

**ECONOMIC ANALYSIS OF HASS-AVOCADO PRODUCTION AND EXPORT
MARKET IN RUNGWE DISTRICT-TANZANIA**

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**A PhD THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL
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MOROGORO, TANZANIA.**

ABSTRACT

The production and exportation of avocados in Tanzania have been steadily increasing over time. Despite this observed growth, there is still great potential for the production and exportation of the Hass avocado variety. This highlights the need for strategies to capture the available potential. To develop appropriate strategies, a clear understanding of the current situation in the country's avocado industry is required. Nevertheless, there is a lack of literature on the economic viability of the avocado business, especially in Rungwe District. Additionally, there is limited knowledge in the public domain regarding the factors that affect avocado production farmers' willingness to participate in the export market. Therefore, the focus of this study was to conduct a comprehensive analysis of the economics of avocado production and the export market in the industry, specifically in Rungwe District. The study selected a sample of 360 farmers from a pool of 4,000 avocado out-growers. Out of the selected farmers, 36 were randomly chosen from ten selected wards, using a probability proportional to size. A questionnaire was administered to the farmers, while key informants were interviewed using a guide. The collected data underwent various analyses, including descriptive analysis, cost-benefit analysis, severity index analysis, and a binary logit model. The results obtained from primary data indicated the current status of avocado production, productivity, and cultivated area. Positive growth was observed in terms of quantity produced, cultivated area, and exported volume. The Cost-Benefit analysis using the Dolye Model revealed a positive net present value (NPV) of 55,075,088 TZS per acre. The benefit-cost ratio was greater than 1 at 1:9, and the internal rate of return (IRR) was 63.78%, surpassing the 10% discounting factor. Similarly, the primary data showed a positive NPV of 57,333,143 TZS per acre. The benefit-cost ratio exceeded 1 at 1:8.78, and the IRR was 70.0145%. However, variations were observed due to differences in plant population per acre among farmers, compared to

the standard farm size for avocados. Consequently, the study employed severity index analysis to rank and identify the constraints. Furthermore, socio-economic factors were assessed to determine their influence on farmers' willingness to participate in the export market. Significant factors influencing farmers' willingness included education, age, non-farm activities, formal employment, credit access, and extension access. Based on the study's results and the available literature, it can be concluded that the avocado industry has significantly improved in terms of production area, output, productivity, and exports. The return on investment has been positive and higher than the prevailing discounting rate. Additionally, the study identified constraints and factors that affect farmers' willingness to participate in the export market. As a result, the study recommends further improvements to catch up with competitors from leading avocado producers. It calls for the implementation of effective policies in the Horticulture subsector to support and promote farmers and exporting companies in increasing production and exports. Local governments in potential avocado production areas, such as Rungwe District, should prioritize and encourage avocado production in order to exploit the untapped potential at the international markets. Moreover, farmers and other stakeholders should collaborate as associations to address the constraining factors related to avocado production and export.

DECLARATION

I, ADRIAN ALPHONCE BARONGO, do hereby declare to the Senate of Sokoine University of Agriculture that this thesis in my own original work done within the period of registration and that it has neither been submitted nor concurrently being submitted in any other institution.

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The above declaration is confirmed by:

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Date

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LIST OF ABBREVIATIONS AND ACRONYMS

ARI	Agriculture Research Institute
BCR	Benefit Cost Ratio
CBA	Commercial Bank of Africa
CBI	Central Bureau of Investigation
CBR	Cost Benefit Ratios
COMTRADE	United Nations International Trade Statistics Database
Eurostat	European Statistical Office
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
Fig.	Figure
FSDT	Financial Sector Deepening Trust
FTF	Feed the Future
GDP	Gross Domestic Product
HODECT	Horticultural Development Council of Tanzania
IRR	Internal Rate of Return
ITC	International Trade Centre
KIA	Kilimanjaro International Airport
LGA	Local Government Authorities
MALF	Ministry of Agriculture, Livestock and Fisheries
MMA	Match Maker Association
MnM	Matunda na Mbogamboga
MOA	Ministry of Agriculture
NBS	National Bureau of Statistics
NPK	Nitrogen, Phosphate and Potassium

NPV	Net Percent Value
R&D	Research and Development
RAC	Rugwe Avocado Company
RDR	Rungwe District Report
REPOA	Research on Poverty Alleviation
TAHA	Tanzania Horticultural Association
TBS	Tanzania, Bureau of Standards
TIC	Tanzania Investment Centre
TPRA	Tanzania Pest-cide Regulatory Authority
TZS	Tanzania Shillings
UN	United Nations
UNECE	United Nations Economic Commission for Europe
USAID	The United States Agency for International Development
USD	United States Dollar
WAC	World Avocado Congress

