EFFECT OF COMMERCIALISATION OF VEGETABLE CROPS ON FARM HOUSEHOLD INCOME IN JUBA, SOUTH SUDAN

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DECLARATION AND RECOMMENDATION

Declaration

I truly declare that this thesis is my original work and it has not been presented wholly or in part here at Egerton University or any other university for the award of a degree.

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Recommendation

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DEDICATION

This thesis is dedicated to my lovely wife madam Priscilla Nyibol for her relentless support in the extended academic journey.

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I would like to quote Gail Devers who said, *"Keep your dreams alive. Understanding to achieve anything requires faith and belief, vision, hard work, determination, and dedication. Remember all things are possible for those who believe".* I give thanks to almighty God for providing me with strength and wisdom to accomplish this task successfully. I am grateful to acknowledge Centre of Excellence for Sustainable Agriculture and Agribusiness Management (CESAAM) for funding this research and facilitating my studies. I also extend my humble gratitude to the Egerton University for granting me an opportunity to pursue master's degree at this highly reputable institution. Nevertheless, I sincerely acknowledge the tireless effort made by the staff from the department of Agricultural Economics and Agribusiness Management. My profound gratitude to my academic advisors, Professor Benjamin K. Mutai and Dr. Hillary K. Bett for their relentless commitment and unreserved dedication throughout the research to make this work come to its existence. To my beloved parents Mr. Angelo Ater and Mrs. Rozetta Peter your unmatched effort to my bright future is acknowledged. Without you, I could have not reach this far. I am also grateful to acknowledge University of Juba for granting me remarkable permission to develop my career. Finally, to everyone who contributed physically, financially and emotionally, throughout this challenging situation, may God almighty bless you and guide you all toward successful future. Peace, mercy and love are unto thee.

ABSTRACT

Agricultural commercialisation is the leverage point for economic growth, poverty reduction and food security in sub-Saharan Africa and South Sudan in particular. It is one of the major employers of labour in South Sudan, which accounts for about 80% of total employment. Agriculture in South Sudan is characterised as subsistence and mainly occupied by smallholder farmers. In the past few years, various studies evaluated the effect of agricultural commercialisation on the welfare of smallholder farmers along with income and food security. However, there is no empirical account on the effect of commercialisation of vegetable crops on the income of smallholder farm household in South Sudan. Therefore, this study focused on the effect of the commercialisation of vegetable crops on household income. The specific objectives of the study were; to determine factors influencing the commercialisation of vegetable crops; to estimate the contribution of vegetable crops to household income, and to determine the effect of commercialisation of vegetable crops on household income. A multi-stage random sampling technique was adopted and semi-structured questionnaire applied to collect primary data from a sample of 151 smallholder farmers. The data collected were analysed using descriptive statistics, a Tobit regression model, the endogenous switching regression model and the gross margin analysis by STATA analytical software. The descriptive results reveal that 77.48% of the respondents are female farmers, 36.65% have access to land, 37.09% have access to education at the primary level, 96.69% have no access to market information, 74.17% do not have group membership and only 54.97% have access to irrigation facilities. The findings further revealed that the mean household commercialisation index (HCI) was 74.81% and the specific HCI for tomato, okra and cowpeas were 74.92%, 72.96%, and 74.84% respectively. The results from Tobit regression model revealed that commercialisation of vegetable crops is influenced by the age of the farmer, farming experience, type of land acquisition, the quantity of crop produced, group membership, total variable costs, total farm revenue, and access to irrigation facilities. The endogenous switching regression model revealed that the commercialisation of vegetable crops has a positive effect on the income of smallholder farm households. It contributed 33.33% to the total household income. Based on the above findings, it is evidence that commercialisation requires a push from the policymakers. Therefore, there is a need for the national government and other developmental agencies to provide institutional support to the farmers to accelerate the transition from subsistence to commercialised farming and formulate policies that encourages the formation of farmer's organisations countrywide.

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LIST OF ACRONYMS AND ABBREVIATIONS

AE	Adult Equivalent
ALVs	African Leafy Vegetables
ASALs	Arid and Semi-Arid lands
ATT	Average Treatment effect of the Treated
ESR	Endogenous Switching Regression Model
FAO	Food and Agriculture Organisation of the United Nations
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
GM	Gross Margin
Ha	Hectare
HCI	Household Commercialisation Index
HDDS	Household Dietary Diversity Score
Hg	Hectogram (metric unit equivalent to 100 grams)
OLS	Ordinary Least Squares
PSM	Propensity Score Matching Model
SPSS	Statistical Package for Social Sciences
SSP	South Sudanese Pounds
UNDP	United Nation Development Program
WFP	World Food Program of the United Nations

CHAPTER ONE
INTRODUCTION

1.1 Background Information

The agricultural sector is one of the distinct sectors for economic prosperity particularly for developing and emerging economies. It accounts for a relatively smaller share of the global economy; however, it contributes crucially to the improvement of the welfare of various households (Alston & Pardey, 2014). In the context of emerging economies and in particular sub-Saharan Africa, agriculture contributes significantly to the wider range of benefits, which include economic growth, poverty alleviation, and enhancement of food and nutrition security (Schaffnit-Chatterjee *et al.,* 2014). Besides, most of these countries are agrarian and therefore their economy relies typically on agriculture as a primary source for economic growth. However, the principal producers in this economic sector are smallholder subsistence farmers, who produce food crops for subsistence purpose. In order to improve the livelihood for this category of farmers, an accelerated transition from subsistence agriculture to commercialised agriculture is very crucial. The commercialisation of agriculture is often viewed as an appropriate alternative for smallholders to increase their household income while contributing to economic growth and development (Muriithi & Matz, 2014).

In the context of South Sudan, the agricultural sector plays a crucial role in the economy as the major employer of labour and contributes about 80% of the total employment (Diao *et al.,* 2012). This is because South Sudan is one of the agrarian countries in the region with a higher population relying on subsistence agriculture. Most of the population are living in rural areas, and agriculture is their main source of livelihoods. Agriculture is one of the strategic sectors that contribute to one-third of the country's GDP for economic development with 95% of the population depending on subsistence farming (UNDP, 2012). Because of the subsistence nature of agriculture, the commodity market share is very low. Therefore, it requires a transformation of agricultural production from subsistence to a market-oriented farming system. Linking farmers to the market through commercialisation of agricultural is the most suitable approach applicable to improve household income as well as reducing destitution level among smallholder farmers (Tufa *et al.,* 2014).

For decades, one of the most popular arguments in the economic literatures is that the commercialisation of agriculture contributes to improving the welfare of the actors downstream. By commercialising agriculture at the level of smallholder farmers, the food and nutrition security can be easily attained among farming households. The realisation of benefits

derived from participation in the output market for agricultural commodities provides smallholders agrarian societies with an opportunity to maximise income especially when barriers to access institutional services are liberalised (Jaleta *et al.*, 2009). Through the commercialisation of vegetable crops, the agricultural sector offers potential opportunities for smallholder farmers in South Sudan to generate incomes that can improve their livelihood (Tizikara *et al*., 2011).

A recent study revealed that the commercialisation of vegetable crops is a viable strategy that can enhance the economic welfare of smallholder farm household by increasing their income level (Dembele *et al*., 2018). This strategy has been influential in the economy of agrarian countries because it transforms the agricultural sector for emerging economies (Opondo & Owuor, 2018), and links farmers and agribusiness firms through inputs supply.

Due to the recent population growth and consumer's preference in urban settings, the demand for a nutritious and healthy diet has increased, consequently resulting in a higher demand for vegetables. Hence, because of this trend, it provides an avenue for vegetable producers to maximize their income through the commercialised production of vegetables. The commercialisation of vegetable crops is one of the persuasive approaches for disadvantaged farmers to generate much-needed income (Ojiewo *et al*., 2015). Nutritional-wise, vegetables consumption is generally advised for all people of different age groups due to its nature for ensuring healthy life. Vegetables are well known as the most important sources of micronutrients for a human being. They contain the highly needed elements for a healthy body. Vegetables provide a variety of benefits that include nutritious food and income for smallholder farm households (Joosten *et al*., 2015). Recent studies have shown that vegetable farming has a comparative advantage especially for a farming population living in areas where arable land is scarce and with an adequate labour force.

Considering the importance of vegetables to the human diet, the crops such as cowpeas, tomatoes, and okra are considered crucial and essential ingredients in the main dishes of South Sudanese. They play a vital role as an integral part of the meal in South Sudan. The consumption of cowpea leaves and okra is observed higher among low-income households in Juba. This has resulted in a higher demand for such crops, hence offering an opportunity for vegetable producers to invest in these types of crops. Due to the associated economical and nutritional benefits derived from cowpeas, the smallholder farmers in peri-urban areas of Juba tend to grow cowpeas throughout the year (World Bank, 2019).

The cowpea scientifically known as (*Vigna unguiculata* Walp) is one of the multi-purpose vegetable crops that provide food for both rural and urban households. Cowpea is one of the valuable commodities that generate revenue to smallholder farmers in many parts of the world. In sub-Saharan Africa, it is mainly grown for subsistence with small proportion of the share supplied to the market (Owade *et al*., 2020). Cowpea is a principal food crop with a variety of benefits for many households in most African countries including South Sudan, where its tender leaves, fresh pods and grains are consumed (Alemu *et al*., 2016). This crop is widely grown in diverse agro-ecological zones of South Sudan by smallholder subsistence farmers for its palatable leaves and beans (Ngalamu *et al*., 2015). The crop is drought tolerant and is mainly cultivated in mixed cropping with other field crops in marginal soil due to its ability of fixing atmospheric nitrogen to the soil (Alemu *et al*., 2016). Being a drought-tolerant and warm-weather crop, it serves as a promising food crop in tropical areas (Agza *et al*., 2012; Alemu *et al*., 2016; Belay *et al*., 2017). In South Sudan, the cowpea is grown mainly for its leaves and beans by smallholder female farmers almost everywhere, for subsistence purpose under the traditional agricultural system (World Bank, 2019). It is suggested that cowpeas have the potential to produce more if the minimum quantity of inputs are used. Its productivity could also improve with the application of fertilizer and irrigation during the dry season.

Apart from cowpeas, other palatable vegetables such as tomato (*Solanum Lycopersicum)* also serves as a complementary food in the main dishes of urban populations of Juba. Tomato is one of the economically viable vegetable crops with a variety of benefits derived principally from its consumption as an ingredient in many dishes of the urban households. Although tomato is well known for being a major contributor to human health, its production is not realized among local producers. Provided the fact that vegetables are sources of minerals, the supply of tomato to the local markets in Juba is primarily dependent on imports from neighbouring countries. There are varieties of tomato products that provide preferences to consumers at a wider range. The ripen fruit of tomato can be consumed raw or cooked as an ingredient in many dishes (Alam *et al*., 2007), and is also processed into tomato paste or ketchup, and/or dried and ground to produce a powder. The tomato provides a wider range of nutrients such as vitamins, minerals and essential amino acids that are crucial to the human body. Tomato enterprise is a lucrative business for households with access to credit facilities. It provides an opportunity for generating income and employment for the urban populations (Degefa *et al*., 2020) because it is one of the labour-intensive undertakings.

Nevertheless, okra (*Abelmoschus esculentus)*, commonly known as "bamia", is another vegetable crop with a higher contribution to the diet of many households in the entire country. Like cowpeas and tomatoes, okra also provides numerous benefits to human health. It contains more nutritional and health benefits that include the reduction of the risk of diabetes and treatment of gastric irritation (Chanchal *et al*., 2018). Okra is one of the economically feasible crops suitable for production by smallholder farmers in tropical and sub-tropical areas. It is consumed in a variety of ways at different stages after harvest. In South Sudan, the fresh fruits of okra are served either in form of soup or stew (Gemede *et al*., 2015), whereas the sundried fruit is processed into powder commonly known as (*Weka*) for use as soup/stew during the off-season. Because of its simple agronomic practices, robust nature of yield, and availability of dietary fibre and distinct seed protein, it has been considered "a perfect villager's vegetable". Moreover, okra is an important vegetable crop with a diverse array of nutritional quality and potential health benefits associated with its consumption (Gemede *et al*., 2015).

There have been lot of efforts made by non-government organisations to improve agricultural production specifically vegetable crops through provision of farm inputs, promotion of small-scale irrigation and provision of training to farmers. This kind of interventions has helped farmers in other developing countries to increase their farm outputs and enhance crop commercialisation towards achieving increased household income and improved food security (Hailua *et al.,* 2015).

For agrarian economies to address the challenges, facing the economic welfare of smallholder farmers there should be a need to promote the transition from subsistence production to a commercialized farming system (Adepoju, 2018). Through commercialisation of vegetable crops, smallholder farm households can have an advantage to improve their economic welfare by increasing income through selling crop surpluses to the market. In most countries of sub-Sahara Africa, the smallholder farmers are considered subsistence-oriented and their economic share has not been adequately accounted for (World Bank Report, 2008; Zhou *et al*., 2013). In South Sudan, agricultural industry is still at its rudimentary level, where a farmer uses local tools and traditional farming techniques for subsistence purpose. However, there is a lack of adequate information regarding commercialisation of vegetable crops among smallholder farmers in Juba.

To provide empirical evidence on this issue, it is important to understand the underlying factors influencing the level of commercialisation of vegetable crops. In addition, it is crucial to evaluate the effect of commercialisation on household income. This could be realised by

understanding factors that have a significant influence on the potentials of smallholder to venture into market-oriented production of vegetables. Thus, providing recommendations for policy-makers to formulate appropriate policies for intervention.

1.2 Statement of the Problem

Agriculture is one of the strategic sectors in the economy of South Sudan; it plays a vital role in the economy in the sense that most of the population rely on subsistence farming for the living. In the past few years, the government of South Sudan in collaboration with NGOs devised various intervention mechanisms aimed at improving agricultural productivity among smallholder farmers. Regardless of the efforts made, majority of smallholder farm households have not shown any outstanding shift from subsistence to the commercialised farming system and subsequently, their economic welfare did not improve. Despite the potential of commercialisation of vegetable crops, the level of commercialisation among smallholder farmers in Juba is insufficient; and hence the level of income continues to remain unsatisfactory. Moreover, there is no adequate empirical evidence to account for the factors influencing the commercialisation of vegetable crops and its contribution to the household income in Juba, South Sudan. Therefore, this study sought to fill this knowledge gap by identifying and analysing factors influencing smallholder's participation in commercialised farming.

1.3 Objectives of the Study

1.3.1 General Objective

To contribute to improved livelihood of smallholder farmers through commercialisation of vegetable crops in Juba, South Sudan

1.3.2 Specific Objectives

i. To determine factors influencing commercialisation of vegetable crops among smallholder farmers
ii. To estimate the contribution of vegetable crops to household income among smallholder farmers
iii. To determine the effect of commercialisation of vegetable crops on household income.

1.4 Research Questions

i. What are the factors influencing the commercialisation of vegetable crops among smallholder farmers in Juba, South Sudan?
ii. What is the contribution of vegetable crops to household income among smallholder farmers in Juba, South Sudan?
iii. What is the effect of the commercialisation of vegetable crops on a household's income in Juba, South Sudan?

1.5 Justification of the Study

The study contributes towards achieving one of the most pressing global sustainable development goals of "no poverty" through increasing income for smallholder low-income households. According to the existing empirical literature, most of the studies focused on the generalised commercialisation of agriculture (Din *et al*., 2017; Hailua *et al*., 2015; Ochieng *et al*., 2015; Olanrewaju *et al*., 2016). This study provides a benchmark for future scholars since there is limited empirical literature on factors influencing the commercialisation of vegetable crops in South Sudan. Therefore, this study provides an understanding of the factors influencing the commercialisation of vegetable crops and their effect on household income for improving the economic welfare of smallholder farmers in Juba. Moreover, the study plays a significant role in the economic development of South Sudan through the provision of evidence-based results in this sector since agriculture is the mainstay of the economy. The study also provides scientifically analysed information that could guide policymakers to enact appropriate agricultural policies that can promote the commercialisation of vegetable crops for the improved welfare of smallholder farmers.

1.6 Scope and Limitation of the Study

The study focused restrictively on smallholder farm households particularly the farming household involved in vegetable enterprise in three peri-urban areas of Juba, South Sudan. In this study, the factors assumed to have a significant influence on the commercialisation of vegetable crops were identified. The factors believed to influence smallholder's decision to participate in the output market were determined along with socio-economic characteristics of the farmer, institutional factors, and farm characteristics of the farming household. The major limitations of the study include lack of adequate financial resources to cover the whole area of Central Equatoria State, and limited time available for the study. In addition, the respondents in the field had difficulties recalling information regarding the total costs of production and the

income earned from the commodities sold in the previous planting season. This was attributed to the lack of records of the past activities because most of the farmers are illiterate. Due to such limitations, the researcher confined the study to only three peri-urban areas and used a household estimated costs of production and average market price for the commodities sold. The study was carried out in the period of February 2020 to May 2021 due to the occurrence of Corona virus pandemic, which interfered with the study plan.

1.7 Definition of Terms

Commercialisation – refers to the participation of farming households in market-oriented production of vegetable crops for economic gains where they can produce a surplus to sell, as opposed to traditional subsistence production.

Enterprise – refers to the farm enterprise, which produces food crops that include vegetable crops.

Farm household income – refers to the income earned by the household head from on-farm activities, which include income earned from the quantity of vegetable crops sold per cropping season captured in South Sudanese Pounds.

Household – refers to a social unit of people living together in a house that serves as a source of labour

Peri-urban areas – these are areas located at the outskirt of the cities that exhibit part of urban and rural characteristics in terms of access to services and substantial reliance on farming activities.

Smallholder farmer – is a farmer characterised by limited landholding with an average farm size of two feddans, roughly equivalent to two acres, and relies on family labour for most of the farm operations.

Total household income – refers to the sum of income earned by the household head from both on-farm and off-farm activities recorded in South Sudanese Pounds (SSP).

Vegetable crops – this refers to vegetable crops such as tomato, okra, and cowpeas produced locally for both subsistence and commercial purposes as a source of nutrients and income to the farming households.

CHAPTER TWO
LITERATURE REVIEW

2.1 Production of Vegetable crops

The global production of vegetable crops has increased in the last ten years as a result of an increase in demand for healthy and nutritious diets in urban areas. This has led to an increase in the areas devoted to production of crops such as tomatoes, okra, and cowpeas from the period of 2010 to 2019. According to the statistical data from FAOSTAT (2021), the global yield for tomatoes in the last ten years has increased from 346,058 hg/ha to 359,337 hg/ha. Additionally the cowpea has shown a substantial increase in yield from 6007 hg/ha to 6163 hg/ha. However, there is a sharp decline in global yield for okra from 68,277 hg/ha in the year 2010 to 36,462 hg/ha in 2019 (FAOSTAT, 2021).

