	0.01	0.00	0.32	0.00	0.27
Quantity produced (tons)	0.74***	0.00	0.20***	0.00	0.04***	0.00
1= household received emergency seed	-0.02	0.50	-0.01	0.52	0.00	0.33
1= small type farms	0.05***	0.00	0.00	0.99	0.00*	0.09
1=household head had temporary job	0.02***	0.00	0.00	0.43	0.00***	0.00

*, ** and *** denotes statistical significance at 10%, 5% and 1% respectively.

Notes: DV means Dependent Variable and APE means Average Partial Effect

The results show that male headed households tend to sale more quantities of cowpea (in tons) than female headed household for the conditional model and unconditional model. Similar result was true for the northern and central regions for maize crop. The probability of participating in cowpeas market as a seller increases for households who received extension services. Similar result was true for the northern and southern regions for maize participation. In the second stage, the effect of this variable is positively related to the quantity of cowpea sold (in tons). Also similar result was found in the central and southern regions for maize model.

The probability of participating in cowpeas market increases for household receiving price information. This outcome is expected and it is similar to the southern region for maize participation. In the second stage, this effect of the variable is insignificant. The probability of participating in cowpea market as a seller decreases for households that have lost their cowpea crop either by fire, drought, flood and theft. This is as expected and is true for the southern region for maize. In the second stage, the effect of cowpea crop lost is negatively associated with the quantity of cowpea sold in the market for both models (conditional and unconditional models). Similar effect of this variable on quantity sold was found for maize market in the southern region.

The probability of participating in cowpeas market increases for households owing small cowpea farm. In the second stage, the effect of this variable increases cowpea quantities sold in the market for the unconditional model but was insignificant for conditional model. This outcome is also similar to the maize market participation for Mozambique as a whole. The probability of participating in cowpeas market increases for household with household head having temporary jobs. This result is similar to the northern, central and southern regions for households' maize market participation. In the second stage, this effect was insignificant for the conditional model. However, this variable has positive effect on the quantity of cowpea sold in the market for the unconditional model. The effect of this variable on the unconditional model was also found for household participation in maize market in all analyzed regions.

The probability of participating in cowpeas' market as a seller increases with the quantity of cowpea produced. This suggests that the more the production of cowpea the high the probability of cowpeas farmer to participate in the market. This result is in line with

Chilundika, (2011) and Gani and Adeoti, (2011) and is true for household participation in maize market. In the second stage, the quantity of cowpea sold increases with the quantity of cowpea produced in both models (conditional and unconditional models). This result is also in line with Chilundika (2011) and Gani and Adeoti, (2011). According to Chilundika (2011), the quantity of beans sold increases with an increase in the beans yield which implied that the quantity of beans produced had a critical role in market entry and extent. Also, this result is similar to all three regions for maize market participation analysis.

5.0 Conclusion and policy implication

In this study, an in-depth analysis of households' decisions regarding maize and cowpea marketing participation in Mozambique was performed. This study took into account other articles (Heltberg and Tarp (2002), Benfica and Mather (2013), Salvucci, (2012), Benfica and Tschirley (2012), and Boughton et al. (2007)) on similar topic. The study had three specific objectives which were to analyze market participation trends, examine the socioeconomic features of participants and determine the factors influencing market participation and the amount sold. The result showed that the participation of households' in agricultural market is low. This could be because of low marketable surplus as most of the production is diverted into household family consumption. Therefore, policy should be put in place to sensitize the market in such a way as to attract farmers to venture into the marketing of their crop produce.

The effect of male households, use of extension services, crop lost, production quantities and household head having temporary jobs which was significantly associated with market participation in the t-test and chi-square analysis was also significant for the double hurdle analysis of market participation and the quantities sold in the market. Male headed households' have greater opportunity in agricultural market than the female headed household. Therefore, agricultural programs geared towards the improvement of farmers market participation should be focused on male headed homes because they are more market oriented.

Extension services play a vital role in households' decision to participate in the market and on the quantity of food-crops to sale in the market. Therefore, it is recommended that extension workers should be made to cover a larger area in each region in Mozambique so that most farmers will be well informed about the market and prices of agricultural food-crops which could enable and facilitate the decision to participate in the market and on the quantities to sale in the market.

Also, experiencing crop lost has shown to negatively affect the households' market participation process and on the quantities of food-crops to sale. Therefore, farmers should be taught of a better production management system to apply on their farms so that crop lost could be minimized. Also for weather related crop lost, climatic information should be produced and disseminated to farmers so they can be aware of periods of adverse weather

condition and therefore apply appropriate production methods for such periods (such methods could be the use of drought resistant seeds for cultivation).

Also, the quantities of food-crops produced significantly determine if the household will sale their produce in the market or not. To improve the level and intensity of market participation, policy should be put in place to encourage farmers to increase their production which should be mostly directed towards agricultural markets. This can be achieved[17] by increasing the landholding of households, provision of credit with minimum interest rate, and increasing the use of improved inputs and/or technology such as fertilizers and pesticides.

The result also showed that household head with alternative off-farm jobs participated more in agricultural markets than household head with no off-farm jobs. It suggests that household head with off-farm jobs have more financial resources to support for crop production and marketing cost. Therefore, agricultural programmes aimed at improving the intensity and level of household market participation should be focused on this group of households' because they are more able to increase production given available monetary resources.

[17] As evident in the empirical result of the t-test and chi-square analysis of this study

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Annex 1

Map of Mozambique showing the three regions

Source: Ryerson and Batterham (2000)