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Worldwide, commercialization in the horticultural subsector has become a centre of attention to develop appropriately, as a way to increasing smallholder farmers' income. For the past two decades, that's from 2000 to 2020, the production of horticultural crops, particularly fruits and vegetables have been a promising and reliable business in Sub-Saharan Africa (Gioe, 2006; Afari-Sefa, 2007; Henson and Jaffee, 2008 and Taha, 2012). The subsector is referred to be the fast-growing sector in terms of revenue generation to smallholder farmers who own less than 5 acres of land. This is due to its higher input-output ratio of its crops, as compared to other commercial crops (Haji, 2008). The horticultural subsector has shown a substantial growth of about 10% yearly, and providing opportunities to all four categories of its products; fruits, vegetable, flowers and spices (Comtrade, 2018). However, Opportunities in fruits and spices are growing faster compared with flowers and vegetable (Comtrade, 2018). In this regard, the horticultural subsector is becoming more potential, particularly in boosting the micro economy of small and medium holder farmers worldwide.

Similarly, in Tanzania the horticulture subsector is growing faster at rate of 9%-12% per annum, thus creating employment opportunities for more than 2.5 million people, who are participating in its value chain (MMA, 2017). In the same vein of horticultural sub sector, fruits production is again becoming a potential business in the sector. Where in Tanzania, farmers produce varieties of fruits, that are mostly demanded in the world markets (MMA, 2017). These include, mangoes, oranges, jackfruits, apples, pineapples, passion fruits, bananas and avocado (Mwakalinga, 2019).

In recent years, the avocado fruit is among the fruits that have taken the interest of investors and other stakeholders in the horticulture sector, and experience a fast-increasing demand from different areas of the world. This is due to its global recognition as a “super food” based on its rich nutrients and increased in its consumption in food delicacies both in Europe, USA and Asia. Also, as the avocado demand keeps growing in both regions, in the food industry and also other avocado fruit uses create new business avenues in cosmetics and pharmaceutical sectors up surging further demand in the future (Faris, 2016). The fast growth in demand and prices are setting up avocado as one of the top crops to be traded. Previous years, the performance of the avocado market grew 104% (Faostat, 2018). The global avocado market was valued at 13.64 billion US dollar in 2018 and is predicted to attain an overall value of 21.56 billion US dollar by 2026 (Comtrade, 2018). The market is projected to show a healthy growth of 5.9% every year during the forecast period of 2018-2026 (TMR, 2020).

Initially, the avocado production was concentrated in Central and South America (Mexico, Colombia & Peru), However, the growing market value incentivize changes with now larger number of other countries increased invest heavily in avocado production responding to the exponential growth in demand which surpasses current supply (Faris, 2016) from 2000 to 2018, with a total production of 5.5 million tons in 2018, and a 69% increase in harvested areas. Currently, more than 80% of the world’s avocado production is in the hands of 11 countries from different regions including Africa and Asia, Mexico leads this list with 33.9% of the world production (Faostat, 2018).

African countries including Kenya, South Africa and Tanzania are among leading producers and exporters of avocado (ITC, 2019; Mwakalinga, 2019). The production and Area under avocado cultivation in Africa has been Increasing yearly at different growth rate from 2000 to 2018 by 43%. But in 2018 to 2019 the results indicated that, there was rapid increase on the area by 352% under cultivation especially due to emerging of new market in china (Faostat, 2019). The trend of exported avocado from Africa was reported to be increasing subsequently on each year, thus from 2001 to 2019, there was increase of exported volume equivalent to 342% Increase (Faostat, 2019; Markup Report, 2020).

The Introduction of the most demanded HASS variety further shows the increase export market for avocado in Tanzania, it proves to be potential for economy as it specifically created about 8.57 million USD in 2018 compared to only 7000 USD in 2009 value (Mwakalinga, 2019). It is very essential as it promotes further agricultural sector commercialization and international value chains. Like in other countries response for the raising word market opportunities for Hass avocado variety in the country is visible through rapid increase in investments for production for export spearhead by major foreign companies including RAC and AFRICADO around year 2008. Although national data on total production volumes are uncertain, that, the results indicated the total Production of all varieties of avocado in Tanzania is approx. 190,000 Tonnes per year. Export for HASS variety volumes rose sharply by 78% for the crop from 6 Tonnes to more than 7 500 tonnes in 2019 (Shirima 2019; Mwakalinga 2019 and Repoa, 2019). The recent export volume per year ranges from 5 000 Tonnes to 8 000 Tonnes to France, Belgium, Netherland, UK, Kenya and South Africa (Shirima, 2019). Despite the HASS variety dominating the exported volume of avocado from Tanzania, the other commercial variety traded for export are Fuertes, Uwesio and Pinkerton, all these are produced in

different potential state in the country as indicated in (Figure 1), these areas are; Mbeya, Njombe, Iringa, Mafinga, Lushoto, Kilimanjaro, Mara and some parts of Kagera Region (MMA, 2017).