In South Sudan, the national production indices for horticultural crops indicate that there is a substantial increase in gross production index for vegetables and fruits from 71.79 to 125.28 in the period from 2012 to 2019 (FAOSTAT, 2021). However, there was also a decline in the trend of gross production index (Figure 1). This suggests that there are underlying factors contributing to a decline in the crop outputs, which could be attributed to socio-economic and institutional challenges. The presence of unidentified factors in production of vegetable crops could also be an impediment for commercialisation.

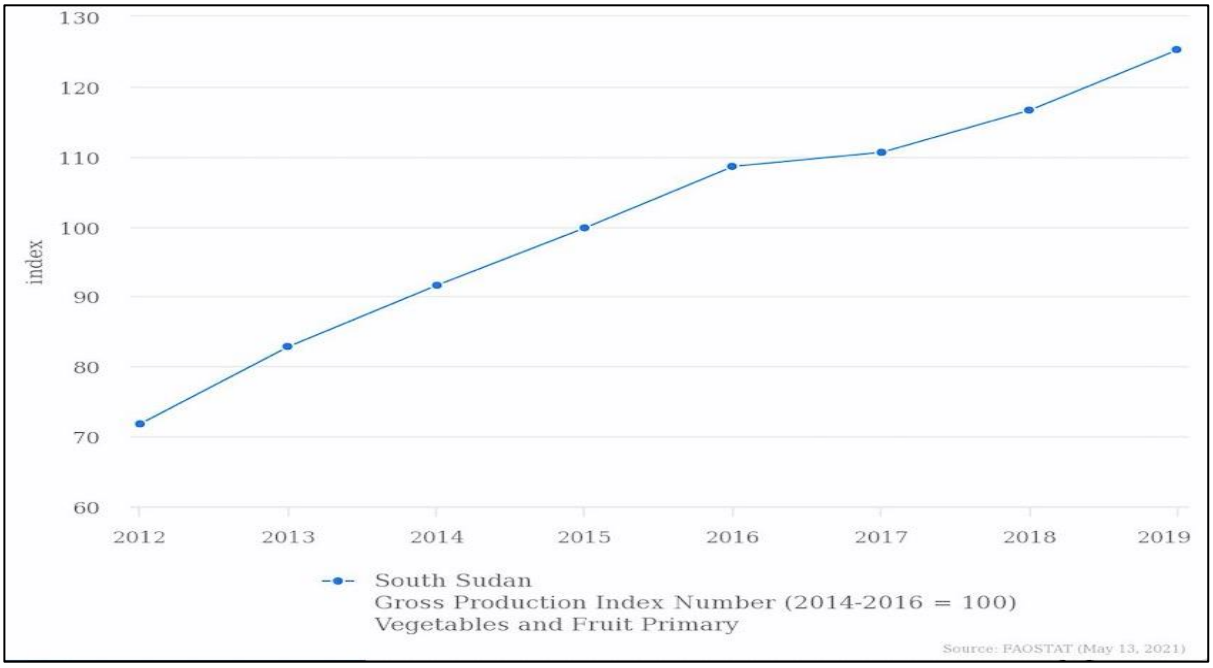

Figure 1: National Gross Production Index for horticultural (vegetable) crops

2.2 Factors influencing commercialisation of vegetable crops

Empirical studies have shown that crop commercialisation among smallholder farming household has a crucial role in enhancing the wellbeing of low-income agrarian economies. It also serves as a mean to ensuring food security and nutrition as well as increasing household income (Olanrewaju *et al.*, 2016). Over the past few years, many scholars have used various methods to ascertain the significant factors that influence the commercialisation of agriculture being cereal crops or vegetable crops.

Using household commercialisation index and Tobit regression analysis, Olanrewaju *et al.*, (2016) in their study assessed crop commercialization among smallholder farming households in Southwest Nigeria. They found that crop commercialization for three different crops (maize, cassava, and yam) vary significantly among different farmers across different areas. The results of the specific crop commercialisation index have shown that cassava among other crops is the propelling crop for commercialisation in the study area. The Tobit regression model results indicated that age, gender, level of education, household size, membership of an association, farm size, access to credit, distance to the market, farm, and off-farm income, are statistically significant in determining the extent of crop commercialisation among smallholder farmers. These findings were also in line with previous results of Omiti *et al*. (2009), which affirm that distance to the market is a major factor that influences the intensity of market participation among smallholder farmers. It is observed that the extent of crop commercialisation among smallholder farmers was comparatively high with significant variations in a different type of crops among farm households. The study, therefore suggests that farmers should increase farm size to increase agricultural production. Nevertheless, governmental institutions are recommended to provide institutional supports such as credit facilities and input subsidy to smallholder farmers to encourage and accelerate the commercialisation of food crops.

In a separate study conducted in the Tigray region of Ethiopia, Hailua *et al.* (2015) evaluated factors affecting the intensity of crop commercialisation and its impact on the livelihood of smallholder farmers. The results of the study revealed that the distance to the market and frequency of access to extension services are important variables in the commercialisation process. The results obtained from propensity score matching model (PSM) further revealed that family size, shortage of family labour, cost of farm inputs, distance to market, as well as crop pests and diseases are negatively affecting the intensity of crop commercialisation. Furthermore, the findings indicated that the farming community had shown

strong interest towards transforming subsistence farming to the market-oriented and commercialized agriculture. The study opined that the role of government is very crucial to boost rural infrastructure development, rural institutions capacity building and create awareness on the benefits of producing market-oriented products.

Using a Tobit regression model Dube and Guveya (2016) in their study to evaluate determinants of agriculture commercialisation among smallholder farmers in Zimbabwe found that the mean household commercialisation index (HCI) was 0.28, which shows that the sampled households are highly subsistence. The findings further revealed that the size of the household, availability of draft power, livestock ownership, and access to irrigation, agricultural training, and distance to the market were statistically significant and positively influenced commercialisation. The study results were reinstated by Kahenge *et al.* (2019) findings, which revealed that household size; livestock ownership and distance to the market are the major factors influencing crop commercialisation. Besides, the number of household members with secondary education and communal tenure was found to have negatively influence the commercialisation of agriculture. The authors recommended for the government to promote the commercialisation of smallholder agriculture through provision of extension services such as training farmers to realize the benefits of commercialise farming while equipping them with the marketing and negotiation skills.

In a separate study conducted in Kenya, Muriithi (2015) applied descriptive statistics and multiple regression analysis to study smallholder horticultural commercialisation on gender roles and implications for household wellbeing. The empirical results indicated that female participation in the commercialisation of vegetables is positively related to their membership in farmer groups, education level, ownership of assets, and business access. The findings further revealed that the share of revenues from the sale of export market vegetables managed by female members of the household is positively influenced by total land cultivated, access to extension services, and the number of children attending school. Therefore, the policy implication of the study was that the development geared towards commercialisation of agriculture emphasized gender inclusion in the selection of agricultural commodities. Such an approach provides a possibility to observe the role of gender (both men and women) in identifying commodity preferences at different stages of the supply chain.

In the past few years, Ochieng *et al.* (2015) stressed on the use of propensity score matching method to evaluate the effect of commercialisation of bananas and legumes on household food security in the Great Lakes region of central Africa. They found that

commercially oriented farmers have more diverse diets than non-commercially oriented ones. They further suggested that the commercially oriented farmers could have more purchase power to purchase other foods that could supplement their production. The results further revealed that the household dietary diversity could significantly increase for households that participate in commercialisation and subsequently reduce the numerous coping strategies adopted at the time of food deficit. The study, therefore, pointed out alternative options for the realisation of the benefits of commercialisation. The need to improve socio-economic conditions of the smallholder farmers by establishing well-structured and operational market centres, providing access to market information as well as education to the smallholder farmers were prioritised for policy attention.

Although the authors suggested that the commercialisation of agriculture have a significant impact on household food security, the study was aggregated in nature. Therefore, this limitation could be overcome by conducting a country-specific study on the effect of commercialisation of vegetable crops on the household income in Juba, South Sudan to inform the policymakers appropriately.

To date, several studies have used a variety of methods to determine factors influencing the level of commercialisation of crops among smallholders. In a study conducted in Gemechis District, West Hararghe zone in Ethiopia, Tufa *et al.* (2014) used a double-hurdle model to evaluate determinants of commercialisation of horticultural crops among smallholders. The results of the probit regression model of the first hurdle revealed that the gender, distance to the market, and cultivated land play a significant role in smallholder commercialisation decisions. By using a similar method, Osmani and Hossain (2015) on their study found that farm size, household size and on-farm income were statistically significant factors triggering participation of smallholder farmers in the output market.

On the other hand, the results of the truncated regression model of the second hurdle showed that the level of education, household size, and access to irrigation, livestock ownership, and distance to the market are the key determinants influencing the extent of commercialisation. They further argued that education increases the ability of farmers to gather and analyse relevant market information, which would improve their ability in terms of better formulation and the execution of farm plans, and acquiring better information to improve their marketing performance. The study recommends that there is a need for designing appropriate intervention mechanisms on the key determinants of commercialisation to improve the performance of horticultural crop commercialisation.

Using Heckman two-stage approach, Din *et al.* (2017) analysed the determinants of commercialisation and its impact on the welfare of smallholder rice farmers in Malakand, Pakistan. The study findings showed that the gender of the respondent, age of the respondent, number of family members, vocational training, and farm size were the major determinants of market participation. Their findings were consistent with Mwema and Crewett (2019), who used the double hurdle approach and found that the farm size and household size have a positive influence on the extent of commercialisation. Furthermore, the results indicated that off-farm income, access to credit, and on-farm income were important factors significantly influencing the welfare of the household. The authors recommended that market participation could be improved through the provision of subsidized prices for farm produce, cold storage facilities, and the introduction of new technologies. Although the authors appreciate the findings obtained, the study was too broader in the scope in the sense that it mainly focused on the overall effect of commercialisation on the general welfare of the household. Therefore, this study overcame these limitations by analysing the effect of the commercialisation of the selected vegetable crops on household income.

In summary, a better understanding of the various factors influencing the commercialisation of agriculture is one of the key strategies to unmask the hurdles in commercialisation of vegetable crops. Evidence from various studies (Din *et al.*, 2017; Dube & Guveya, 2016; Olanrewaju *et al.*, 2016; Hailua *et al.*, 2015; Muriithi, 2015; Tufa *et al.*, 2014) has identified major determinants of commercialisation and linked them to socioeconomic and institutional factors. These determinants include the age of the household respondent, gender, level of education, household size, group membership, farm size, market distance, livestock ownership and access to irrigation. Although various factors were identified as the main impediments to commercialisation, their influence on smallholder farmer's level of participation in the output market might not be equally the same across different settings.

2.3 Contribution of vegetable crops to household income

Agricultural commercialisation among smallholder households in developing countries has had a considerable contribution to household income, food security and poverty reduction as evidenced by diverse studies. Various scholars emphasized the use of gross margin as a suitable approach for analysing studies that embark on contribution.

Nyaruwata (2019) used gross margin and ratio analysis to study the contribution of selected indigenous vegetables to household income and food availability in the Wedza district in Zimbabwe. The results showed that selected indigenous vegetables (pumpkin leaves, spider

plants, and cowpea leaves) contribute 3% of the total household income. Furthermore, the findings revealed that cowpea leaves had the highest margin as well as the highest return per dollars spent. This is because of the growth habit of cowpea of its intensive lateral growth when frequently harvested which results in higher yield thus more income potentials. The author, therefore, recommends that the formation of well-structured formal institutions should be encouraged to promote the spirit of entrepreneurship among indigenous vegetable producers. The author emphasizes that through this approach households should be organized into groups that will enable them to view farming of indigenous vegetables as a business to improve their profit and provide employment.

In a separate study conducted in Kiambu, Kenya, Mwaura *et al*. (2013) adopted gross margin analysis to evaluate the contribution of African Leafy Vegetables (ALVs) to household wellbeing. The results of the study have shown that the average share of income from ALVs to the total income was 0.3629 with a standard deviation of 0.3307. The study pointed out that ALVs contributes to about 36.29% of the total crop income. The findings were consistent with those of Ojiewo *et al*. (2010), which affirmed that the production of vegetables is vital for the improvement of household welfare. In the study area, ALVs were noted as indispensable contributors to household income. Some important factors which include the education level of the household respondent, size of the land available for farming, technical support and distance to the source of water were reported as the key factors influencing the gross margin of ALVs. The authors suggested that the female-headed farmers together with youth should be empowered through capacity building programmes and provision of technical support as well as establishing a transparent land tenure system to improve their livelihood.

Using a sample size of 120 households, Mwema *et al*. (2012) analysed the contribution of selected indigenous fruits on household income and food security in Mwingi, Kenya. The results of the Logit model indicated that household size, education, and income were the significant variables influencing household decision to consume indigenous fruits. The gross margin analysis of the contribution of indigenous fruits to household income showed that of the total household income, indigenous fruits contribute higher values compare to crop enterprise. The higher contribution of indigenous fruits was noted from the low-income earners as compared to higher-income earners. The finding of this study was later reinstated by Osmani *et al*. (2014) by revealing that commercialisation of agriculture among smallholder farmers play a significant role by contributing to gross domestic product and economic

development. The latter emphasized government intervention through the provision of input subsidies and credit facilities to promote market participation among smallholder farmers.

Another study by Shimbe (2008) on the contribution of urban agriculture to household poverty reduction, in the Morogoro Municipality in Tanzania evaluated the contribution of urban agriculture to household poverty alleviation. By using a sample of a hundred (100) selected households coupled with the use of gross margin, Gini coefficient, and coefficient of variation, the results obtained from gross margin analysis showed that rice has the highest gross margin compared to vegetables. The study recommended that integration and legitimisation of urban agriculture into the urban economy could become a vital part of the urban economy. However, the study was carried out in the context of the urban setting, and would be convenient to evaluate the contribution of specific vegetable crop to the household income in peri-urban areas to observe significances in different context.

In summary, the estimation of the contribution of vegetable crops to the household income is an alternative way to augment the income for smallholder farmers through promoting the commercialisation of vegetables. Many studies (Mwaura *et al*., 2013; Nyaruwata, 2019; Shimbe, 2008) have shown that there is a positive contribution of agriculture as a whole to household income, food security and poverty reduction.

2.4 Effect of commercialisation of vegetable crops on household income

In the past, the effect of commercialisation on household income has not been observed among land-constrained farmers. However, recent studies have shown that commercialisation has a very significant and positive impact on household income (Adepoju, 2018), as farmers tend to sell their farm surpluses to increase their income.

According to Zhou *et al*. (2013), commercialisation of smallholder agriculture provides both positive and negative impact to the household's welfare. It is reported that at household level, agricultural commercialisation contributes to increase productivity and income through market participation. Although other scholars argued that agriculture commercialisation has negative impact on household nutrition, the positive impacts of commercialisation cannot be overweight by the negative ones since farmers can still have the purchasing power to buy other essential food items from additional income earned.

Using Endogenous Switching Regression Model (ESR), Hichaambwa *et al*. (2015) analysed the welfare effects of smallholder farmer and factors influencing smallholder's participation in horticultural markets in Zambia. The findings showed that there is a significant net positive change in income as a result of participation in the horticultural market. The results

further indicate that there is a higher percentage increase in the income among horticultural sellers because of engagement in horticultural markets. By the same token, using Endogenous Switching Regression and Propensity Scoring Matching model, Krause *et al*. (2019) also found that per capita household income and food security of a household is positively influenced by the commercialisation of vegetables. The authors suggested that participation in the horticultural market could provide incentives for socially marginalised and land-constrained farmers to overcome the barriers to income generation thus improving livelihood.

Opondo and Owuor (2018) in their study conducted in Kilifi County, Kenya proposed the use of an endogenous switching regression model to analyse the effect of cassava commercialisation on household income in Arid and Semi-arid Lands (ASALs). By using the endogenous switching regression model, the study findings showed that farmers who undertook commercialisation have higher income relative to their counterparts (those who did not commercialise). Their findings further revealed that farm households who commercialised tend to benefit above the normal expectation, that is if they commercialise or not but they are well off commercialising than not commercialising. This finding also corroborates with the results of Olwande and Smale (2014), which revealed that market participation has a significant effect on household income. The authors recommended that commercialisation could be improved by upgrading rural road networks to reduce transportation costs. This promotes a good balance of off-farm activities and cassava commercialisation.

One of the most likely pathways towards improving the livelihoods of farm households especially in developing countries is to incorporate farmers' activities into markets. Chege *et al*. (2015) studied the impact of export horticulture farming on the per capita calorie intake of a smallholder farmer in the Eastern and Central regions in Kenya. The results generated from the analysis using the propensity score-matching model revealed that the export of horticultural commodities has a significant impact on food security. It was noted that participation in the export of horticultural crops has a positive impact on food security in the high potential areas and a negative impact in arid areas where food deficit is observed. The study further emphasizes advocacy that aimed to disentangle regional differences, particularly growing and marketing conditions plus income distribution patterns within the household to boost the export of horticultural commodities. The findings of the study concurred with Kuhlgatz and Abdulai (2011) who found that the household welfare was hardly affected at the lower levels of export shares of revenue, but subsequently rose with increasing level of specialisation. The study similarly pointed out that the welfare impacts of export for farmers who decided to participate

in the export market in Ghana were demonstrated by the rise in income as a result of the increasing level of specialisation.

However, the use of the Propensity Score Matching model could be criticised for inefficiency in solving structural differences of unobserved properties of the farmer. Due to the inefficient nature of the model, the outputs generated carries bias estimates. Additionally, the presence of unobserved factors such as individual skills, and ability or motivation could simultaneously influence farmers' decision to undertake both the production and marketing of a given crop for improved household incomes. In such conditions, the propensity score-matching model may not capture this limitation and hence continue to produce bias estimates. Therefore, the study preferred the use of an endogenous switching regression model to overcome the shortcomings that exist in the propensity score-matching model.

Analogously by using an endogenous switching regression model, Kimty (2016) analysed the effect of market participation on farm household food security in Cambodia and found that farm households enjoy higher household dietary diversity scores when they participate in the output market. The findings confirm that market participation among smallholders contributes positively to household food security. Furthermore, the finding showed that the average farm households who decided to participate in the output market could make significant gains of approximately 0.20 of household dietary diversity score (HDDS) per household member. By adopting a similar approach, Mwende (2016) also reveal that agricultural commercialisation significantly reduces food insecurity and poverty among commercialised households. In conclusion, the authors suggested that special policy attention should be paid to irrigation infrastructure development, education in particular agricultural field training programs that can improve farming productivity and facilitate market participation. The authors further recommended community development policies should be developed to offset market failures.

Similarly, in analysing the welfare effect of market participation on smallholder farm household in Guinea, Camara (2017) use endogenous switching regression model (ESR). The results from the study showed that agricultural commercialisation significantly increases the income and welfare of smallholder farmers as well as poverty reduction. The findings further revealed that participation in the cereals market increases the income of households by 74%. The results of this study are also consistent with the findings of Muriithi and Matz (2015) who also found that participation in the domestic market enhances both household income and ownership of assets. The authors suggested that the development of access to the market by

smallholder farmer households is crucial for decision-makers and policymakers who seek evidence-based strategies that can get millions of Guineans out of poverty.