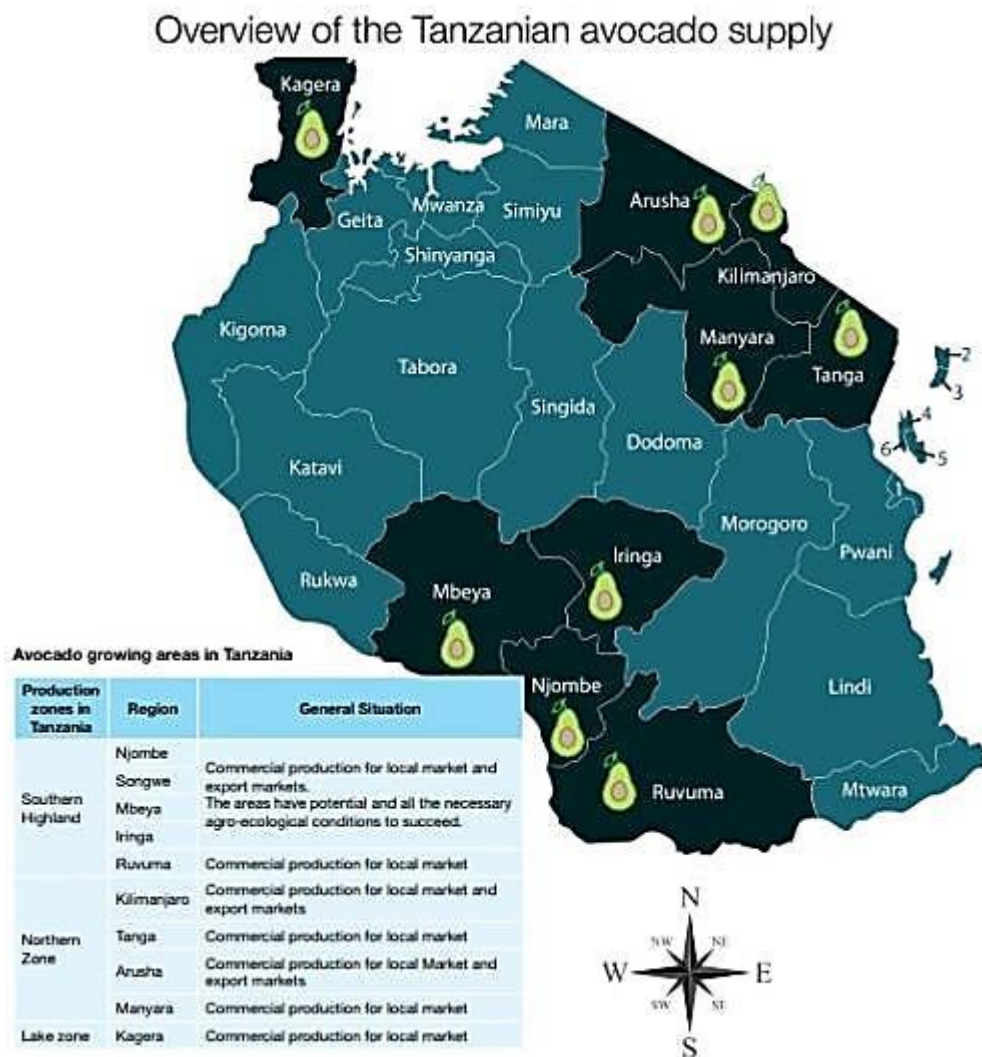


Figure 1: A map of Tanzania showing potential areas for hass-avocado production

1.2 Problem Statement and Justifications of the Study

In recent years, that from 2010 to 2018 the consumption trend of hass avocado fruit has shown a notable average growth of 35% in developed countries (EUROSTAT, 2018). This reflects the growth of the desired market of the fruit from developing countries like Tanzania. Then from 2010 to 2018 the household consumption of hass-avocado fruit in Europe, notably changed as follows; In France the average consumption raised from 1.6 kg to 2.2 kg/person yearly, Scandinavian countries the consumption similarly raised from 1.5 kg to 2 kg per person, German the consumption increased from 0.25 kg up to 0.65 kg (EUROSTAT, 2018).

Moreover, the global production of all commercial varieties primarily 'hass' increased from 2,783,400 tonnes to 6 0005 285 Tonnes, equivalent to 115.7% increase, that's from 2000-2018. This was parallel with production area, increased from 329 372 ha (2000) up to 592 389 ha (2018) that's equivalent to 79.8% increase. In African view, the response was also impressive toward avocado production and exportation, that's in the same range of period (2000-2018), the production increased from 484,718 Tonnes to 717 697 Tonnes (48%), while the exported volume was remarkably increased from 44,537tonnes to 196,995Tonnes equivalent to 342% increase. These reported trends, indicated the promising future of export markets for hass avocado as the commercial variety in the global business (FAOSTAT, 2019).

In Tanzanian context, '*Hass*' Avocado production is mainly in the highly valuable agricultural zones; Rungwe, Njombe, Iringa, Siha-Moshi, kagera etc. Which are historically important for other cash crops (tea, coffee, timber) and food crop production (potatoes, bananas, etc.) (Mwakalinga, 2014). The trend in crop production in these areas show a notable shifting from the traditional cash and food crops in respective zones to

hass avocado production (Shirima, 2019). This was mainly catalysed with reliable export market due to presence of large-scale investing companies like; Rungwe avocado company, Kuza Africa, Korongo 3, Lima Kwanza and Africado for exporting hass avocado, within and out of the regions. Moreover, exponential rise of price of avocado per Kg, from 250 Tsh (2012) to 1 500 Tsh (2019) in the mentioned areas, also triggered the interest of the farmers to engage in the business of avocado production (Mwakalinga, 2019, Repoa 2019). Regard on potential of avocado to and business viability, thus it is beneficial economically to actors/farmers as potential income and still unmet demand provides room for further production and market exploitation potential from Tanzania (Taha, 2019). Then, increase number of investments in Hass-Avocado in these respective potential areas by large foreign investors companies, medium scale investors and small holder producers. Led to more than 1886.7 Ha of land area allocated to the crop in 2019 compared to only 198 Ha in 2008 (Shirima, 2019).

Similarly, in Rungwe District the avocado production is based on three main varieties: Hass, Fuertes and local ones. The most exported variety is Hass, whose production has been increasing relative to an increase in the area under cultivation (RAC, 2015). In 2008 the area under Hass-avocado production was approximately 60 ha, while in 2019 the area increased up to 1 136.7 ha (RAC, 2018). Out of these 1 136.7 ha under avocado production, it is only 673.7 ha equivalent to 59.3% that are managed by the out-growers and 463 ha equivalent to 40.7% is under Rungwe Avocado Company and Kuza Africa as main producers and exporters in the district (RAC, 2018). The production of local avocado varieties in the district is done on 371.3 ha only, which makes a total of 1 508 ha as the total area of avocado production in the district (Rungwe District Report 2018). The numbers of out-growers and non-out-growers have been increasing steadily from 100 farmers in 2008 to approximately 12 000 farmers in 2019. This is a great potential in

terms of manpower in the industry. The trend of avocado production in the district for both local and improved varieties was on average of 29 158 tons per year for the period of five years from 2014 to 2019 (Rungwe District Report, 2018).

Then with all these, underlying impressive information on hass avocado production as an investment portfolio, discussed from global to Rungwe district level, yet little has been done, in terms researches or studies undergone to explore future economic analysis of perennial crops, in this case, it's hass -avocado Production investment in the region particularly in Rungwe District. However, the study appreciates, the empirical data available for avocado production in the region, that have much focused on value chain analysis, value addition, diseases, pest management and agronomic analysis of the fruit (Mwakalinga 2014, Shirima, 2019, Repoa, 2019 and Tantrade, 2020), but leaving aside the basic knowledge on the future economic analysis of producing the fruit, With consideration, avocado tree is a perennial crop in nature, having the long gestation period, an extended period of output flow, and varying stages of productivity over its lifetime (Khuda, 2006). Therefore, all these features entail that, detailed analysis is needed on determining the economics of growing the fruit and sufficient knowledge regarding returns on commercial avocado investment in the study area. This would lead into rational decisions at the farm level during various production stages. Since, farmers in Rungwe need prior information regarding investment and returns in avocado production.

Henceforth, keeping in view the importance of avocado investment in the study area, Therefore, the study was focused to address the main question on how the production of hass avocado in Rungwe District is economically viable. Then to address this question the study would focus on the following three objectives. At first, to have a clear understanding on the status of avocado production and exportation in the Tanzania.

Secondly to determine economic viability of producing hass avocado as an investment portfolio to small-holders' farmers in Rungwe district. Moreover, the study intended to assess the severity level of the existing constraints or challenges which affect both avocado farmers and exporters in production and access to the export market from Rungwe District.

1.3 Justification of the Study

Most studies done in avocado industry in Tanzania such as REPOA (2019), Shirima (2019), MMA (2017) and Mwakalinga (2014 and 2019), were mostly addressing the agronomic part of avocado production, analysis on the value chain and market of avocado varieties in Tanzania. None of them focused on the economics related to avocado production and its future return as an investment portfolio in horticulture industry. Unfortunately, the farmers and other stakeholder in Rungwe District and other potential area in the country, lack information, particularly on economic analysis of long-term investment in fruit orchards. Therefore, the presence of this study in Rungwe District, justified the provision of reliable and accurate information among growers, exporters and policy makers to enhance avocado investment Rungwe and Nation at large. Keeping in view that the return on investment in avocado production should exceed the investment cost, considering the avocado investment has high opportunity cost.