Muriithi and Matz (2014) sought to use ordinary least square regression to investigate the welfare effects of vegetable commercialisation from smallholder producers in Kenya. The result of their study revealed that the commercialisation of vegetables contributes positively to welfare improvement among smallholder farmers. The authors further reported that per Adult Equivalent (AE) income for a household commercialising through the export market increases by 0.5% for every 1% point increase in income generated from export vegetables out of total household income. In general, the study concluded that the commercialisation of vegetables has mixed effects on household welfare, this is because production for the export market is associated with higher income thus the ability of commercialisation to alleviate poverty appears limited due to the mixed evidence for an association with asset holdings. The conclusion of this study contradicts the findings of Hichaambwa *et al*. (2015), which showed that the commercialisation of horticultural crops improves household income. Therefore, the study aimed to evaluate the effects of the commercialisation of horticultural crops on farm household income to ascertain this controversy in the literature.

In summary, the use of the Endogenous Switching Regression model has been recognized by several authors (Camara, 2017; Hichaambwa *et al*. 2015; Kimty, 2016; Mwende, 2016; Opondo & Owuor, 2018) for the studies focusing on the effect of commercialisation. They found that the ESR model is sufficient to produce adequate results by addressing self-selection biases in the study. However, some authors (Chege *et al*., 2015; Krause *et al*., 2019) suggested that such studies could also be analysed using the Propensity Score Matching model. Many authors in the literature have emphasized on the use of Endogenous Switching Regression model and so it is more relevant and appropriate for this study.

2.5 Research Gaps in Literature

Generally, most of the previous studies focused primarily on the factors influencing the commercialisation of agriculture from a broader perspective with minimal attention towards vegetable crops. The reviewed studies have linked the low level of income among smallholder farmers to the lack of adequate participation in the output market. However, information on the factors influencing the level of commercialisation among smallholder vegetables producers is scanty. Additionally, most of the studies were conducted in developing countries. None of those studies provided empirical evidence on the commercialisation of vegetable crops and their effect on the income of farm households particularly in South Sudan. Moreover, the

existing literature dwells so much on the broader contribution of agriculture to household income and fail to evaluate the significant contribution of specific vegetable crop. On this account, it is crucial to identify the factors influencing commercialisation among smallholders and to uncover the causal relationship that exists between the commercialisation of vegetable crops and the household income. In summary, the reviewed literatures emphasized on the crucial role of commercialisation to the economic development for emerging and developing economies. The literature presents range of benefits associated to agricultural commercialisation, which include increased per capita income, enhanced food security and improved economic welfare of the farming households. Therefore, this study presents the basis for understanding the potential of commercialisation among smallholder farmers and contributes to the existing literature since the implications of commercialising vegetable crops on farm household income are not fully ascertain in the context of South Sudan.

2.6 Theoretical framework

Utility Maximization Theory

This study was underpinned by the theory of utility maximisation developed by Von Neumann and Morgenstern in the year 1944. The utility maximisation theory is a standard economic theory that elucidates the rational choice in decision-making. The theory postulates that the utility function measures the degree to which goals of individual persons are achieved as a result of their decision-making. Based on this theory, the preference and choice over the alternative decision in the commercialisation of vegetable crops can be observed as an issue of binary option. A farm household that chooses to maximise utility or net returns from the farming activities is faced by the pair-dominant choice of either to make a shift from subsistence farming to commercialise farming or continue as a subsistence producer. The utility derived from commercialisation is determined by Z, which denotes a vector of variables influencing farmer's ability to adjust from one enterprise to the new enterprise while considering the adjustment costs (Hichaambwa *et al*., 2015). For instance, in the context of South Sudan, the requirements to adjust from one vegetable enterprise to the other under normal conditions involve risk management practices, which on the other hand become costly for smallholder farmers.

Some of the variables accommodated in Z also determine the relative returns that a smallholder farmer could earn from the sales of vegetable crops and other on-farm undertakings. For that reason, the likelihood that a smallholder farmer participates in the commercialisation of vegetable crops is determined by the expected utility of participating in

commercialised farming, against the expected utility of not participating in commercialised farming U_h^*, against the expected utility of not participating in commercialised farming U_n^*. In this situation, a smallholder farmer would decide to evaluate both the costs and benefits associated with commercialisation and will only choose to participate if $U_h^* > U_n^*$. However, U_h^* and U_n^* are represented as latent variables that cannot be easily observed, so what is explicitly observed is the actual participation of a farmer in the commercialisation of horticultural crops U, with $U = 1$ if $U_h^* > U_n^*$ and $U = 0$ if $U_h^* \leq U_n^*$. Therefore, the preference and choice over alternatives for participation in the commercialisation of vegetable crops can be represented in the equation below as:

$$U = \alpha Z + \mu \tag{2.1}$$

where α denotes a vector of parameters determining the preferences and choices over alternative decisions in commercialisation, Z is a vector of explanatory variables influencing farmer's decision to participate in market-oriented farming, and μ is an error term with the zero mean and variance δ^2.

Albeit smallholder farmers are heterogeneous, as a result, the decision to participate in the commercialisation of vegetable crops varies subsequently across different farmers. For instance, farm households who choose to engage in commercialising production are expected to earn higher income from the sale of farm produce, hence contributing to household income. The household income is determined based on socio-economic factors, institutional factors, and farm characteristics believed to influence the commercialisation of vegetable crops. Hence, the production and marketing of vegetable crops may influence the income of smallholder farmers. Therefore, based on this theory, the smallholder farmer will decide whether to commercialise or not based on the utility derived from commercialisation.

2.7 Conceptual framework

The conceptual framework shows the inter-relationship within the key variables of the study. In this study, the commercialisation of vegetable crops was directly determined by considering socioeconomic factors of the respondent such as age, gender, and household size, level of education, on-farm and off-farm income. The institutional factors such as access to credit, access to extension services, distance to market, access to market information, access to irrigation facilities, and group membership. In addition, the farm characteristics such as farm size, land ownership, and land acquisition types.

It is believed that socio-economic factors such as age, gender, household size, and farmer level of education have a positive influence on the commercialisation of vegetable crops. For instance, the level of education of smallholder farmers is hypothesised to influence the decision to either commercialise or not. This is because smallholder farmers with a high level of education have acquired adequate knowledge on the benefits associated with commercialisation relatively to those with a low level of education. In other words, those with a higher level of education have easy access to market information on the prevailing market prices and can understand how best to increase their farm productivity to exploit the available market opportunities.

Institutional factors such as access to credit, distance to market, and group membership, on the other hand, are also expected to influence commercialisation among smallholder farmers. For example, access to credit is postulated which would directly affect the level of production. This is because the production of vegetable crops such as tomato is capital intensive, thus, lack of credit will have a significant effect on tomato productivity, which in turn affects the ability to commercialise.

The study further hypothesises that; farm characteristics such as farm size and land ownership also have a direct influence on the commercialisation of vegetable crops among smallholder farmers. For instance, farmers who own more acres of land are more likely to produce large quantities of vegetable crops that can be used for both subsistence and commercial purposes. Farm size can also determine whether the farmer should be practising subsistence farming or market-oriented farming (commercialised farming).

Moreover, the study further assumed that intervening variables such as government policies and climate change factors also have direct influence on the commercialization of the vegetable crops. For instance, climate variability factors such as floods and drought are postulated to have influence on the quantity and quality of crops produced which ultimately influences the amount of vegetables sold thus affects the total revenue. Government policies on farm input subsidies also influences the production of the vegetable crops.

The commercialisation of vegetable crops is conceptualised to have a positive effect on household income. It is assumed that smallholder farmers who participate in the output market will have an increase in their level of income compared to those who do not. Besides, the commercialisation of vegetable crops can also increase farm income thereby resulting in increased in purchasing power of the farming households, and hence improving the welfare of

smallholder farmer. Figure 2 illustrates the inter-relationship between the key variables of the study.

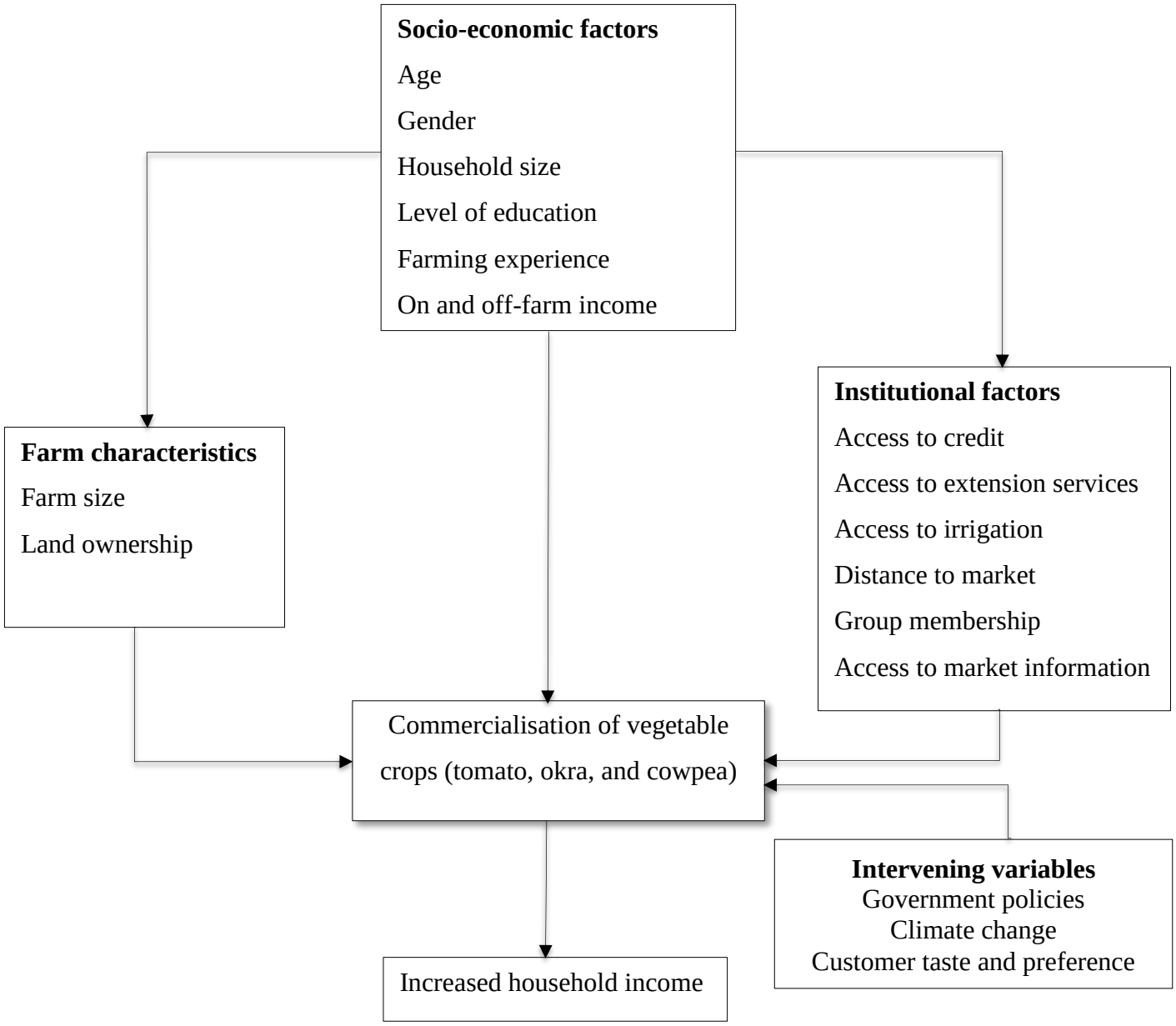

Figure 2: Conceptual framework

CHAPTER THREE
METHODOLOGY

3.1 Study Area

The study was conducted in peri-urban areas of Juba, the capital city of the Republic of South Sudan and the administrative city of Central Equatoria State. Juba is the political, social and economic hub of South Sudan with an estimated population of 392,525 persons (FAO/WFP, 2019). The city is located to the west of White Nile at 31^0 5′ East and 4^0 8′ North. It is one of the busy cities in the country with a variety of business undertakings. Due to its strategic position in the country, it became the most important market for food commodities including vegetable crops such as tomatoes, cabbages and many other crops. The study was centred in three peri-urban areas, which include; Gezira Kondokoro, Gomba Shirkat, and Lologo. These areas were selected from three sub-counties of Gondokoro, Rajaf East and Rajaf West respectively. The selected areas are located at a latitude of 30^0 8′ - 31^0 6′ East, and a longitude of 4^0 7′ - 4^0 9′ North (Figure 2). The study sites were selected purposely because of the potential of agriculture in which vegetable farming is the main livelihood activity for smallholder farming households. Nevertheless, the land is suitable for vegetable production with easy access to the water source. In addition, the farming households in these selected areas are the local suppliers of vegetables to the urban setting.

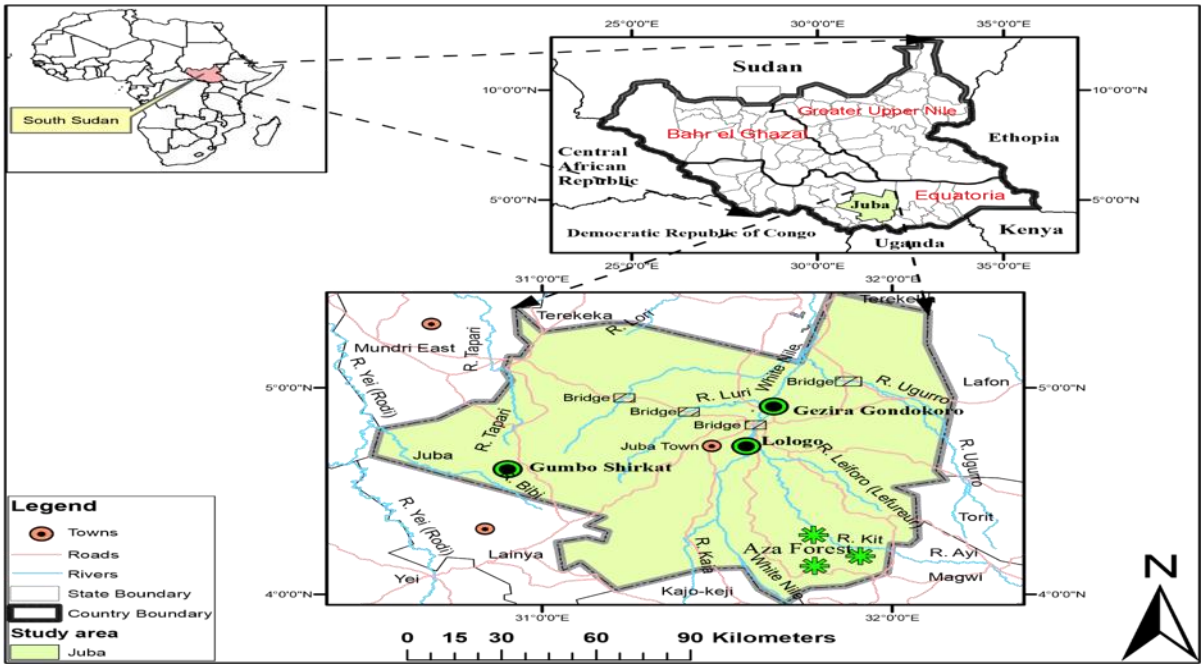

Figure 3: Map of Juba, South Sudan

Source: Dept. of Geography/Egerton

3.2 Research Design

The study was carried out using a cross-sectional research design in which data were collected once at a time. The cross-sectional research design is one of the useful research design that suit this study appropriately because much of the data required were obtained in a relatively short period of time and it also allows for data collection at one point in a time from different respondents.

3.3 Target Population

The target population for this study was the farming households, which include both male and female-headed households residing in Peri-urban areas of Juba (the designated areas of the study). A population of 15,399 farming households (FAO/WFP, 2019) in Juba were targeted for the study, which is represented by the determined sample size. In this study, the unit of the study was smallholder farmer.

3.4 Sampling Procedure and Sample Size Determination

The study adopted a multi-stage sampling procedure. In the first stage, three sub-counties locally known as payams were selected purposively based on the potential of vegetables farming. Secondly, three peri-urban areas one from each of the selected sub-counties was selected based on the suitability of land for vegetable farming and accessibility to water sources such as River Nile.

In the third stage, a randomised sampling technique was applied to select the desired number of respondents and to even and unbiased distribution of the respondents. At this stage, the desired sample size was determined by the sampling technique adopted from Cochran (1963) as per the formula shown in equation (3.1). This approach is widely considered suitable for this kind of study because it guarantees representation of the desired target population. It is one of the cost-effective methods appropriate for acquiring a reasonable amount of data (Anderson *et al*., 2007). The formula shown in equation (3.1) is universally applicable for sample size determination especially when the population of the target individuals is unknown.

$$\mathrm{n} = \frac{\mathrm{pqz}^2}{\mathrm{e}^2} \tag{3.1}$$

where n = minimum sample size, p = proportion of the population containing variables of interest, q is weighting variable computed as $(q = 1 - p)$, z = confidence level at 95% (standard value is 1.96). ε = degree of accuracy desired set at 0.08 (8%). According to Kothari and Garg (2014), an acceptable error of less than 10% is allowed. Therefore, the study used an

acceptable error of 8% to approximate the sample size. Since the proportion of the population is not known with certainty $p = 0.5$, $q = 1 - 0.5 = 0.5$, $z = 1.96$. Substituting the values in equation (3.1) above generates a sample size of 151 respondents

3.5 Data Collection

In this study, a semi-structured questionnaire was developed and used to collect primary data from the respondents.

The data were then collected with the help of five enumerators familiar to the local context. The enumerators were trained on how to use the data collection tool appropriately to minimize the chances of making errors at the time of data collection. The valid questionnaires were administered by the researcher for effective collection of primary data through one-on-one interview with the household head. Since farmers in Juba do not keep farm records, this study relied on the limited information that the farmers could recall from their previous cropping season.

3.6 Validity and reliability test

To ensure content validity, the questionnaires were subjected to pre-test for relevance check and to ascertain whether the questions developed were meaningful, clear and objective-based before embarking on actual data collection. A pre-test interview for 15 respondents, which considers 10% of the total target respondents, was conducted in Luri payam, a different location from the target area of study to test both the validity and reliability of the study instrument. After the pre-test of the questionnaire, ambiguous, irrelevant and hard to answer questions were fine-tuned as per the report from the research assistants. The rationale for carrying out pilot testing is to check for suitability and reliability of the instrument. Moreover, the pre-test was also done for the improvement of questionnaires before starting the actual data collection to include the omitted elements necessary for the study and exclude irrelevant questions to the study.

The comments received were used to improve the content of the research tool. Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials (Fitzner, 2007). The pre-test of the questionnaire revealed consistency in responses received from the 15 sample of the respondents used during the pre-test.