The current study has additional inputs to the body of literature, by using productivity cycle of the avocado tree and make economic analysis on the investment in avocado orchard. This is done, using the output obtained at different stage of the production of the tree to determine the economic return of avocado production, that's using Cost, Benefit Analysis as the tool of analysis. This basically provided new insight in the body of horticultural knowledge especially in the fruits production in the country. Instead of using

directly several simulation methods, make use of Productivity circle of the tree to obtain future benefit on the investment of avocado farm.

Moreover, avocado production capacity in potential areas in Tanzania is not matching with existing potentials in the given areas due to various constraining factors which tend to affect the production capacities in the country and lowering down the marketability of the fruits and competitiveness of the country in the global market. Therefore, the findings from this study will provide useful information by showing the severity level (Magnitude) of each identified constraint to avocado production in the study area, this would be a major step forward in resolving this setback encountering both avocado productions, especially to stakeholders and policy makers.

In addition, the findings from this study are aligned with the National Horticulture Development Strategy 2012 – 2021: which was written by Horticultural Development Council of Tanzania (HODECT), and sets a road map for transforming horticulture sector in Tanzania through achieving the seven pillars of its strategic initiatives including the promotion of horticulture, expanding production base and improve quality; strengthen industry linkages and mobilize human resources which are expected to directly address the most critical constraints in the industry and provide the catalyst for expanding the market for Tanzania horticulture.

Furthermore, the study findings are aligned with five years national development plan, phase 3 (FYDP III), by showing that in engaging in avocado production as a long-term investment to small-holders' farmers in Rungwe district, would firstly improve the basic needs and reducing food poverty as indicator in the national development plan. Then, involving in export market of Hass-avocado would comply with the theme of national

development plan. Thus, the study has the contribution in agricultural sector policy as it aligns with agricultural sector development program II (ASDP II) by promoting investment and trade in avocado industry.

1.4 Objectives

1.4.1 Overall objective

The overall objective of the study was to undertake an economic analysis of hass avocado production and marketing to smallholders-farmers located in Rungwe District, Mbeya region to establish an investment knowledge and awareness of agricultural business to the farmers, so as they can have base of making an appropriate decision on this long-term hass avocado investment portfolio.

1.4.2 Specific objectives

The specific objectives of the study were to:

- i. Assess the current situation of hass- avocado production and export market trade in Tanzania.
- ii. Determine the economic viability of producing hass-avocado in Rungwe District.
- iii. Analyse the factors to hass- avocado farmers' willingness to participate directly in the export market.
- iv. Examine the severity level of hass-avocado production and export market constraints in Rungwe District.

1.4.3 Research questions

- i. What is the current situation of hass-avocado production and export market in Tanzania?
- ii. Is it economically viable for smallholder farmers in Rungwe District to engage in hass-avocado production?
- iii. What is the severity level of hass-avocado production and export market constraints in Rungwe District.?

1.4.4 Hypothesis

- i. H_0 : Socio-economic factors have no influence on the willingness of the avocado farmers towards participation in the export market from Rungwe District.

1.5 Organisation of the Thesis

The thesis is organized into five chapters. Chapter one presents the background information, problem statement and justification of the research, objectives of the study and research questions. Chapter two includes theories underpinning the study, detailed narration of the key terms used in the study, a review of relevant literature, conceptual framework and the gap that the study filled in. Chapter three presents the analytical part of the study, which involves the methods applied to the study. Empirical results and discussion of the study are presented in Chapter four. Then, Chapter five presents conclusions and recommendations based on the findings obtained based on the objectives of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Production theory

Production theory was applied to expound the existing association between inputs used and outputs obtained in the production of commercial variety of avocado ‘hass’, which is the transformation of factor inputs into outputs (Thomas and Maurice, 2008). It’s a neo-classical production theory, where the smallholders-farmers in Rungwe District were assumed to be rational producers with an intention of maximizing profit by minimizing costs of avocado production, with respect to given resource constraints or input costs (Debertin, 2012). The Production function used as the physical or technical relationship, that transforms inputs (resources) into outputs (commodities) (Debertin (2012).

In this case, main objective of the farmers of hass avocado as economic producers was to maximize their profit by either increasing the quantity of output produced or reducing the cost of production at a certain level of output. Therefore, in this study, the aim was to have an appropriate combination of inputs(resources) in order to maximize output level per each acre of land (Cerdan-infantes *et al.*, 2008; Debertin, 2012).

Likewise, production technology was the significant component in the application of the theory, regarding the quantity produced. This is a very vital part of the theory of production economics which describe the production technology as the framework for the economic behavior of the producers. But principally Production technology explains the existing relationship between input and output produced, this relationship is based on empirical observation between inputs and output (Rasmussen, 2012).

However, rational assumptions do not hold, and most of the farmers fail to realize potential production levels due to lacking of knowledge of how resourcefully to combine farm inputs.

2.1.2 Profit maximization theory

The major concern in avocado production among farmers is the minimization of cost(s) for a given level of output, and the maximization of revenue for a given level of inputs. However, some farmers would have incurred high costs of avocado production because they lack alternative means of minimizing the costs and maximizing profit. Thus, the literature suggests that most of farmers might be motivated to produce based on their attitude towards risk; the utility derived from production; and for-profit reasons (Huffman, 2011; and Muehlhauser, 1974). Hass avocado is referred to be a cash crop in the study area (Rungwe district) and it employs more than 4,000 families (RAC, 2018) who are the owner of avocado farms. It is, therefore, safe to argue that profit maximization is the priority of the majority of these farmers.

Therefore, generally this study was guided by the theory of profit maximization (Debertin, 1986; and Muehlhauser, 1974). Hass avocado producers invest in hass avocado production to get a certain output that minimizes costs and maximizes profit. According to Cellini (2015) the farmer's profit is equal to total revenue received (TR) minus total cost incurred (TC). The production costs of hass-avocado are determined by fixed cost and variable costs invested to produce a certain output through which a profit can be obtained after selling the gained output less the cost of production. Understanding the profitability in hass-avocado production among farmers was at the center of the presentation study which aimed at analyzing whether it is profitable in the long run to produce improved varieties (hass) in terms of returns on investment.

In this study, the theory was applied based on motives of individual farmers in the study area. The argument of using individual farmer's motives in relation to the theory was grounded on the facts that, avocado farmers were regarded as rational decision-making units at household level. Therefore, the decision on what and where to invest was driven by either profit or utility maximization (Mattila, 1999). Thus, for the case of this study, the argument was on profit maximisation since the avocado farmers were taken as producers not consumers.

In profit maximization theory, the assumption is; farmers at the household level are regarded as rationally behaving units (Mattila, 1999), and therefore, they aimed at maximizing their profit for any crop enterprises they dealt with, either in short or long-term of investment decision (Kumar, 2012). With regard to avocado production in Rungwe District, the avocado production investments to the farmers were long-term depending on the nature of the crop itself, that's perennial crop.

In that case, for the farmers in Rungwe district, to have a better application of this theory the necessary and sufficient conditions for profit maximization theory were to be met. One; the necessary conditions for profit maximization required; the profit function should have a slope equal to zero, that can be determined by finding the point on the profit function where the first derivative is equal to zero (Derbetin, 2012).

Given the profit function below:

$$\pi = pF(k, l, f_i) - rK - wL - uf_i \dots\dots\dots(1)$$

Where the terms used in the equation as determined as π = *determined Profit*, k = *Capital employed by avocado farmers*, l = *Labor employed*, f_i =*Other Inputs Factors (Fertilizer,*

Pesticides, Herbicides, and fungicides) $r, w, u =$ coefficients of the variables used in the equation respectively

Therefore, on determining the profit maximization, then the first derivative of the given function with respect to **labor** is set to be zero. Thus, when capital and other inputs factors are kept constant in the equation.

$$0 = \frac{\partial \pi}{\partial L} = p \frac{\partial \pi}{\partial L} (k, f_i, l^*) - w \dots\dots\dots(2)$$

Where the terms used in the equation as determined as $\pi =$ determined Profit, $k =$ Capital employed, $l =$ Labor, $f_i =$ Other Inputs Factors (Fertilizer, Pesticides, Herbicides, and fungicides) $r, w, u =$ coefficients of the variables used in the equation respectively

Therefore, on determining the profit maximization, then the first derivative of the given function with respect to **capital** is set to be zero. Thus, when capital and other inputs factors are kept constant in the equation.

$$0 = \frac{\partial \pi}{\partial k} = p \frac{\partial \pi}{\partial k} (f_i, l, k^*) - r \dots\dots\dots(3)$$

Where the terms used in the equation as determined as $\pi =$ determined Profit, $k =$ Capital employed, $l =$ Labor, $f_i =$ Other Inputs Factors (Fertilizer, Pesticides, Herbicides and fungicides) $r, w, u =$ coefficients of the variables used in the equation respectively

Therefore, on determining the profit maximization, then the first derivative of the given function with respect to **other inputs variable** is set to be zero. Thus, when capital and other inputs factors are kept constant in the equation.

$$0 = \frac{\partial \pi}{\partial f_i} = p \frac{\partial \pi}{\partial f_i} (k, l, f_i^*) - u \dots\dots\dots(4)$$

Where the terms used in the equation as determined as $\pi =$ *determined Profit*, $k =$ *Capital employed*, $l =$ *Labor*, $f_i =$ *Other Inputs Factors (Fertilizer, Pesticides, Herbicides and fungicides)* $r, w, u =$ *coefficients of the variables used in the equation respectively*

Secondly, the second derivative of the profit function should be equal to negative Debertin (2012). Thus, the two conditions make the entire theory of Profit maximation to be held.