3.7 Analytical Framework

Objective 1: To determine factors influencing commercialisation of vegetable crops

To analyse this objective, the household commercialisation index (HCI) and the Tobit model were used. The household commercialisation index (HCI) is one of the oldest methods used by various researchers but still in use today for determining the level of commercialisation among smallholder farmers. The household commercialisation index (HCI) measures the ratio of the gross value of selected vegetable crops sales by smallholder farmer *i* per season *j* to the gross value of selected vegetable crops output by the same smallholder farmer *i* in the same season *j* expressed as a percentage (%). The HCI index was used to assess the level of commercialisation of vegetable crops among smallholder farmers in Juba, South Sudan.

The household commercialisation index for the vegetable crops under consideration can be computed using the follow formula.

$$\mathrm{HCI}_i = \left(\frac{\text{Gross value of vegetable crops sales per season}_\mathrm{j}}{\text{Gross value of selected vegetable crops output per season}_\mathrm{j}}\right) \times 100$$

The crop-specific commercialisation index was calculated for tomato, okra, and cowpeas respectively in this study. The household commercialisation index for a specific crop was computed purposely to help in determining the specific crop that has a major contribution to the commercialisation of vegetables among the three selected crops in the study area. The HCI for specific crop produced and sold was calculated using the formula given below:

$$\mathrm{HCI}_{Tomato} = \left(\frac{\text{Gross value of tomato sales per season}}{\text{Gross value of total tomato output per season}}\right) \times 100$$

$$\mathrm{HCI}_{Okra} = \left(\frac{\text{Gross value of okra sales per season}}{\text{Gross value of total okra output per season}}\right) \times 100$$

$$\mathrm{HCI}_{Cowpeas} = \left(\frac{\text{Gross value of cowpeas sales per season}}{\text{Gross value of total cowpeas output per season}}\right) \times 100$$

Subsequently, the result obtained in calculating the household commercialisation index (HCI) for the total vegetable crops was later summed and divided by the total number of household respondents to obtain the mean household commercialisation index. The mean household commercialisation index computed was then considered as a measure to show whether a farmer is commercialising or not (this means that those households with HCI above

the mean are considered commercialising, and those households with HCI below the mean are considered non-commercialising).

Although some scholars extensively criticised the use of HCI as being insufficient to determine whether a farmer is commercialising or not, its use is still appropriate for emerging economies. This is because in the context of developing countries, a smallholder farmer does not engage fully in the output market. The Tobit regression model was then run in the STATA computer program to determine factors influencing the commercialisation of selected vegetable crops. The Tobit model was chosen over the binary Logit model because its estimation assumes that both the decision to commercialise and the intensity of commercialisation are jointly determined with the same variables. Although the ordinary least squares (OLS) model may also be applicable for the analysis, the study has adopted the Tobit regression model because OLS regressions yield bias estimates of the parameters. The model can be specified as:

$$y_i^* = \beta_0 + \beta_i X_i + \varepsilon_i \quad (3.2)$$

where y_i^* is the ratio of selected vegetable crops sales to output produced for i^{th} farmer (HCI), β is a vector of parameter to be estimated, X is a set of explanatory variables assumed to determine commercialisation of vegetable crops, and ε_i is the error term.

$\varepsilon_i \approx N(0, \sigma^2)$, y_i^* denotes a latent variable which is only observed for the values greater than zero and censored otherwise. The observed y is defined by the following equation.

$$y_i = 0 \text{ if } y_i^* = \beta_0 + \beta_i X_i + \varepsilon_i \leq 0 \quad (3.3)$$

$$y_i = \beta_i X_i + \varepsilon_i \text{ if } y_i^* = \beta_0 + \beta_i X_i + \varepsilon_i > 0 \quad (3.4)$$

A zero value of y_i^* is observed when a smallholder farmer has no surplus to sell but has access demand of the commodities. While $y_i^* = 100$ if household sell all outputs.

Objective 2: To estimate the contribution of vegetable crops to household income

In this study, the contribution of vegetable crops to total household income was estimated using a gross margin analysis adopted from previous studies. The gross margin analysis is restricted to calculate the difference between total revenues and total variable costs in vegetable crops enterprises for the previous planting season. The gross revenue was calculated as a total sum of quantity of vegetable crops produced by the smallholder farmer per planting season multiplied by the prevailing market price. In some cases, the farmer reported that the quantity of crop produced is not sold (consumed), in such a case, the value of the crop yield was estimated by multiplying the quantity of crops yield by the market price at that particular production season. The total variable costs, which include the cost of inputs, labour

costs and costs of transport, was obtained directly from the respondents during the field survey. The labour costs which represents hired labour and family labour was obtained by factoring in the cost of hiring casual workers and cost of providing meal to the family members. The family labour cost was obtained as an estimate of the amount of money spend on providing food and water to the family members during cropping season.

The use of gross margin (GM) can be criticised for ignoring the fixed costs within or among farming enterprises. However, the gross margin analysis remains useful where the value of fixed costs is considered negligible especially in agricultural enterprises, which operates mostly at a small-scale level (Arene & Mbata, 2008). It is assumed that fixed costs such as land, equipment, and machinery are not treated as inputs since they are used not only for vegetable crops enterprise but also rather for other farm enterprises available. The gross margin for the three selected crops was computed using the following formula:

$$GM_i = TR_i - TVC_i \quad (3.15)$$

where GM_i is the gross margin of the selected vegetable crops of the i^{th} household per cropping season.

$TR_i = Q \times P$ where TR_i is the total revenue earned from the selected vegetable crops of the i^{th} household per cropping season, Q is the quantity of vegetables harvested per cropping season, and P is the prevailing market price.

TVC_i is the total variable costs incurred in vegetable enterprise for the selected vegetables of the i^{th} household per cropping season. This includes costs for purchasing inputs (seeds, fertilizers, pesticides, and packaging materials), transport and labour (land preparation, planting, weeding, pesticide application, harvesting, packaging).

TVC_i = Seeds + Fertilizers + Pesticides + Packaging materials + Labour + Transport

To assess contribution of each crop to household income, the percentage of contribution for specific crop was computed as shown by the formula below:

$$\frac{GM_{Tomato}}{\text{Household income}} \times 100 \quad (3.16)$$

$$\frac{GM_{Okra}}{\text{Household income}} \times 100 \quad (3.17)$$

$$\frac{GM_{Cowpeas}}{\text{Household income}} \times 100 \quad (3.18)$$

where GM_{Tomato}, GM_{Okra}, and $GM_{Cowpeas}$ are gross margins of tomato, okra, and cowpeas, respectively. Household income represents an income earned from both on-farm and off-farm activities captured in South Sudanese Pounds (SSP).

The results obtained from the calculation of each crop were therefore used to determine the type of crop that has higher contribution to the household income. Besides, the results obtained has provided the basis for making accurate inference on the type of crop that a farmer should invest on more to maximise the returns.

To evaluate the significant contribution of each crop to the household income, a Z-test and the F-test statistical analysis was carried out. The Z-test involves comparison of the values of Z-computed and Z-critical to either reject or fail to reject the null hypothesis. On the other hand, the value obtained from F-test was compared with the P-value to either reject or fail to reject the null hypothesis.

Objective 3: To determine the effect of commercialisation of vegetable crops on household income

To evaluate the effect of commercialisation on household income, the researcher adopted the endogenous switching regression model, which is more relevant to this research. In this study, the average household income per annum was considered for use to represent a measure for an income earned by the farm household. The endogenous switching regression model is an economic framework that specifies a decision process and regression model associated with each decision option. In most empirical studies (Alene & Manyong, 2007), the use of endogenous switching regression has been extensively appraised for its ability to solve self-selection biases that resulted from voluntary self-selection of the respondent for the study. The model assumes that farmers' decision on commercialisation of vegetable crops is endogenous to household income and therefore, certain unobserved characteristics may influence the decision on whether to commercialise or not.

The study adopted the endogenous switching regression model as used previously by Opondo and Owuor, (2018) in their study on the effect of cassava commercialisation on household income over the Propensity Score Matching (PSM) model. This is because, in the PSM model, the unobservable factors such as individual skills that can influence simultaneously farmers' production and commercialisation as well as the household income are ignored (Camara, 2017; Khonje *et al*., 2015).

Therefore, the endogenous switching regression model is chosen over propensity score matching because it accounts for the association between the unobserved characteristics of

those who are commercialising and their household income. The endogenous switching regression model is supported by the Full Information Maximum Likelihood estimation (FIML), which is very useful in correcting the selection bias within the estimates of household income.

Based on this model, a binary decision choice for smallholder farmer's commercialisation decision conditional on observed characteristics can be analysed using the Probit model as shown below:

$$\mathrm{P_i^*} = \beta X_i + \varepsilon_i \tag{3.5}$$

$$\mathrm{P}_i = 1 \text{ if } \mathrm{P}_i^* > 0 \text{ (commercialise)}$$

$$\mathrm{P}_i = 0 \text{ if } \mathrm{P}_i^* \leq 0 \text{ (do not commercialise)}$$

where P_i^* represents the unobservable or latent variable for commercialisation, P_i is its observable counterpart which indicates whether a farmer will involve in horticultural crops commercialisation or not. X represents the vector of observed characteristics that affects commercialisation, i represent vegetable farming households, and ε_i denotes the error term. The predicted probability obtained for the Probit equation (3.5) will be used in the second stage to obtain estimates of commercialisation.

Therefore, in the endogenous switching regression model, commercialisation is analysed in two regimes. The model can be presented as follows:

$$\text{Regime 1: } y_{1i} = \beta_1 Z_{1i} + \mu_{1i} \text{ if } \mathrm{D}_i = 1 \text{ for commercialisation} \tag{3.6}$$

$$\text{Regime 2: } y_{2i} = \beta_2 Z_{2i} + \mu_{2i} \text{ if } \mathrm{D}_i = 0 \text{ for non-commercialisation} \tag{3.7}$$

$$\mathrm{D}_i = \begin{cases} 1, if\ \beta X_i + \varepsilon_i > 0 \\ 0, if \beta X_i + \varepsilon_i \leq 0 \end{cases} \tag{3.8}$$

where Z_{1i} and Z_{2i} are vectors of exogenous variables, β_1 and β_2 are vectors parameters, μ_{1i}, μ_{2i}, ε_i are random disturbance terms having a normal distribution with mean vector zero and covariant matrix:

$$\Omega = \begin{bmatrix} \sigma_\varepsilon^2 & \sigma_{1\varepsilon} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_1^2 & . \\ \sigma_{2\varepsilon} & . & \sigma_2^2 \end{bmatrix} \tag{3.9}$$

where σ_ε^2 stand for the variance of the error term in the selection equation, σ_1^2 and σ_2^2 are variances of the error term in the continuous equations. $\sigma_{1\varepsilon}$ is the covariance of ε_i and μ_{1i} ; $\sigma_{2\varepsilon}$ is the covariance of ε_i and μ_{2i} . The covariance between μ_{1i} and μ_{2i} is not determined, as y_{1i} and y_{2i} are not observed simultaneously. Where σ_ε^2 is assumed to be equal to 1.

The model mentioned above is estimated using the Full Information Maximum Likelihood (FIML). According to Lokshin and Sajaia, (2004), the FIML approach can fit binary and continuous parts of the model to yield consistent standard errors. The conditional expectations is computed based on the estimation of the model's parameters as follows:

$$\mathrm{E}(y_{1i}|\mathrm{D}_i = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_1\rho_1 f(\alpha Z_i)/F(\alpha Z_i) \quad (3.10)$$

$$\mathrm{E}(y_{1i}|\mathrm{D}_i = 0, x_{1i}) = x_{1i}\beta_1 - \sigma_1\rho_1 f(\alpha Z_i)/\{1 - F(\alpha Z_i)\} \quad (3.11)$$

$$\mathrm{E}(y_{2i}|\mathrm{D}_i = 1, x_{2i}) = x_{2i}\beta_2 + \sigma_2\rho_2 f(\alpha Z_i)/F(\alpha Z_i) \quad (3.12)$$

$$\mathrm{E}(y_{2i}|\mathrm{D}_i = 0, x_{2i}) = x_{2i}\beta_2 - \sigma_2\rho_2 f(\alpha Z_i)/\{1 - F(\alpha Z_i)\} \quad (3.13)$$

where ρ_1 is the correlation coefficients between ε_i and μ_{1i} ; and ρ_2 is the correlation coefficient between ε_i and μ_{2i}. The average treatment effect of the treated (ATT) is the average difference in outcomes of those who are commercialising and those who are not, which will be estimated using computed conditional expectations. This can be shown in the equation below:

$$\mathrm{ATT} = \mathrm{E}(y_{1i}|D_i = 1, x_{1i}) - \mathrm{E}(y_{1i}|D_i = 0, x_{1i}) \quad (3.14)$$

The variables presented in Table 3.1 were chosen based on the related literature reviewed (Din *et al.*, 2017; Dube & Guveya, 2016; Hailua *et al.*, 2015; Muriithi, 2015; Olanrewaju *et al*., 2016; Tufa *et al.*, 2014). In addition, Table 3.1 also contains variables of interest that were hypothesized to influence the outcome of the study.

Table 3.1: Description of model variables for objective one and three

Variables	Description	Variable type	Unit of measurement	Expected sign
Dependent Var.				
HCI	Household Commercialisation Index	Continuous	Ratio	
Y	Household income	Continuous	South Sudanese Pounds	
Independent Var.				
AGH	Age of household respondent	Continuous	Years	+/-
GND	Gender of household respondent	Dummy	1= male, 0 = otherwise	+/-
HHSZE	Size of household	Continuous	Number of people in the house	+
EDLV	Level of education	Categorical	0=informal, 1=primary, 2=secondary, 3=tertiary	+/-
FRMEXP	Farming experience	Continuous	Years	+/-
GRPMEM	Group membership	Dummy	1=member, 0=otherwise	+
FRMSZE	Farm size	Continuous	Hectare	+
LNDOWN	Land ownership	Dummy	1= own, 0 = otherwise	+
EXTSERV	Access to extension services	Dummy	1= access, 0 =otherwise	+
DISTMKT	Distance to market	Continuous	Kilometres	+/-
CRD	Access to credit	Dummy	1= access, 0 =otherwise	+
ON-INC	Household on-farm income	Continuous	SSP	+
OFF- INC	Household off-farm income	Continuous	SSP	+
MINFO	Access to market information	Dummy	1= access, 0 =otherwise	+/-
ACCIRRG	Access to irrigation facilities	Dummy	1= access, 0 =otherwise	+/-

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Descriptive Statistics Results

4.1.1 Summarized statistics for dummy and categorical variables used in the analysis

Table 4.1 shows the descriptive statistics for dummy and categorical variables hypothesized to have influence on commercialisation of vegetable crops in the study area.

Table 4.1: Descriptive statistics for dummy and categorical variables used in the study

Variable		Percentage (%)
Gender	Male	22.52
	Female	77.48
Access to education	Yes	60.93
	No	39.07
Education level	Informal	39.07
	Primary	37.09
	Secondary	19.87
	University	3.97
Household occupation	Yes	99.34
	No	0.66
Land Ownership	Yes	67.55
	No	32.45
Type of land acquisition	Seasonal contract	2.04
	Rented	65.31
	Others	32.65
Type of crop	Tomato only	0
	Okra only	6.62
	Cowpeas only	9.93
	Tomato and okra	0.66
	Okra and Cowpeas	65.56
	Tomato, Okra and Cowpeas	17.22
Source of seeds	Agrovet Shop	35.76
	NGOs	9.93
	Others	54.30

Access to credit	Yes	60
	No	40
Access to market information	Yes	3.31
	No	96.69
Group membership	Yes	25.83
	No	74.17
Access to irrigation facilities	Yes	54.97
	No	45.03

Based on the results presented in Table 4.1, the major actors in the vegetable enterprise in Juba are women with a proportion of 77.48% of the total respondents interviewed. The gender disparity in this enterprise could partly be associated with the fact that men in Peri-urban areas tend to engage in non-farm activities more than women, hence leaving the major roles of farming to the women.

About 60.93% of the total respondents interviewed reported having access to education. Furthermore, 37.09% of the respondents have a primary level of education, while 39.07% have informal education. This could be attributed to the fact that most of the respondents were displaced persons from the villages where there are no schools. This indicates that the illiteracy level is very high, which reflects that farmers in Juba are not sufficiently endowed with human capital that can boost their understanding of good agricultural practices.

The results further revealed that 99.34% of the total households interviewed reported farming as their main occupation. However, only 32.65% of the interviewed households have access to land ownership (a small proportion of the respondents owned the land for farming). Many farmers 65.31% acquire farming land through renting. The result also showed that 65.56% of vegetable crops grown by smallholder farmers in Juba are okra and cowpeas under mixed cropping. The study further revealed that tomato is the least produced among other vegetables due to its production constraints. Only a few farmers who have acquired a reasonable level of education incorporate tomato in their enterprise with other crops such as okra and cowpeas.

About 54.30% of the total farmers reported that they obtained their seeds from their local markets while a proportion of 35.76% reported that they purchased their seeds from the Agro-vet shops. Only 9.96% of the total interviewed households reported that they receive their seeds from NGOs. The proportion of farmers getting seeds from Agrovet shops compared to

local markets is relatively small. This is because the prices of seeds sold at Agro-vet shops are relatively expensive compared to the local markets. Hence, the majority of the farmers prefer to source their seeds from the local markets regardless of the quality issues.

From the total sample of farmers interviewed, 60% of the farmers reported having successfully acquired credit in form of loan from other sources such as relatives, friends and shop owners nearby. There is a lack of institutional support, whereby banks or micro-finance institutions could offer loans to the farmers to facilitate farming activities (Museli, 2017). Availability of institutional support could render smallholder farmers an opportunity to increase their production capacities to meet market demands.

Similarly, most of the farmers interviewed (96.69%) reported a lack of access to the market information, which includes information on the prices of inputs and outputs. Market information is one of the most important requirements in a farming enterprise. Market intelligence informs farmers about the prevailing market prices and availability of potential buyers, thereby facilitating farmer's decisions on the quantity and quality of crop to produce. The information asymmetry (lack of information) has a negative impact on the income of smallholder farmer. It brings about exploitation to the smallholder farmers through the opportunistic behaviour of the intermediaries. The presence of intermediaries (brokers) in vegetable enterprise reduces the marginal return of the farmer especially those farmers selling their produce at the farm-gate prices. In this case, the smallholder farmers in Juba do not have the opportunity to reap the benefit derives from selling farm produce at a retail prices.

The findings further indicated that 74.17% of farm households interviewed do not belong to any social group. This implies that the knowledge transfer or sharing would not be easy among smallholder farmers, and therefore they might not obtain the benefits associated with being a member of any social or farming group. The group membership in the agricultural sector offers a wide range of benefits that includes the ability to learn new things, access credit facility, and obtain strong bargaining power as well as gaining easy access to extension services. It is evident that formation of farming groups contributes positively to the welfare of a smallholder farmer (Moranga, 2016). The farming groups or cooperatives are widely used by agriculture extension providers and NGOs in form of Farmer's Field School (FFS) to impart the necessary knowledge required enhancing farmer's productivity. The farmer's field school is a participatory approach through which farmers participate practically and theoretically in knowledge transfer. A farmer who is a member of the farming group is likely to acquire new skills and technologies necessary to improve farm productivity.