$$0 \geq \frac{\partial^2 \pi}{(\partial L)^2} = p \frac{\partial^2 F}{(\partial L)^2} (k, f_i, l^*) \dots \dots \dots (5)$$

$$0 \geq \frac{\partial^2 \pi}{(\partial k)^2} = p \frac{\partial^2 F}{(\partial k)^2} (f_i, l, k^*) \dots \dots \dots (6)$$

$$0 \geq \frac{\partial^2 \pi}{(\partial f)^2} = p \frac{\partial^2 F}{(\partial f)^2} (k, l, f_i^*) \dots \dots \dots (7)$$

Where the terms used in the equation as determined as $\pi =$ *determined Profit*, $k =$ *Capital employed*, $l =$ *Labor*, $f_i =$ *Other Inputs Factors (Fertilizer, Pesticides, Herbicides, and fungicides)* $r, w, u =$ *coefficients of the variables used in the equation respectively*.

2.1.3 Random Utility Theory

This study is also underpinned by the Random utility according to which individuals make choices based on their preferences and the perceived utility or value of different options. In the case Rungwe district, the avocado farmers, would weigh the potential benefits and costs of exporting avocados versus selling them locally to the exporting companies farmers would need to consider factors such as the potential profits from exporting avocados, the costs of meeting quality standards and complying with

regulations, the risks associated with fluctuations in demand and prices, and the potential benefits of diversifying their income streams. They would also need to consider their own preferences and values, such as their desire to maximize profits, their willingness to take on risk, and their commitment to meet their customer's needs. As rational utility maximizers, avocado farmers would choose option that maximizes their utility.

Thus, the avocado farmer's utility function can be presented as:

$$u = F(X_1, X_2, X_3 \dots \dots \dots X_n) \dots \dots \dots (8)$$

Where:

u ; represents the overall utility or satisfaction that an individual derives from consuming a set of goods or services, and

$X_1, X_2, X_3 \dots \dots \dots X_n$; the different attributes or characteristics of those goods or services.

F ; represents the function which shows the relationship between these attributes and the overall utility and can take different forms depending on the specific context.

2.2 Operationalization of Key Terms

2.2.1 Production potentials

A Potential, is the term applied in agricultural sector, meaning unexploited capacity of the farmers to produce based on the available supporting factors of production, alike land, labour, favourable climatic conditions, availability of inputs factors and existence of exporting companies (MMA, 2017). In other way, can be defined as an opportunity to produce a certain volume of output at a certain time” In the framework of the first approach, the production capacity is considered from the point of view of the resources available to the organization or firm. Moreover, production Potential can be explained as the possibility to produce but not yet actual production or prenominal capable of being or becoming but not yet in existing (ITC, 2018). In connection with avocado production,

especially the commercial avocado ‘*hass*’ in Rungwe district. It’s determined to have great potential in production of hass avocado due to supporting factors of production in place. Such as; favorable climatic condition (enough rainfall ranging from 990 mm in the low land zone and 2700mm in the high land zone. The district is located in high altitude ranging from 770m to 2265m above from the sea level. Then, availability of labor (family labor), availability of inputs factors particularly manual, and related input factor (RD Report 2019), which tend to make the place to have great potential of production.

2.2.2 Export market potential

Export market potential is classified as an available opportunity in the export market through available exporting means or government entities (Shirima, 2019), in case of avocado industry, it is further defined as higher demand of an average of 600 metric tonnes increasingly yearly of the fruit in the global market. Then its underutilization of the existence supportive infrastructures, competitive prices which has been increasingly yearly thus from €2 to €4 in the world market and supportive policy from the Ministries of Agriculture and Transport (Mwakalinga, 2014).

2.2.3 Export market of avocado

Export market in different products is continuing catching up the interest of investors globally, due to its potential at individual and national level on gaining foreign currency (ITC, 2018). This export market is now becoming a matter of survival rather than a matter of choice for many firms in the world of continued globalization of the world’s economies, and intensifying worldwide competition have stimulated an ever-increasing number of firms to internationalize.

Exportation in the avocado industry is a fundamental strategy in ensuring firm’s survival or growth, and, most of the countries which do export the avocado achieve competitive

advantage in international markets with a positive influence on current and future export performance. Countries especially from Latin America (Peru, Brazil, Colombia, Dominican Republic) have allocated more attention and resources in order to export their avocado to Europe and to a new emerging market of China (ITC, 2018).

2.2.5 Economic analysis

Economic analysis is an economic tool used on estimating the accrued return of the investment against investment cost (IFC, 2016). This analysis is based on community perspective and takes a broader view of the profitability of the project including external effects such as environmental impacts and health impacts. The value of external effects is typically assigned using economic opportunity costs or shadow prices. An economic analysis does not include taxes, tariff and subsidies. Variable indicators are NPV, CBR, IRR and Payback-period.

The goal of the economic analysis is to demonstrate that the project has a net effect to the society or community. This is typically based on the household economy. Then it is also more frequently being used to brand private investments as being socially responsible. Thus, financial analysis serves a very specific purpose, whereas the economic analysis is used to communicate the benefits of the project to many different stakeholders including the farmers (IFC, 2016).