Over half of the interviewed farmers, 54.97% reported having access to irrigation facilities. This group of farmers obtained their irrigation facilities (watering cans, treadle pumps and motor pumps) from the local markets and developmental organisations dealing with food security projects. The other proportions of farmers 45.03% rely on rainfall for crop production, hence resulting in low or no production during dry seasons.

4.1.2. Summarised statistics for continuous variables used in the analysis

The Table 4.2 presents the descriptive statistics for continuous variables used in the study to determine influence of commercialisation of vegetable crops on smallholder farm households.

Table 4.2 Descriptive statistics for continuous variables used in the analysis

Variable	Mean	Std. Dev.
Age	33.67	10.02
Household size	7.42	2.56
Farming experience	11.96	8.23
On-farm Income	26611.92	41930.84
Off-farm Income	1139.27	5470.46
Farm size	0.80	0.93
Quantity of crop produced	87.90	104.32
Quantity of crop sold	69.70	100.60
Market Price for tomato	651.67	0
Market price for Okra	1362.93	0
Market price for Cowpeas	956.05	0
Distance to the market	5.31	2.92
Total farm revenue	84399.29	135433.70
Total variable cost	6983.44	13521.04
HCI	74.81	18.90
HCI for Tomato	74.92	18.89
HCI for Okra	72.96	19.64
HCI for Cowpeas	74.85	21.51

According to the findings shown in Table 4.2, the average age of the farmer involved in vegetable farming is approximately 34 years old (33.67). This implies that the horticultural subsector is predominantly occupied by youth. Although older farmers are considered more

experienced than the youth, the participation of young farmers in the vegetable enterprise surpass their involvement in output market for vegetable crops. This further indicates that most of the farmers engaged in a vegetable enterprise are youth within the economically productive age bracket with high potential to participate in numerous livelihood activities including farming enterprises (Nyaruwata, 2019). The fact that vegetable farming is a labour-intensive enterprise rendered youth an opportunity to be the major actors in the vegetables enterprise.

The results also indicated that the average household size is approximately seven persons per household (7.42), which implies that family labour is common among smallholder farmers in Juba. In addition, the larger family size tends to rely on the quantity of farm output for subsistence. This is considered as one of the possible reasons why some farmers do not commercialised due to lack of surplus to sell. Although household with bigger size of members is considered well off to implement the labour-intensive enterprise, there is also a likelihood that they would engage in subsistence farming.

Furthermore, the finding revealed that the average number of years experienced in vegetable farming by a farmer in Juba is approximately twelve years (11.96 years). This indicates that most of the farmers in Peri-urban areas of Juba have fairly been practising vegetable farming as their main undertaking since independence in 2011. This could also indicate that most of the farmers are either displaced persons or returnees who settled there before or after independence. It is hypothesised that farming experience is important if the farmers were to improve the degree of commercialisation, as a more experienced farmer is likely to commercialise because of the endowed knowledge and skills (Agwu *et al.*, 2013).

The study also found that the average off-farm and on-farm incomes are 1,139.27 and 26,611.92 South Sudanese Pounds (SSP) respectively. This shows that farmers in the study area earn more income from farming activities compared to off-farm employment. This result is consistent with the finding of Gebreselassie *et al.* (2018) who found that farmers who participated in marketing their farm produce receive a higher income than the non-participants.

Farm size for smallholder farmers in Juba is about one acre (0.80). The results indicate that most of the farmers are small-scale mainly producing for subsistence purpose. These findings support the notion that there is no standardize acreage of land described to characterize whether a farmer is a smallholder or not. The term smallholder is therefore a contextual term, which varies across the countries and regions of the world. Land is one of the crucial factors of production and the most vital resource for crop production (Opondo & Owuor, 2018) that could be a constraining factor for commercialisation.

The average quantities of vegetable crops produced and sold is 87.90 Kilograms and 69.70 Kilograms respectively with the mean household commercialisation index of 74.81% (Table 4.2) implying that the sampled households are commercialising their produce. Moreover, on average the farm revenue is 84,399.29 SSP per cropping season, while the mean total variable cost of production per cropping season is 6,983.44 SSP. The lowest amount of total variable costs can be attributed to the fact that most of the farmers depend extensively on family labour for farm activities. Hence, resulting in a reduction of the total variable cost to a minimum amount as compared to those with smaller household size.

Although some outliers are revealed for the quantity of crop produced and total variable costs, it could be argued that some farmers were badly affected by flood and diseases in the previous cropping season, hence resulting to low or zero yield. On the other hand, farmers whose crops were not affected had more harvests. Similarly, farmers endowed with large family labour were able to minimize the labour costs. From this standpoint, the presence of outlier values in Table 4.2 could be attributed to the corresponding environmental factors and farmer's endowment for family labour.

Market distance and market prices were also important variables in crop commercialisation. The results of the study revealed that the mean distance to the output market is 5.31 kilometres. This implies that the distance to the input-output market is not a major constraint to the farmers in Peri-urban areas of Juba. However, the poor condition of the road with insufficient packaging materials might be the constraining factors for farmers willing to sell their farm produce to the competitive markets. Farmers located far away from the market are less likely to sell their farm produce to the market. Due to longer distance to the market, they are likely to incur more costs. This finding corroborates with Opondo and Owuor (2018) who found that a distance to the market is significantly influencing commercialisation. They argued that farmers living far away from the output market are likely to experience reduction in their marketing activities. This in return drives the local producers to sell their farm produce at farm gate price. Furthermore, the study revealed that the average prevailing market prices for tomato, okra, and cowpeas in the previous year of harvest were 651.67; 1,362.93, and 956.05 South Sudanese Pounds respectively.

The mean household commercialisation index (Mean HCI) among smallholder farmers involved in vegetable enterprise was 74.81. This finding implies that farmer above the computed mean, are highly commercialised while those below the mean are subsistence producers. On the other hand, the statistical results indicated that farmers who participated in

the output market have a bigger share of the farm products sold to earn more income. Additionally, the finding reveals that the specific crop commercialisation index among smallholder farmers was different. The results in Table 4.2 indicate that the mean commercialisation index for tomato was 74.92, Okra was 72.96, and Cowpeas was 74.85. This implies that tomato and cowpea are the mostly commercialized vegetable crops for smallholder farm households who produces these crops in a mix cropping. Although the commercialisation index for tomato is greater than that of cowpea, it could be explained that few farmers who grew tomato in the previous cropping season sold all the quantity produced to the market. Hence, the mean value of the commercialisation index for tomato has increased due to the few number of farmers producing and selling tomato for the high demand.

4.2. Factors influencing commercialisation of vegetable crops

Table 4.3: Parameter estimates of the Tobit model

Variable	Coefficient.	Std. Err.	P-Value
Age	-0.3221	0.1772	0.078*
Gender	-3.1646	2.4784	0.211
Access to education	2.4348	1.9191	0.214
Farming experience	0.6086	0.1713	0.001***
Type of land acquisition			
Rented	-24.9961	7.5444	0.002***
Others (given)	-22.0675	6.7251	0.002***
Quantity of crop produced	-66.7537	6.7778	0.000***
Group membership	-8.4103	3.0536	0.010**
Total variable costs	0.0011	0.0003	0.001***
Total farm revenue	56.3857	5.6637	0.000***
Access to extension services	3.4809	2.8892	0.237
Distance to the market	0.4559	0.3321	0.179
Access to market information	-4.3658	5.2031	0.408
Access to irrigation	7.8217	2.7551	0.008**
Household size	-0.2774	0.3325	0.4110
Number of observations	151		
Log likelihood	-59.5159		
LR Chi^2 (15)	89.06		

Prob > Chi^2	0.0000***

Key: *** = significant at 1%, ** = significant at 5%, * = significant at 10%

The results from Tobit regression model with the mean household commercialisation in Table 4.3 shows that the age of the respondent, farming experience, type of land acquisition, a quantity of crop produced, group membership, total variable costs, total farm revenue and access to irrigation facilities have a significant influence on the commercialisation of vegetable crops. Moreover, The Chi-square test statistic ($Ch^2(15)=89.06$) confirmed that the coefficients of the level of commercialization are significantly different from zero at 1% significance level indicating that the model fulfilled the condition of good fit.

The results obtained from the Tobit regression model in Table 4.3, indicate that age of the respondent is negatively and statistically significant at a 10% significance level. This shows that if the age of the farmer increases by one year, the extent of commercialisation of vegetable crops decreases by 0.3221. This suggests that as the farmer grows old, the energy devoted to farming activities decreases hence the farmer may only produce for subsistence purposes. Furthermore, the decrease in level of commercialisation with an increase in the age of the farmer could be explained that an older farmer with more dependents is faced by the condition of producing mainly for subsistence thus reducing the chances of commercialising. This could also be attributed to the fact that younger farmers regardless of few years' experience in farming tend to play a crucial role in the agricultural value chain. Because of the age advantage, youth involved in the vegetable enterprise are liable to increase their output level, hence producing more for subsistence and surplus to the market. This finding corroborates with Melese *et al.* (2018) who found that the age of the farm household negatively influences the decision of the farmer to commercialise as well as the level of commercialisation among smallholder farmers. Similarly, Olenrewaju *et al.* (2016) found that the age of the farmer is one of the crucial factors that influences commercialisation among smallholder farmers.

The study also revealed that farming experience is positively and statistically significant at a 1% significance level. This implies that an increase in the number of years in farming results to the increase in the level of commercialisation by 0.61 units for a farming household that chooses to commercialise. It could be explained that farmers with more years of farming have acquired more skills such as the marketing skills that could contribute to the increased level of commercialisation than farmers with few years of experience in farming. Moreover, farmers who have spent many years in farming tend to know more about the suitable conditions and timing for farming thus provide them with an opportunity to predict the suitable time for

selling their products when the demand is high. Therefore, the more experience gained in farming influences the amount of farm output that a farmer could produce which in return determines whether a farmer can specialise in subsistence agriculture or commercialised agriculture. This study finding corroborates that of Agwu *et al*. (2013) who found that farmers with more years of experience in farming are likely to engage in the commercialisation of their farm produce due to endowed skills and expertise.

The results also showed that the type of land acquisition is negatively influencing the level of commercialisation at a 1% significance level. The study considered land in the analysis as one of the influential factors of production and the type of land acquisition determines the number of acres a farmer can allocate for farming. This study suggests that if the amount of land acquired through rent and others (sharecropping) decreases by one acre, then eventually the level of commercialisation of vegetable crops will decrease by 24.99 units for those who rent and 22.06 units for those who engaged in sharecropping. The study found that a higher proportion of the farmers 65.31% acquired the land through renting and a few of them 32.65% acquired land from their friends or relatives as given only for farming. This is because most of the farmers in those Peri-urban areas are either internally displaced persons or returnees. Because of the importance of land, most of the farmers tend to rent the land from the host communities for farming purpose although some of the farmers have access to land through an offer by their friends or relatives and few have the land title deeds. The finding concurred with Mbiti *et al.* (2021) who found that the proportion of land allocated for vegetable production significantly influences the commercialisation of vegetables in Kenya.

The findings further revealed that the quantity of crop produced per cropping season is negatively and statistically significant at a 1% significance level. This implies that the decision to participate in the output market (commercialisation) depends on the quantities of crops that a farmer could produce. For instance, if the quantity of crop produced (the output quantity) per cropping season decreases by one unit (Kg) the level of commercialisation of the crop under consideration decreases by 0.66.75 units. This implies that the lower the output of the selected crops per cropping season, the lower the likelihood that a farmer will not commercialised. This finding is in line with previous studies of Melese *et al.* (2018) who found that an increase in onion, tomato and mango productions increases the probability of farmers engaging in commercialisation.

Additionally, the study indicates that group membership is negatively and statistically significant at 5% significance level. The group membership, referred to the affiliation of the

farmer to any type of agricultural group, is a key variable influencing commercialisation. A possible explanation could be that group membership increases the opportunity for accessing the information on market-related issues thus minimising the transaction costs. The finding concurred with the results of Olenrewaju *et al*. (2016) who found that group members have a significant influence on farmer's decision to commercialise. However, the findings disagree with the results of Muriithi (2015) who found that being a member of a farmer group positively influences the commercialisation among smallholder farmers. Although other studies reported that group membership is positively influencing commercialisation, the finding of this study explained that lack of farmer's participation in farming groups in the study area negatively influences the level of commercialisation among smallholder farmers. This relationship could be further explained that if the farmer is not a member of any social group, then the probability to engage in the output market decreases by 8.41 units. This implies that a farming household that has not joined any type of agricultural group have less chances of acquiring new skills from the group members, hence limiting opportunities to engage in commercialised farming.

The total cost incurred by the farmer in the vegetable enterprise, which includes the cost of inputs, labour and transportation were hypothesized to influence the level of commercialisation. The study revealed that the total variable cost influences the level of commercialisation among smallholder farmers positively and significantly at a 1% significance level. This implies that if the farm total variable cost of production increases by one SSP, the level of commercialisation increases by 0.0011 units. This could possibly be explained that the market-oriented farmer will opt to sell farm produce to recover the cost of production and to earn profit. However, Hailua *et al.* (2015) results contradict this finding where the cost of farm inputs was negatively influencing vegetable commercialisation among smallholder farmers. This contradiction in the study could be imputed to the variation in the type of farm inputs and the number of inputs used across individual farmers. For example, the majority of farmers in Juba have reported that the used of family labour to implement farm activities, and they source their seeds from the local market at reasonable prices. Moreover, in most cases, farmers in Juba do not use fertilizers and pesticides that can account for reduction in total variable cost among smallholder farmers.

Regarding total farm revenue, the study findings revealed that the total farm revenue is positively influencing the level of commercialisation at a 1% significance level. For instance, the result indicates an increase in total farm revenue by one South Sudanese Pound, increases the level of commercialisation of vegetable crops among farm households by 56.39 units for

those who chooses to commercialise. This implies that the more the income (revenue) the farmer earns from the sales of farm output, the higher the chances of engaging in commercialised vegetable farming. The finding is consistent with Osmani and Hossain (2015) who found that on-farm income is positively and significantly influencing farmer's decision to commercialise. The authors argued that households with higher level of farm production tend to participate in the output market because of higher value of crops produced and sold.

The other outcome that emerged from the analysis is the farmer's access to irrigation facilities, which determines the possibilities for a farmer to produce during the off-season. The results of the study revealed that, access to irrigation facilities is positively significant at a 5% significance level. This indicates that farmers with access to irrigation facilities can produce during the dry season and hence tends to benefit from the higher prices offered when there is a shortage of supply in the market. This implies that if the chance of accessing irrigation facilities increases by one unit, the likelihood of the farmer commercialising increases by 7.82 units. Lack of farmer access to irrigation facilities is notably the main impediment for smallholder farmers in Juba to continue farming during the off-season. The finding corroborates with the findings of Tufa *et al*. (2014) who found that access to irrigation facilities is significantly influencing the decision of smallholder farmers in Ethiopia to take part in the commercialisation of horticultural crops. The authors asserted that the smallholder farmers with access to irrigation facilities have more opportunities to supply higher quantities of horticultural products. Moreover, the authors argued that access to irrigation provides incentives for smallholder farmers to improve their cropping intensity and economies of scale. It is evident that lack of access to irrigation facilities has negative impact on commercialisation, since farmers cannot produce during dry season.

In summary, it is observed that commercialisation of vegetable crops among smallholder farm households is influenced by a myriad challenges which include socioeconomic characteristics of the farm household and institutional factors.

4.3. Contribution of vegetable crops to household income

Production and marketing of vegetables contribute a considerable percentage to the total household income among land-constrained farmers. The statistical results showed that the selected vegetable crops contribute significantly to household income with an average share of 33.33% (Figure 3). The positive contribution of vegetables to household income has motivated smallholder farmers to embrace vegetable enterprise as their main livelihood activity.

Furthermore, Figure 3 illustrates the percentage contribution of each vegetable crop to the total household income in the study area.

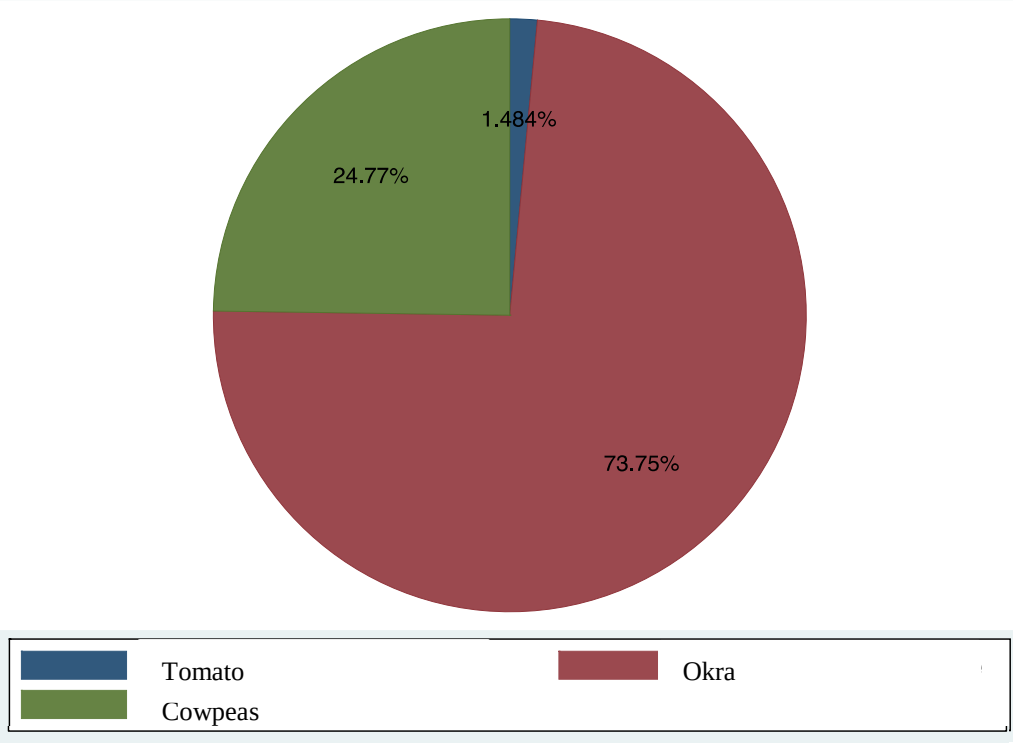

Figure 4: The percentage contribution of vegetable crops to household income

The results shown in Figure 3 indicate that okra is the major crop that contributes a higher percentage to the household income (73.75%). The finding showed that farmers in Juba mainly produce okra compared to cowpeas and tomato due to the higher demand for okra and simplest way of cultivation. The fact that the potential yield of okra is very high with higher market demand, incentivised farmers in Juba to produce more. Additionally, the agronomic practices for okra do not require more labour. Moreover, the higher demand for okra has contributed to the increase in it prices, hence increasing the income of smallholder household. Furthermore, the results obtained from the average gross margin revealed that okra is the leading crop with a higher share of 56,115.62 South Sudanese Pounds (SSP) to the household income in the previous cropping season compared to cowpeas and tomato. The finding concurred with the finding of Dembele *et al.* (2018) who reported that okra contributed higher to the household income among women-led vegetable enterprises in Mali.

On the other hand, the finding showed that cowpeas also contributed to the total household income with a proportion of 24.77%. However, the lower percentage share of cowpeas could be attributed to the fact that most of the farm households produce cowpeas mainly for home consumption with only inadequate surplus sold to the market. The finding

also shows that tomato has the least share to the household income with the proportion of 1.484%. The results of the gross margin analysis also revealed that the average gross margin for cowpeas was 1,535.01 South Sudanese Pounds per cropping season. Overall, the results indicated that okra has the highest proportion share to the total household income followed by cowpeas as shown in Table 4.4.

Table 4.4: The results of Gross Margin (GM) for the selected vegetable crops in SSP

Type of crop	Mean	Std. Dev.
Tomato	592.5786	4578.392
Okra	56115.62	121666.8
Cowpeas	15353.01	15254.72

The results of the Z-Statistical test presented in Table 4.5 indicate that all the three selected vegetable crops in the study area positively and significantly contributes to the total household income. However, the specific share of each crop to the total household income differs across farming households due to variation in preferences for crop under production. Moreover, the Z-Statistical test supported the results of gross margin in which okra is the key contributor to the total household income with the mean of 282.2078 SSP. These study findings are in line with those of Mwaura *et al*. (2013) and Ojiewo *et al.* (2010) who asserted that vegetable farming is a key contributor to the household income of smallholder farmers.

Table 4.5: Z-Statistics for the contribution of vegetable crops to household income

Type of crop	Mean	Std. Error	Z-Statistics
Tomato	5.6799	0.0825	68.8650***
Okra	282.2078	0.0825	$3.4e+^{03}$***
Cowpeas	94.7866	0.0825	$1.1e+^{03}$***

Key: *** = significant at 1%, ** = significant at 5%, * = significant at 10%

4.4. Effect of commercialisation of vegetable crops on household income

To analyse the effect of commercialisation on farm household income, the study employed the endogenous switching regression model. The model results of the first stage determine factors influencing the decision of farm household to commercialise, (Table 4.6). In the second stage of the model, the effect of commercialisation of horticultural crops on household income is determine and the treatment effect of commercialisation on household income is analysed Table 4.8.

Table 4.6: Probit Model on factors determining the decision to commercialise

Two-step Probit with endogenous regressors Number of obs = 146

Wald $chi^2(15)$ = 26.98

Prob > chi^2 = 0.0289

Variables	**Coefficients.**	**Standard. Error**	**P-Values**
Market information access	-4.048548	5.961753	0.497
Level of education			
Primary	.6809722	.706781	0.335
Secondary	.3541545	.7117715	0.619
University	-.1328091	1.047788	0.899
Extension service access			
Yes	-.353187	.7598532	0.642
Land ownership			
Yes	.4919727	.5515444	0.372
Group membership			
Yes	1.038332	.8137674	0.202
Total quantity of crop produced	-17.97224	3.96311	0.000***
Farm size	.0032609	.2579874	0.990
Household size	.0105436	.094285	0.911
Contribution of Okra	-.001871	.0008548	0.029**
Contribution of Cowpeas	.0090433	.0042398	0.033**
Total Farm Revenue	17.08746	3.907475	0.000***
Total Variable Cost	.0001647	.0000942	0.081*
Contribution of Tomato	.0137194	.0072118	0.057*
_cons	-113.7215	26.76867	0.000
Instrumented: Market Information			
Wald test of exogeneity:	$chi^2(1)$ = 0.60	Prob > chi^2 = 0.4391	

Key: *** = significant at 1%, ** = significant at 5%, * = significant at 10%

To test for endogeneity in the model, the variable "access to market information" was thought to be correlated with an error term in the household income equation. Therefore, a distance to agrovet shop and produce market was used as instruments variables. The Wald test of exogeneity (corr=0) with null hypothesis revealed that there is no endogeneity found

(0.4391). This implies that the finding fail to reject the null hypothesis at 5% significance level. This shows that there is absence of endogeneity in the model. Moreover, the Chi-*square* statistics $Chi^2(15)=26.98$ with Prob > chi^2 of 0.0289 confirmed that the coefficient of the decision to commercialize is significantly different from zero at 5% significance level indicating that the model fulfilled the condition of good fit.

The results in Table 4.6 indicate that the quantity of crop produced is negatively significant at a 1% significance level. This implies that if the farm yield decreases by one kilogram, the probability for commercialising decreases. This shows that farmer's level of crop commercialisation is influenced by the quantity of crop produced. For instance, farmers who produce more output of the crops under consideration have higher possibilities of commercialising than households with less crop yield. The finding is in line with Adepoju (2018) who argued that increase in farm output increases the amount of household income when the farmer has surplus to sell. However, the finding disagrees with Olanrewaju *et al*. (2016) who reported that the total quantity of crop produced is positively significant. Although the authors argued that, increase in the quantity of food crop produced serves as an incentive for farmers to commercialise, the finding of the current study indicates that commercialisation is negatively influenced by the decline in the quantity of crop outputs. It can be argued that as the output quantity decreases, the level of commercialisation decreases too, and eventually a farmer can resort to subsistence-oriented production, unless the factors contributing to a decline in crop yield are addressed.

The contribution of the crops under consideration was found to have a significant influence on farmer's decision to participate in the output market for vegetables. It was expected that the contribution of each vegetable crop under consideration would have a positive impact on commercialisation. In this study, the specific contribution of okra to the total household income is negatively significance at 5% significance level. The results revealed that the share of okra to the total household income is negatively influencing farmers' decision to commercialise. This could be attributed to the fact that okra is a highly grown crop and most preferable for home consumption particularly among farmers with larger households size. Although okra has a relatively higher share to the total household income, its level of production depends on the farmers' preference and benefits realized when selling surplus. The finding is in contrast with Dembele *et al*. (2018) who reported that okra has positive influence on the performance of the vegetable enterprise.

Another important factor influencing commercialisation of vegetable crops among smallholder farmers in Juba is the contribution of cowpeas to the total household income. The results revealed that the contribution of cowpeas to the total household income is positively significant at a 5% significance level. This could be interpreted that if the contribution of cowpeas increases, the probability of farmers producing more cowpeas for commercial purpose also increases. This implies that farmers growing cowpeas would continue to produce it and allocate sufficient amount to the market to increase their household income. The share of cowpeas to the total household income could be an incentive for cowpeas producers to shift their gears from subsistence-oriented farming to the market-oriented one.

Moreover, the finding showed that the contribution of tomato to the total household income is positive and significantly influences commercialisation at a 10% significance level. This could be explained that when the share of tomato to the household income increases, then there is a likelihood that a farmer would choose to commercialise production of tomato as opposed to subsistence production. Furthermore, the contribution of a particular crop to household income could be a vital factor in determining whether a farmer should participate in the output market or not. Regardless of the smallest share of tomato to the total household income, there is a possibility that household who decided to invest in tomato enterprise for business would have more income over those who produce for subsistence.

The results further showed that the total farm revenue is positively significant at 1% significance level. This implies that the likelihood for commercialisation of vegetable crops increases with an increase in total farm revenue. This could be explained by the fact that farmers who choose to engage in the output market have the advantage to increase their income when the prices of food commodities appreciate. Furthermore, the amount of income earned from the sale of farm outputs could catalyse commercialisation if the benefits derived from participating in the output market are realized. The finding is in line with the finding of Carletto *et al*. (2017) who found that agricultural commercialisation has positive impact on the household welfare through increased farm income. The results further concurred with Agwu *et al*. (2013) who observed that income is positively and significantly influencing farmer's decision to commercialise. The author argued that increase in farm income increases the probability of commercialisation among farming households.

The total variable cost, which includes the cost of inputs and labour, is positively significant at a 10% significance level. This implies that the total variable cost incurred during production and post-harvest activities had a significant influence on the level of

commercialisation among vegetable producers. The results indicate that farmers with higher values of the total variable cost would prefer to sell their harvests to cover the costs and gain profit. In other words, a farmer who can realise the costs incurred in production would decide to sell the harvested surplus to maintain the business (vegetable enterprise). The cost would be viewed as one of the determinants for farm household to either commercialise or maintain the status quo. In contrast, Akinlade *et al*. (2013) found that the total variable cost is negatively and significantly affecting market participation among vegetable farmers in Southwest Nigeria.

To ascertain the effect of commercialisation of vegetable crops on household income, the study analysed some variables hypothesized to determine the effect and the results shown in Table 4.7 were significantly effecting household income.

Table 4.7: Parameters estimates in Endogenous Switching Regression Model

Variable	Coefficient	Std. Error	P-Value
Total Household Income: Regime 0			
Age	-66.39832	211.3695	0.753
Household size	1189.23	833.7088	0.154
Farm size	-4039.305	2877.181	0.160
Total farm revenue	.2057115***	.0649599	0.002
Total Variable Cost	-.9554883	1.04676	0.361
_cons	12906.84	11797.93	0.274
Total Household Income: Regime 1			
Age	-48.9652	274.2394	0.858
Household size	.0085674	1025.816	0.235
Farm size	-150.334	2963.991	0.960
Total farm revenue	.1595073***	.030891	0.000
Total Variable Cost	1.330757***	.2750008	0.000
_cons	-3879.095	11495.24	0.736
Selection regime: If a household is commercialising			
Age	-.0009535	.0269649	0.972
Household size	.0085674	.0631813	0.892
Farm size	-.4098785	.2045183	0.045
Access to market information	1.417606	1.461685	0.332
Gender	.1225273	.4991366	0.806

Type of crop	-.1008827	.1349299	0.455
Education level	-.1035387	.2174532	0.634
Farming experience	.0190941	.0378263	0.614
Total farm revenue	.0001787***	.0000367	0.000
Group membership	.2470652	.4719858	0.601
Total quantity of crop produced	-.1648094***	.0338309	0.000
_cons	1.332738	1.00589	0.185
/Lns0	9.754206		
/Lns1	9.988885	.0152994	0.000
/r0	-.3045315	.8845271	0.731
/r1	.123077	.5719209	0.830
sigma_0	17226.54		
sigma_1	21782.99	333.2675	
rho_0	-.295454	.807314	
rho_1	.1224593	.5633442	
LR test of independent equations	**Chi^2 (2) = -4.79**	**Prob > chi2 = 1.0000**	

Key: *** =significant at 1%, ** = significant at 5%, * = significant at 10%

In Table 4.7, the results of the regime selection equation are reported in the section indicated, “selection regime: If a household is commercialising”. The results of the household income regression for the commercialised regime are reported in the first regime (regime 0), and the household income regression for the non-commercialised regime are reported in the second regime (regime 1) of the selection equation.

The correlation coefficients denoted, as rho_0 and rho_1 in the table of results presents positive and negative significant values for the correlation between the regime selection equations and the outcome equation. Subsequently, the results show that the coefficient for rho_1 is positive and significantly different from zero, hence the model suggests that individuals who choose not to commercialise and continue to grow vegetables for subsistence purposes, tend to earn little income compare to those who choose to commercialise (Lokshin & Sajaia, 2004). In other words, the model indicates that individuals who have chosen to participate in the output market are likely to earn more income than their counterpart (the non-commercialising individuals). This implies that the commercialisation of vegetable crops to the household income is positively significant. The finding is in line with Krause *et al.* (2019) who

found that the commercialisation of vegetables has a positive and significant influence on per capita household income.

The likelihood ratio test for the joint independent of the three equations (the selection and the outcome equations) is reported in the last section of regression output. The Likelihood Ratio test is statistically significant, implying that the equations are jointly dependent hence providing evidence of the presences of endogeneity in the model. The variables sigma 0, sigma 1, /Lns0, /Lns1, /r0, and /r1 are ancillary parameters (additional parameters) employed in the maximum likelihood estimation procedure. Where sigma 0 and sigma 1 are the square roots of the variances of the residuals of the regression part of the model. While Lns0 and Lns1 is the log; and r0 and r1 are the transformers (the transformation of the correlation between the errors from the two equations).

The model results revealed that the coefficient of total farm revenue is positive and significant at 1% significance level for both households in two regimes (regime 0: commercialising and regime 1: non-commercialising households). The results suggest that household who commercialised have higher income earning from the sale of their farm produce, hence increasing their total household income. This confirms to a study by Olanrewaju *et al*. (2016) which reported that increase in the farm revenue as a result of increasing sale leads to possibilities for increasing crop commercialisation among farming households.

Similarly, the finding revealed that household in the second regime (non-commercialising households) could increase their household income through total farm revenue if they decide to sell their farm produce. This implies that the non-commercialising households mainly produce for household consumption and possibly engage in commercialisation when there is surplus from the total produce. This could be further explained that the quantity of crops produced and consumed is valued in monetary form and can reflect the total farm revenue that a household could earn to increase the income. Therefore, the total farm revenue can have a significant influence on the income of both commercialising and non-commercialising households.

Moreover, the total variable cost, which includes the cost of inputs and labour, is positively significant at 1% significance level in the second regime. This implies that the total variable cost incurred in production and post-harvest activities had a significant influence on farmer's decision to participate in commercialised farming. The results indicate that farmers with higher values of the total variable cost would prefer to sell their harvests to cover the costs

and gain profit. In other words, a farmer who can realise the costs incurred in production would decide to sell the harvested surplus to maintain the business.

The results revealed that the output quantities of vegetable crops, is negative and have a significant influence on the income of smallholder farm households. The quantity of crop produced is directly influencing the total farm revenue earned. It could be explained further that if the total farm output increases the total farm revenue will increase and eventually did the household income. In other words, the quantity of crop produced and total farm revenue is proportional to the household income.

The other relevant section of the endogenous switching regression model focused on the treatment effect of the commercialisation on household income and the expected household income for the two regimes. Furthermore, the conditional and unconditional expectations were computed based on the parameters using full information maximum likelihood (FIML) for the two regimes. However, the comparison on the coefficients across the regimes was made to determine the coefficient that has produced the effect of commercialisation on household income (Table 4.8).

Table 4.8: Treatment effect of commercialisation on household income

Sub-samples	Decision phase		Treatment effects
	Commercialized (N = 89)	Non-commercialized (N = 62)	
Commercialized	(a_1) 32636.29	(n_1)13631.05	TT = 3.5721***
Non-commercialized	(a_0) 26202.47	(n_0) 20738.71	TU = 2.2670**

Key: *** = significant at 1%, ** = significant at 5%, * = significant at 10%

The results shown in Table 4.8 represent the expected household income under two different regimes (the commercialising and non-commercialising households). The expected household income for the household that commercialises is 32636.29 SSP while the households that do not commercialise is 26202.47 SSP.

Additionally, the results of the treatment effects indicate that the farm households that undertake commercialised farming would have earned less by 3.5721 than if they had not commercialised. Comparably, the farm households that did not undertake commercialised farming would have earned 2.2670 if they had commercialised. This implies that the commercialisation of vegetable crops has a remarkable impact on the income of smallholder farm households in Juba. The findings further indicate that a farm household that chooses to commercialise production of vegetable crops have an opportunity to increase the level of

income above the normal expectation. This finding concurred with Opondo and Owuor (2018) who found that farm households that commercialise tend to benefit more above the normal expectation than their counterparts (the non-commercialising households). The finding also agrees with Murithi and Matz (2014) who found that the commercialisation of vegetables has positive impact on the welfare of smallholder farmers.

In summary, there is a positive relationship between the agricultural commercialisation and the household income (Yusuf *et al*., 2018; Zhou *et al*., 2013). The results of the study supports the proposition that commercialisation has a positive multiplier effect on the income of smallholder households who chooses to participate in commercialised production of vegetable crops.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the results of this study, it can be summarized that:

i. The factors that are significantly influencing the commercialisation of vegetable crops among smallholders in Juba are; the age of the farmer, farming experience, the type of land acquisition, the quantity of crop produced, a group membership, total variable costs, total farm revenue, and access to irrigation facilities.
ii. It is noted in this study that the commercialisation of vegetable crops by smallholders in peri-urban areas of Juba contributed 33.33% to the total household income. Nevertheless, the specific share of each selected vegetable crop to the household income was recorded whereby okra contributed 73.75%, Cowpeas 24.77% and Tomato 1.48%.
iii. There was direct association between the commercialisation of vegetable crops and the household income. Some variables have shown that commercialization has a positive impact on the income of the smallholder farm households in Juba while other variables have indicated negative impact based on the farmers' choice or preference.

5.2 Recommendations

The study suggests the following possible courses of actions for the government to consider when aiming for enhancing the livelihood condition of farming households.

i. Accelerate the efforts to promote domestic production of vegetables by developing appropriate land tenure laws that ensure easy access to farming land.
ii. Provide irrigation facilities to the farmers through a market-based incentive approach to encourage farmers to produce vegetable year-round without relying only on rainfall.
iii. Promote commercialisation of vegetable crops through the provision of extension services to improve the yield and income among smallholder farmers.
iv. Improve farmer's access to market information through effective communication channels like radio to inform farmers about commodities and price trends in the market.
v. Promote the formation of farmer's organization or cooperatives across the country.

5.3 Areas for further research

To better understand the effect of commercialisation of vegetable crops on the farm household income and to validate the existing literature, then;

i. Further studies should comprehensively consider other types of indigenous vegetables.
ii. Further research should focus on the linkages between commercialisation, income and food security for smallholder farm households.
iii. Future scholars should consider replicating similar kind of study in other geographical areas of South Sudan to validate the finding of this study.

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APPENDICES

Appendix I: Questionnaire

A. QUESTIONNAIRE IDENTIFICATION

I am **Emmanuel Ater**, pursuing a Master of Science in Agribusiness Management at Egerton University, Kenya. I am researching the **Effect of Commercialization of Horticultural crops on farm household income in Juba, South Sudan**. The purpose of this study is purely academic. You have been selected to participate in this interview, therefore, I humbly request your consent to allow me to interview you and any information provided in this interview will be held strictly confidential. Thank you very much.

Name of interviewer:…… Farm household No…….

Village:……. Date of interview: ……../……./……..

B. HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

Please provide the information required in the space given below:

1. **Age of household respondents:** How old are you? _____ Years old.
2. Gender: Male (__) Female (__)
3. **Household size:** How many people are living in this house? _____
4. Have you been to school? Yes (__) No (__)
5. **Level of education:**
   What is your level of education?
   Informal (__) Primary (__)
   Secondary (__) Tertiary (__)
   Codes: 1= informal 2 = primary 3 = Secondary 4 = Tertiary (university)
6. Is farming your main occupation? Yes (__) No (__)
   Codes: 1 = Yes 0 = No
7. **Farming experience:**
   How long have you been farming? _____ Years
8. **Off-farm activities:**
   Do you have any other activities apart from farming that earns you money?
   Yes (__) No (__)

Codes: 1= Yes 0 = No

9. If yes, what is the estimated income per month (the range of income per month in SSP)? _____ SSP

10. What is your estimated income earning from farm produce per month in SSP? _____ SSP

C. FARM CHARACTERISTICS

11a. Do you own land for farming? Yes (__) No (__)

Codes: 1 = Yes 0 = No

11b. If yes tick and fill in the details provided in the following table.

Type of land ownership	**Size of the land (Hectares)**
1 = Owned (__)	
2 = Rented (__)	
3 = Inherited (__)	

12. In the table below, show the labour costs for crops grown per hectare in (man-days).

Type of crop	**Land preparation (SSP)**	**Planting (SSP)**	**Weeding (SSP)**	**Harvesting & Packaging (SSP)**	**Transportation (SSP)**	**Total cost (SSP)**
Tomato						
Okra						
Cowpeas						
Gross Total (SSP)						

13. In the table below, provide the costs for seeds and fertilizer used on your farm per season.

Crop type	**Cost of seeds**			**Cost of fertilizer**		
	Amount of seeds (Kg)	**Cost /Kg (SSP)**	**Total Cost (SSP)**	**Amount of fertilizer (Kg)**	**Cost /Kg (SSP)**	**Total cost (SSP)**
Tomato						

Okra						
Cowpeas						
Gross Total (SSP)						

14. Fill in the table below for crop produced in the last season (Feb. 2019 – Feb. 2020).

Crop type	**Quantity produced (Kg)**	**Quantity sold (Kg)**	**Prevailing market price (SSP)**	**Total revenue (SSP)**
Tomato				
Okra				
Cowpeas				
Gross total (SSP)				

D. INSTITUTIONAL FACTORS

15a. Did you apply for credit in the last farming season? Yes (__) No (__)

Codes: 1=Yes 0 = No

15b. If yes, did the application succeed? Yes (__) No (__)

Codes: 1=Yes 0 = No

15c. If yes, how much was obtained in SSP? _____

15d. If no in question "**15b**" above, what was the reason?

1= lack of collateral (___) 2 = outstanding loans (___)

3 = was not interested (___) 4 = others, specify (_____)

15e. What are the sources of credit available in your area?

1= commercial banks (___) 2 = microfinance institutions (___)

3 = farmers group (___) 4 = others, specify (_____)

16a. Have you ever received any form of extension services such as training on vegetables?

Yes (__) No (__) **Codes:** 1=Yes 0 = No

16b. If yes, how often do you meet with extension agent/officer? (The frequency of meeting)

1= weekly (__) 2 = once in a month (__) 3 = once in a year (__)

16c. What is the mode of meeting?

1= farm visit (__) 2 = group visit (__)

3 = field day visit (__) 4 = office visit (__)

5 = others, specify (_____)

17a What is the distance from your farm to;

	Distance (KM)	**Road type**
i. The nearest agri-input supply shop	**(_____)**	**(_____)**
ii. Nearest agricultural produce market	**(_____)**	**(_____)**

Road type code: 1= Tarmac, 2 = Maram, 3 = Mud road, 4 = Walking path

17b. Do you have access to market information (such as prices of input supplies, prices of outputs in the market compare to own price at farm gate)? Yes (__) No (__)

Codes: 1=Yes 0 = No

17c. If yes, what were the three most important sources?

1= Newspaper (__) 2 = Farmer cooperatives (__) 3 = Radio (__)

4 = TV (__) 5 = Extension agents (__) 6 = Community meetings (__).

18a. Do you belong to any social group in your area? Yes (__) No (__)

Codes: 1= Yes 0 = No (__)

18b. If yes, fill in the following table with appropriate codes provided.

Group type	**Year joined**	**Group activity**

Group type codes	**Group activity codes**
1= Women group	1= Farming
2= Crops marketing group	2= Business
3= Farm input supply group	3= Saving and credit
4= Youth association	4= Social matters
5= Producers group	5= Others (specify) _____

19a. Do you have access to irrigation facilities such as motor pump, watering pipes and cans?

Yes (__) No (__) **Codes:** 1 = Yes 0 = No

19b. If yes, who provides the facilities?

1. Government agencies (__) 2. NGOs (__)

3. Groups (__) 4. Self (__)

Codes: 1= Government agencies 2 = NGOs 3 = Groups 4 = Self

19c. Do you use river Nile as source of water for irrigation during dry season?

YES (__) / NO (__) **Codes:** 1 = Yes 0 = No

19d. If yes, what is the approximate distance from your farm to the river in meters?

_____ Meters

STATA outputs for descriptive statistics

```
. tab  GENDER
 Sex of the |
 respondent |      Freq.     Percent        Cum.
------------+-----------------------------------
     Female |        117       77.48       77.48
       Male |         34       22.52      100.00
------------+-----------------------------------
      Total |        151      100.00

. tab  EDUC_ACCESS
     If the |
 respondent |
have access |
         to |
  education |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |         59       39.07       39.07
        Yes |         92       60.93      100.00
------------+-----------------------------------
      Total |        151      100.00
 . tab  HH_OCCUPATION
     If the |
 respondent |
is a farmer |      Freq.     Percent        Cum.
------------+-----------------------------------
```

```
         No |          1        0.66        0.66
        Yes |        150       99.34      100.00
------------+-----------------------------------
      Total |        151      100.00
. tab  IF_OFF_FARMINCOME
     If the |
 respondent |
       have |
   off-farm |
     income |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        139       92.05       92.05
        Yes |         12        7.95      100.00
------------+-----------------------------------
      Total |        151      100.00
. tab  LAND_OWSHP LAND_ACQTYPE
    If the |
respondent |    Types of land acquisition
 owns land | Seasonal      Rented  Others(sp |     Total
-----------+---------------------------------+----------
         No |          1          32          15 |        48
        Yes |          0           0           1 |         1
-----------+---------------------------------+----------
      Total |          1          32          16 |        49
. tab  CROP_TYPE
Type of crop produced by |
          the respondent |      Freq.     Percent        Cum.
-------------------------+-----------------------------------
```

```
                  Okra only |         10        6.62        6.62
              Cowpeas only |         15        9.93       16.56
           Tomato and Okra |          1        0.66       17.22
          Okra and Cowpeas |         99       65.56       82.78
Tomato, Okra and Cowpeas |         26       17.22      100.00
-------------------------+-----------------------------------
                   Total |        151      100.00
```

```
. tab  SOURCE_SEEDS
```

```
Source of seeds |      Freq.     Percent        Cum.
----------------+-----------------------------------
   Agrovet Shop |         54       35.76       35.76
           NGOs |         15        9.93       45.70
Others(specify) |         82       54.30      100.00
----------------+-----------------------------------
          Total |        151      100.00
```

```
. tab  CRDT_APPLY RSN_NOTCRDT
```

```
    If the |
respondent |
   applied |    Reason for not
   for the | accessing the credit
    credit | Lack of c  Outstandi |     Total
-----------+----------------------+----------
        No |         1          0 |         1
       Yes |         2          2 |         4
-----------+----------------------+----------
     Total |         3          2 |         5
```

```
. tab  CRDT_ACCESS
```

```
    If the |
 respondent |
   received |
 the credit |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |          4       40.00       40.00
        Yes |          6       60.00      100.00
------------+-----------------------------------
      Total |         10      100.00
tab INFO_MKTACCESS
    If the |
 respondent |
have access |
  to market |
information |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        146       96.69       96.69
        Yes |          5        3.31      100.00
------------+-----------------------------------
      Total |        151      100.00
. tab GRP_MEM
    If the |
 respondent |
 belongs to |
 any social |
      group |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        112       74.17       74.17
```

```
        Yes |         39       25.83      100.00
------------+-----------------------------------
      Total |        151      100.00
. tab  IRRIG_ACCESS IRRIG_PROVFac
    If the |
respondent |
      have |
 access to |      Provider of irrigation
irrigation |            facilities
facilities |      NGOs     Groups       Self |     Total
-----------+---------------------------------+----------
       Yes |        36          1         45 |        82
-----------+---------------------------------+----------
     Total |        36          1         45 |        82
. tab  WATER_SRCE
     Sources of |
water available |
 for irrigation |      Freq.     Percent        Cum.
----------------+-----------------------------------
     River Nile |         71       47.02       47.02
  Shallow wells |         10        6.62       53.64
      Boreholes |         28       18.54       72.19
Others(specify) |         42       27.81      100.00
----------------+-----------------------------------
          Total |        151      100.00

. tabstat  Age , s(mean sd var)
```

```
    variable |      mean        sd  variance
-------------+----------------------------
         Age |  33.66887  10.01846  100.3696
------------------------------------------

. tabstat  HHldSize , s(mean sd var)

    variable |      mean        sd  variance
-------------+----------------------------
    HHldSize |  7.423841  2.562387  6.565828
------------------------------------------

. tabstat  FarmEXP , s(mean sd var)

    variable |      mean        sd  variance
-------------+----------------------------
     FarmEXP |  11.96026  8.233169  67.78508
------------------------------------------

. tabstat  Onfarm_Incm, s(mean sd var)

    variable |      mean        sd  variance
-------------+----------------------------
 Onfarm_Incm |  26611.92  41930.84  1.76e+09
------------------------------------------
. tabstat OFF_farmIncm, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
```

```
OFF_farmIncm |  1139.272  5470.459  2.99e+07
-------------------------------------------

. tabstat FarmSize, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
    FarmSize |  .7976821   .930411  .8656646
-------------------------------------------

. tabstat Quantity_Produced, s(mean sd var)
 variable |      mean        sd  variance
-------------+----------------------------
Quantity_P~d |  50.81788  96.21622  9257.562
-------------------------------------------

 . tabstat Quantity_Sold, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
Quantity_S~d |  42.06074  95.77047  9171.983
-------------------------------------------


.
. tabstat Mrkt_Price, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
  Mrkt_Price |  1479.139  170.0351  28911.92
-------------------------------------------

. tabstat TOTAL_FARMREV, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
TOTAL_FARM~V |  84399.29  135433.7  1.83e+10
```

```
------------------------------------------
. tabstat Amnt_Credit, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
 Amnt_Credit |  735.0993  4735.261  2.24e+07
------------------------------------------
. tabstat Mrkt_Distance, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
Mrkt_Dista~e |  5.313245  2.925262  8.557157
------------------------------------------


.
. tabstat Distance_WaterSrc, s(mean sd var)
    variable |      mean        sd  variance
-------------+----------------------------
Distance_W~c |  .1859603  .3032649  .0919696
------------------------------------------
. tabstat HCI_Tomato , s(mean, sd var)
    variable |      mean        sd  variance
-------------+----------------------------
  HCI_Tomato |  74.91902  18.88501  356.6438
------------------------------------------
. tabstat HCI_Okra , s(mean, sd var)
    variable |      mean        sd  variance
-------------+----------------------------
    HCI_Okra |   72.9599  19.63459  385.5171
------------------------------------------
```

```
. tabstat HCI_Cowpeas , s(mean, sd var)
    variable |      mean        sd  variance
-------------+------------------------------
 HCI_Cowpeas |  74.85143  21.50924  462.6475
----------------------------------------------
```

STATA outputs for objective one

```
. tobit HH_COMindex Age i.GENDER i.EDUC_ACCESS FarmEXP i.LAND_ACQTYPE LOG_TOTALQP i.GRP_MEM Total_VariableCost
LOG_TOTALF
> R i.EXTNS_ACCESS Mrkt_Distance i.INFO_MKTACCESS i.IRRIG_ACCESS HHldSize , ul (74.81)

Tobit regression                                  Number of obs   =         47
                                                      LR chi2(15)     =      89.06
                                                      Prob > chi2     =     0.0000
Log likelihood = -59.515911                       Pseudo R2       =     0.4280

------------------------------------------------------------------------------
       HH_COMindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
               Age |  -.3221153   .1771502    -1.82   0.078    -.6829585    .0387279
                   |
            GENDER |
              Male |  -3.164623   2.478353    -1.28   0.211    -8.212863    1.883618
                   |
       EDUC_ACCESS |
               Yes |   2.434752    1.91907     1.27   0.214    -1.474265    6.343769
           FarmEXP |   .6085714   .1712984     3.55   0.001      .259648    .9574947
                   |
      LAND_ACQTYPE |
```

Rented	-24.99613	7.544401	-3.31	0.002	-40.36357	-9.628683
Others(specify)	-22.0675	6.725136	-3.28	0.002	-35.76615	-8.368842
LOG_TOTALQP	-66.75372	6.77782	-9.85	0.000	-80.55969	-52.94775
GRP_MEM						
Yes	-8.410327	3.053647	-2.75	0.010	-14.6304	-2.190252
Total_VariableCost	.0011257	.0003141	3.58	0.001	.000486	.0017654
LOG_TOTALFR	56.38571	5.663711	9.96	0.000	44.84911	67.92231
EXTNS_ACCESS						
Yes	3.480919	2.889262	1.20	0.237	-2.404316	9.366153
Mrkt_Distance	.4559175	.3321307	1.37	0.179	-.2206105	1.132446
INFO_MKTACCESS						
Yes	-4.365806	5.203139	-0.84	0.408	-14.96425	6.232642
IRRIG_ACCESS						
Yes	7.821735	2.75513	2.84	0.008	2.209718	13.43375
HHldSize	-.277444	.3325215	-0.83	0.410	-.9547682	.3998801
_cons	-244.3315	40.1179	-6.09	0.000	-326.049	-162.614
/sigma	3.429028	.5340451			2.341214	4.516842

Obs. summary: 0 left-censored observations
21 uncensored observations
26 right-censored observations at HH_COMindex>=74.81

```
. reg HH_COMindex Age i.GENDER i.EDUC_ACCESS FarmEXP i.LAND_ACQTYPE LOG_TOTALQP i.GRP_MEM Total_VariableCost
LOG_TOTALFR
> i.EXTNS_ACCESS Mrkt_Distance i.INFO_MKTACCESS i.IRRIG_ACCESS HHldSize

      Source |       SS       df       MS              Number of obs =      47
-------------+------------------------------           F( 15,    31) =   12.08
       Model |  7633.71253    15  508.914169           Prob > F      =  0.0000
    Residual |  1305.60653    31  42.1163396           R-squared     =  0.8539
-------------+------------------------------           Adj R-squared =  0.7833
       Total |  8939.31906    46  194.333023           Root MSE      =  6.4897

------------------------------------------------------------------------------
       HH_COMindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
               Age |  -.1665481   .1992777    -0.84   0.410    -.5729776    .2398814
                   |
            GENDER |
              Male |  -.2457749     2.7051    -0.09   0.928    -5.762864    5.271314
                   |
       EDUC_ACCESS |
               Yes |   .4375262   2.390901     0.18   0.856    -4.438749    5.313802
           FarmEXP |   .2218423   .2080393     1.07   0.295    -.2024566    .6461412
                   |
      LAND_ACQTYPE |
            Rented |  -13.96246   9.216114    -1.52   0.140    -32.75885     4.83393
  Others(specify)  |  -13.30885   9.133754    -1.46   0.155    -31.93726    5.319569
                   |
       LOG_TOTALQP |  -57.51857   6.167343    -9.33   0.000    -70.09695   -44.94019
```

```
                  |
        GRP_MEM |
            Yes  |   -2.11422   3.181028    -0.66   0.511     -8.60197    4.373529
Total_VariableCost |   .0000436   .0000634     0.69   0.497    -.0000857    .0001729
       LOG_TOTALFR |   54.51242   5.391931    10.11   0.000      43.5155    65.50933
                  |
      EXTNS_ACCESS |
            Yes  |  -1.491727   3.112128    -0.48   0.635     -7.838954      4.8555
     Mrkt_Distance |   .1004675    .428781     0.23   0.816     -.7740371     .974972
                  |
    INFO_MKTACCESS |
            Yes  |   6.145304   5.625675     1.09   0.283     -5.328336    17.61894
                  |
      IRRIG_ACCESS |
            Yes  |   3.628914   2.496357     1.45   0.156     -1.462439    8.720267
         HHldSize |  -.3662967   .4600614    -0.80   0.432     -1.304598    .5720048
            _cons |  -263.0047   40.49981    -6.49   0.000     -345.6046   -180.4048
------------------------------------------------------------------------------
```

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
         Age |      1.89    0.529253
    1.GENDER |      1.46    0.683104
1.EDUC_ACC~S |      1.43    0.698142
     FarmEXP |      1.38    0.722276
LAND_ACQTYPE |
```

```
          2  |     21.28    0.046986
          3  |     20.23    0.049432
 LOG_TOTALQP |     25.32    0.039499
   1.GRP_MEM |      2.36    0.423420
Total_Vari~t |      2.19    0.455747
 LOG_TOTALFR |     24.14    0.041426
1.EXTNS_AC~S |      2.16    0.462393
Mrkt_Dista~e |      1.71    0.584013
1.INFO_MKT~S |      1.44    0.694955
1.IRRIG_AC~S |      1.67    0.597068
    HHldSize |      1.57    0.636815
-------------+----------------------
    Mean VIF |      7.35

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of HH_COMindex

         Chi²(1)      =     0.29
         Prob > chi²  =   0.5900

STATA outputs for objective two
. ztest CONT_Tomato_HHincome == CONT_Okra_HHincome, unpaired
Two-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
```

```
---------+--------------------------------------------------------------------
CONT_T~e |     147     5.67989    .0824786           1    5.518235    5.841545
CONT_O~e |     147    282.2078    .0824786           1    282.0461    282.3695
---------+--------------------------------------------------------------------
    diff |          -276.5279    .1166424              -276.7565   -276.2993
------------------------------------------------------------------------------
    diff = mean(CONT_Tomato_HH~e) - mean(CONT_Okra_HHin~e)        z = -2.4e+03
Ho: diff = 0
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(Z < z) = 0.0000         Pr(|Z| > |z|) = 0.0000          Pr(Z > z) = 1.0000

. ztest CONT_Cowpeas_HHincome == CONT_Okra_HHincome, unpaired
Two-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
CONT_C~e |     147    94.78655    .0824786           1    94.62489     94.9482
CONT_O~e |     147    282.2078    .0824786           1    282.0461    282.3695
---------+--------------------------------------------------------------------
    diff |          -187.4213    .1166424              -187.6499   -187.1926
------------------------------------------------------------------------------
    diff = mean(CONT_Cowpeas_H~e) - mean(CONT_Okra_HHin~e)        z = -1.6e+03
Ho: diff = 0

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(Z < z) = 0.0000         Pr(|Z| > |z|) = 0.0000          Pr(Z > z) = 1.0000
```

```
. ztest CONT_Cowpeas_HHincome == CONT_Tomato_HHincome , unpaired
Two-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
CONT_C~e |     147    94.78655    .0824786           1    94.62489     94.9482
CONT_T~e |     147     5.67989    .0824786           1    5.518235    5.841545
---------+--------------------------------------------------------------------
    diff |            89.10666    .1166424                88.87804    89.33527
------------------------------------------------------------------------------
    diff = mean(CONT_Cowpeas_H~e) - mean(CONT_Tomato_HH~e)         z = 763.9304
Ho: diff = 0

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(Z < z) = 1.0000         Pr(|Z| > |z|) = 0.0000          Pr(Z > z) = 0.0000


. ztest CONT_Cowpeas_HHincome == 0
One-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
CONT_C~e |     147    94.78655    .0824786           1    94.62489     94.9482
------------------------------------------------------------------------------
    mean = mean(CONT_Cowpeas_HHincome)                            z =  1.1e+03
Ho: mean = 0

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
```

```
 Pr(Z < z) = 1.0000         Pr(|Z| > |z|) = 0.0000          Pr(Z > z) = 0.0000

. ztest CONT_Okra_HHincome == 0
One-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
CONT_O~e |     147    282.2078    .0824786           1    282.0461    282.3695
------------------------------------------------------------------------------
    mean = mean(CONT_Okra_HHincome)                               z =  3.4e+03
Ho: mean = 0

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(Z < z) = 1.0000         Pr(|Z| > |z|) = 0.0000          Pr(Z > z) = 0.0000


. ztest CONT_Tomato_HHincome == 0
One-sample z test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
CONT_T~e |     147     5.67989    .0824786           1    5.518235    5.841545
------------------------------------------------------------------------------
    mean = mean(CONT_Tomato_HHincome)                             z =  68.8650
Ho: mean = 0

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
```

```
 Pr(Z < z) = 1.0000         Pr(|Z| > |z|) = 0.0000         Pr(Z > z) = 0.0000


. reg TOTAL_HHincome CONT_Tomato_HHincome CONT_Okra_HHincome CONT_Cowpeas_HHincome

      Source |       SS           df       MS      Number of obs   =       147
-------------+----------------------------------   F(3, 143)       =      2.70
       Model |  1.4160e+10         3  4.7201e+09   Prob > F        =    0.0477
    Residual |  2.4957e+11       143  1.7452e+09   R-squared       =    0.0537
-------------+----------------------------------   Adj R-squared   =    0.0338
       Total |  2.6373e+11       146  1.8064e+09   Root MSE        =     41776

------------------------------------------------------------------------------
       TOTAL_HHincome |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------+-------------------------------------------------------
 CONT_Tomato_HHincome |  -65.71517   95.02833    -0.69   0.490    -253.5569    122.1266
   CONT_Okra_HHincome |   2.097774   8.602713     0.24   0.808    -14.90714    19.10269
CONT_Cowpeas_HHincome |  -85.27707   35.04351    -2.43   0.016    -154.5473   -16.00685
                _cons |   36370.69   4491.581     8.10   0.000     27492.22    45249.16
------------------------------------------------------------------------------
. test CONT_Tomato_HHincome= CONT_Okra_HHincome
( 1)  CONT_Tomato_HHincome - CONT_Okra_HHincome = 0

F(  1,    143) =    0.49
      Prob > F =    0.4847

. test CONT_Tomato_HHincome= CONT_Cowpeas_HHincome
( 1)  CONT_Tomato_HHincome - CONT_Cowpeas_HHincome = 0
```

```
F(  1,    143) =    0.04
      Prob > F =    0.8443

. test CONT_Okra_HHincome = CONT_Cowpeas_HHincome
( 1)  CONT_Okra_HHincome - CONT_Cowpeas_HHincome = 0

F(  1,    143) =    4.69
      Prob > F =    0.0320

STATA outputs for objective three

ivprobit IF_COMM i. EDUC_LEVEL i. EXTNS_ACCESS i. LAND_OWSHP i. GRP_MEM LOG_TOTALQP FarmSize HHldSize
CONT_Okra_HHincome CONT_Cowpeas_HHincome LOG_TOTAlFR Total_VariableCost CONT_Tomato_HHincome ( INFO_MKTACCESS =
Mrkt_Distance Distnce_Agrovet ), twostep
Checking reduced-form model...
Two-step probit with endogenous regressors        Number of obs   =        146
                                                  Wald chi2(15)   =      26.98
                                                  Prob > chi2     =     0.0289
------------------------------------------------------------------------------
                     |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
       INFO_MKTACCESS |  -4.048548   5.961753    -0.68   0.497    -15.73337    7.636273
                     |
          EDUC_LEVEL |
            Primary  |   .6809722    .706781     0.96   0.335    -.7042931    2.066237
          Secondary  |   .3541545   .7117715     0.50   0.619    -1.040892    1.749201
         University  |  -.1328091   1.047788    -0.13   0.899    -2.186436    1.920818
```

EXTNS_ACCESS						
Yes	-.353187	.7598532	-0.46	0.642	-1.842472	1.136098
LAND_OWSHP						
Yes	.4919727	.5515444	0.89	0.372	-.5890345	1.57298
GRP_MEM						
Yes	1.038332	.8137674	1.28	0.202	-.5566224	2.633287
LOG_TOTALQP	-17.97224	3.96311	-4.53	0.000	-25.7398	-10.20469
FarmSize	.0032609	.2579874	0.01	0.990	-.5023853	.508907
HHldSize	.0105436	.094285	0.11	0.911	-.1742516	.1953388
CONT_Okra_HHincome	-.001871	.0008548	-2.19	0.029	-.0035463	-.0001956
CONT_Cowpeas_HHincome	.0090433	.0042398	2.13	0.033	.0007336	.0173531
LOG_TOTAlFR	17.08746	3.907475	4.37	0.000	9.428947	24.74597
Total_VariableCost	.0001647	.0000942	1.75	0.081	-.00002	.0003493
CONT_Tomato_HHincome	.0137194	.0072118	1.90	0.057	-.0004156	.0278543
_cons	-113.7215	26.76867	-4.25	0.000	-166.1871	-61.25586

Instrumented: INFO_MKTACCESS
Instruments: 1.EDUC_LEVEL 2.EDUC_LEVEL 3.EDUC_LEVEL 1.EXTNS_ACCESS 1.LAND_OWSHP
1.GRP_MEM LOG_TOTALQP FarmSize HHldSize CONT_Okra_HHincome
CONT_Cowpeas_HHincome LOG_TOTAlFR Total_VariableCost
CONT_Tomato_HHincome Mrkt_Distance Distnce_Agrovet

Wald test of exogeneity: $chi^2(1) = 0.60$ Prob > $chi^2 = 0.4391$
Note: 0 failures and 1 success completely determined.

```
.    movestay TOTAL_HHincome Age HHldSize FarmSize TOTAL_FARMREV Total_VariableCost, select(IF_COMM = Age HHldSize
FarmSize INFO_M
> KTACCESS GENDER CROP_TYPE EDUC_LEVEL FarmEXP TOTAL_FARMREV GRP_MEM TOTAL_QProduced) iterate(0)


Fitting initial values .....Iteration 0:   log likelihood = -1750.0171
convergence not achieved
Endogenous switching regression model             Number of obs    =        151
                                                  Wald chi2(5)     =      13.79
Log likelihood = -1750.0171                       Prob > chi2      =     0.0170
------------------------------------------------------------------------------
                   |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
TOTAL_HHincome0    |
               Age |  -66.39832   211.3695    -0.31   0.753     -480.675    347.8784
          HHldSize |    1189.23   833.7088     1.43   0.154    -444.8094    2823.269
          FarmSize |  -4039.305   2877.181    -1.40   0.160    -9678.476    1599.866
     TOTAL_FARMREV |   .2057115   .0649599     3.17   0.002     .0783924    .3330305
Total_VariableCost |  -.9554883    1.04676    -0.91   0.361    -3.007101    1.096124
             _cons |   12906.84   11797.93     1.09   0.274    -10216.68    36030.35
-------------------+----------------------------------------------------------------
TOTAL_HHincome1    |
               Age |   -48.9652   274.2394    -0.18   0.858    -586.4646    488.5342
          HHldSize |   1218.073   1025.816     1.19   0.235    -792.4903    3228.635
          FarmSize |   -150.334   2963.991    -0.05   0.960     -5959.65    5658.982
     TOTAL_FARMREV |   .1595073    .030891     5.16   0.000      .098962    .2200526
Total_VariableCost |   1.330757   .2750008     4.84   0.000     .7917655    1.869749
             _cons |  -3879.095   11495.24    -0.34   0.736    -26409.36    18651.17
```

select						
Age	-.0009535	.0269649	-0.04	0.972	-.0538037	.0518966
HHldSize	.0085674	.0631813	0.14	0.892	-.1152657	.1324005
FarmSize	-.4098785	.2045183	-2.00	0.045	-.810727	-.00903
INFO_MKTACCESS	1.417606	1.461685	0.97	0.332	-1.447243	4.282456
GENDER	.1225273	.4991366	0.25	0.806	-.8557626	1.100817
CROP_TYPE	-.1008827	.1349299	-0.75	0.455	-.3653404	.163575
EDUC_LEVEL	-.1035387	.2174532	-0.48	0.634	-.5297392	.3226618
FarmEXP	.0190941	.0378263	0.50	0.614	-.055044	.0932322
TOTAL_FARMREV	.0001787	.0000367	4.86	0.000	.0001067	.0002507
GRP_MEM	.2470652	.4719858	0.52	0.601	-.67801	1.17214
TOTAL_QProduced	-.1648094	.0338309	-4.87	0.000	-.2311168	-.098502
_cons	1.332738	1.00589	1.32	0.185	-.6387692	3.304246
/lns0	9.754206	.	.	.	.	.
/lns1	9.988885	.0152994	652.89	0.000	9.958898	10.01887
/r0	-.3045315	.8845271	-0.34	0.731	-2.038173	1.42911
/r1	.123077	.5719209	0.22	0.830	-.9978673	1.244021
sigma0	17226.54	.			.	.
sigma1	21782.99	333.2675			21139.5	22446.08
rho0	-.295454	.807314			-.9666276	.891484
rho1	.1224593	.5633442			-.760697	.8465986

LR test of indep. eqns. : chi^2(2) = -4.79 Prob > chi^2 = 1.0000

. predict mTOTAL_HHincomemills1, mills1

```
. predict mTOTAL_HHincomemills2, mills2
. reg TOTAL_HHincome Age HHldSize FarmSize TOTAL_FARMREV TOTAL_QProduced INFO_MKTACCESS GENDER CROP_TYPE EDUC_LEVEL
FarmEXP GRP_ME
> M mTOTAL_HHincomemills1 if IF_COMM ==1
      Source |       SS           df       MS      Number of obs   =        89
-------------+----------------------------------   F(12, 76)       =     28.76
       Model |  1.9614e+11         12  1.6345e+10   Prob > F        =    0.0000
    Residual |  4.3193e+10         76   568332748   R-squared       =    0.8195
-------------+----------------------------------   Adj R-squared   =    0.7910
       Total |  2.3933e+11         88  2.7197e+09   Root MSE        =     23840


------------------------------------------------------------------------------
TOTAL_HHincome |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
           Age |   16.18552   368.2866     0.04   0.965    -717.3207    749.6918
      HHldSize |    2485.62   1169.415     2.13   0.037     156.5276    4814.712
      FarmSize |  -337.6407   3436.845    -0.10   0.922    -7182.711    6507.429
  TOTAL_FARMREV |   .7099652   .1652895     4.30   0.000     .3807626    1.039168
 TOTAL_QProduced |   -553.187   219.8463    -2.52   0.014    -991.0489   -115.325
 INFO_MKTACCESS |   5202.851   14821.75     0.35   0.727    -24317.23    34722.93
         GENDER |  -8565.555   7030.713    -1.22   0.227    -22568.43    5437.324
      CROP_TYPE |  -3176.335   2046.682    -1.55   0.125    -7252.656    899.9855
     EDUC_LEVEL |  -4253.216   3553.108    -1.20   0.235    -11329.84    2823.413
         FarmEXP |   136.4027   578.5755     0.24   0.814     -1015.93    1288.736
         GRP_MEM |   1550.565   6486.084     0.24   0.812    -11367.59    14468.72
mTOTAL_HHincomemills1 |   9013.089   6088.464     1.48   0.143    -3113.138    21139.32
           _cons |   11338.59   15800.01     0.72   0.475    -20129.86    42807.04
```

```
. predict a1 if IF_COMM ==1
(option xb assumed; fitted values)
(62 missing values generated)
. predict a0 if IF_COMM ==0
(option xb assumed; fitted values)
(89 missing values generated)
. reg TOTAL_HHincome Age HHldSize FarmSize TOTAL_FARMREV TOTAL_QProduced INFO_MKTACCESS GENDER CROP_TYPE EDUC_LEVEL
FarmEXP GRP_ME
> M mTOTAL_HHincomemills2 if IF_COMM ==0

      Source |       SS           df       MS      Number of obs   =        62
-------------+----------------------------------   F(12, 49)       =      1.74
       Model |  6.6995e+09        12   558295622   Prob > F        =    0.0859
    Residual |  1.5689e+10        49   320184074   R-squared       =    0.2992
-------------+----------------------------------   Adj R-squared   =    0.1276
       Total |  2.2389e+10        61   367025690   Root MSE        =     17894

------------------------------------------------------------------------------
       TOTAL_HHincome |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------+-------------------------------------------------------
                  Age |   251.5288   302.1213     0.83   0.409    -355.6066    858.6643
             HHldSize |   1475.007   870.5218     1.69   0.097    -274.3716    3224.387
             FarmSize |  -6399.534   3152.479    -2.03   0.048    -12734.68   -64.3899
        TOTAL_FARMREV |    .297446   .2266639     1.31   0.196    -.1580521    .7529441
      TOTAL_QProduced |  -66.55262    215.231    -0.31   0.758    -499.0755    365.9703
       INFO_MKTACCESS |  -12791.89   14199.75    -0.90   0.372    -41327.36    15743.59
               GENDER |  -3736.508   6849.232    -0.55   0.588    -17500.55    10027.54
```

```
            CROP_TYPE |  -3141.757    2203.22    -1.43   0.160    -7569.293    1285.778
          EDUC_LEVEL |   3890.202   3354.319     1.16   0.252    -2850.554    10630.96
            FarmEXP |  -323.7141   410.2511    -0.79   0.434    -1148.145    500.7163
            GRP_MEM |  -7934.012   5664.154    -1.40   0.168    -19316.56    3448.532
mTOTAL_HHincomemills2 |  -7861.385   8389.338    -0.94   0.353    -24720.39    8997.621
              _cons |   20621.55   16936.19     1.22   0.229       -13413    54656.11
------------------------------------------------------------------------------
. predict n1 if IF_COMM ==1
(option xb assumed; fitted values)
(68 missing values generated)
. predict n0 if IF_COMM ==0
(option xb assumed; fitted values)
(89 missing values generated)
. ttest a1 =n1, unpaired
Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      a1 |      89    32636.29    5004.301    47210.48    22691.29    42581.29
      n1 |      83    13631.05     1244.32     11336.3     11155.7    16106.39
---------+--------------------------------------------------------------------
combined |     172    23465.16    2748.512     36046.4    18039.77    28890.54
---------+--------------------------------------------------------------------
    diff |            19005.25    5320.466                8502.558    29507.94
------------------------------------------------------------------------------
    diff = mean(a1) - mean(n1)                                    t =   3.5721
Ho: diff = 0                     degrees of freedom =      170
```

```
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9998         Pr(|T| > |t|) = 0.0005          Pr(T > t) = 0.0002

. ttest a0 =n0, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      a0 |      62    26202.47    2009.321    15821.41    22184.59    30220.36
      n0 |      62    20738.71    1330.951    10479.92    18077.31    23400.11
---------+--------------------------------------------------------------------
combined |     124    23470.59    1225.182    13643.04    21045.42    25895.76
---------+--------------------------------------------------------------------
    diff |            5463.765    2410.145                692.6419    10234.89
------------------------------------------------------------------------------
    diff = mean(a0) - mean(n0)                                    t =   2.2670
Ho: diff = 0                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9874         Pr(|T| > |t|) = 0.0252          Pr(T > t) = 0.0126
```

Appendix III: Research Permit

THE REPUBLIC OF SOUTH SUDAN
Ministry of Higher Education, Science & Technology
Office of the Undersecretary

RSS/MoHEST/USO/J/33

Date: 4th March 2020

To Whom It May Concern

Subject: *Mr. Emmanual Angelo Ater*

I am very delighted to introduce to your esteemed office;**Emmanuel Angelo Ater,** a Master Degree Candidate in Department of Agricultural Economics & Agribusiness Management at the Egerton University/ Kenya. Mr. Ater has successfully defended his proposal (titled "Effect of Commercialization of Horticultural Crops on Farm Household Income"): a case of Tomato, Okra & Cowpea in Juba/ South Sudan)

The above- mentioned scholar intends to collect his data for academic purposes only, in **Juba.**

Hence, the Ministry of Higher Education, Science & Technology/ RSS will appreciate very much if your esteemed establishment could allow this scholar to access information/ data which is relevant to his research work.

Dr. Adil Athanaziou Surur
Undersecretary

Cc: Hon. Minister
Cc: Director General for Training & External Relations
Cc: File

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Factors Influencing Commercialization of Horticultural Crops Among Smallholder Farmers in Juba, South Sudan

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Abstract
This paper aims at analyzing socio-economic and institutional factors influencing the commercialization of horticultural crops among smallholder farm households in Juba, South Sudan. The study adopted a multi-stage sampling technique to select a sample of 151 respondents. The survey was conducted using semi-structured questionnaires to collect primary data. The data collected were analyzed using descriptive statistics and a Tobit regression model by STATA analytical software. The results from descriptive statistics indicated that 77.48% of the farmers are female, 36.65% have access to land, 37.09% have access to education at the primary level, 96.69% have no access to market information, 74.17% do not have group membership and only 54.97% have access to irrigation facilities. The findings further revealed that the mean household commercialization index (HCI) was 74.81% and the specific HCI for the selected vegetable crops; tomato, okra and cowpeas were 74.92%, 72.96%, and 74.84% respectively. The results from the Tobit regression model revealed that commercialization of horticultural crops is influenced by the age of the farmer, farming experience, type of land acquisition, the quantity of crop produced, group membership, total variable costs, total farm revenue, and access to irrigation facilities. The finding revealed that the age of a farmer, types of crop produced, type of land acquisition, and group membership are negatively significant whereas, farming experience, total variable costs, total farm revenue, and access to irrigation facilities are positively significant. The study suggests that further evaluation of the factors influencing the commercialization of indigenous and exotic vegetables would be required in rural and peri-urban settings of South Sudan. This study provides an insight for policymakers to formulate appropriate policies that can promote domestic production and accelerate the transition of smallholder farmers from subsistence to the market-oriented production system.

Keywords: Commercialization, Horticultural crops, Peri-urban areas, smallholder, Tobit regression model
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