2.2.6 Economic viability

The investment is economically viable if its economic benefits exceed its economic costs at given period of time (Hennessy *et al.*, 2008). Economic viability analysis basically embraces a cost-effectiveness analysis to determine whether the investment is the lowest-cost alternative to achieve the expected benefits or return. Therefore, for the project or investment to be economically viable should be sustainable, Meaning, it has an ability to live longer, grow, and develop (de lima, 2015).

O'Donoghue *et al.* (2016) established different definitions of economic viability in his literature works. From his findings, there was a difference between the United States and the European concept on economic viability. The U.S. definition expressed the term Economic viability as the ability of meeting the income needs of the household member, while the European definitions understand the viability as an opportunity cost measure (O'Donoghue *et al.*, 2016).

2.3 Review on the operational terms in Avocado Fruit (*Persea americana*) and Its Varieties

Avocado as the fruit

This is the fruit, with a long history on its spreading from Latin- America to other parts of the world especially Africa. Originally, is a native fruit from Central America and Mexico. It is alleged that it originated from Santa Marta Region in Colombia in the 14th Century and later on continued spreading in Venezuela, West Indies, Chile, Madeira, and Canary Island between the 16th and 17th centuries (Focus, 2006). Then plant was introduced to the United States in Hawaii, Florida and California from Mexico in the first half of the 18th century. The dissemination of this fruit in Africa took place much later, at the end of 19th century, by colonial powers like “Portuguese, Germans, British and French” (Focus, 2006). It is argued to spreading very fast to the rest of the world due its commercial and health importance (Faris, 2016).

It is a climatic fruit by nature, matures on the tree, but ripens off the tree. It is harvested when it is hard and green and kept in a cool temperature at 3.3 to 5.6°C, and differs in maturity time depending on the nature of the given variety. There are more than 100 varieties which are known globally, but few are commercial like Hass, Fuertes, Pinkerton, Zutano, etc. It is highly grown in tropical areas with low temperature (Gabi, 2011).

In Tanzania, the avocado fruit was introduced by German colonial power in the late of 1880s, particularly in the northern part of the country and went on spreading to the other areas of the country (Mwakalinga, 2019). However, a new commercial variety of Hass-avocado was introduced more recently in 2007 by Africado Company in Kilimanjaro and later on in Rungwe District in 2009 by Rungwe Avocado Company (Rungwe Dc, 2010).

2.3.1 Hass-avocado variety

This is the variety of interest in the study. It is classified as a Guatemalan variety; its fruits are picked when they have more than 23% dry matter, green in colour that turns dark on ripening, with a medium rough outer skin. It has a weight ranging from 200-350 grams, has advantages over other varieties in terms of yield, and is richer in flavour owing to higher oil content and longer shelf life. Once picked, they ripen in one to two weeks at room temperature, but when kept at 5°C it can stay more than a month. It has a very high potential to grow because of its marketability in the global market and its resilience to logistic activities. It is for those reasons mentioned before, makes this variety of avocado to become the variety of choice for export, and regarded as commercial for most of African countries. Globally, it accounts for 80% consumption (Feed the Future Report, 2015).

Classification of Avocado varieties

Avocados are generally classified into three major classes, which are distinguished based on the form of taste, colour and shapes;

Extra Class

Avocados in this class must be of superior quality. They must be characteristic of the variety. They must be free from defects, with the exception of very slight superficial

defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package. If present, the stalk must be intact.

Class I

Avocados in this class must be of good quality. They must be characteristic of the variety. The following slight defects, however, may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- a) a slight defect in shape
- b) slight defects in colouring
- c) slight skin defects (cockiness, healed lenticels) and sunburn, provided they are not progressive; the maximum total area should not exceed 4 cm².

Class II

This class includes avocados that do not qualify for inclusion in the higher classes but satisfy the minimum requirements specified above. The following defects may be allowed, provided the avocados retain their essential characteristics as regards the quality, the keeping quality and presentation:

- a) defects in shape
- b) defects in colouring
- c) skin defects (corkiness, healed lenticels) and sunburn, provided they are not progressive; the maximum total area should not exceed 6 cm². In no case may the defects affect the fruit flesh. The stalk, if present, may be damaged

Classification based on dry matter content

The avocado fruit should have minimum dry matter content, this is an indication of the maturity level and is measured by drying to constant weight: then the percentages represent the dry matter content for each variety.

- a) 21 % for the variety Hass,

- b) 20 % for the varieties Fuerte, Pinkerton, Reed and Edranol,
- c) 19 % for the other varieties except for Antillian varieties that may show a lower dry matter content.

Classification of avocado based on Sizes

The Size is determined by the weight or count of the fruit. The minimum weight for avocados is 123 g except for Hass where it is 80 g and for Antillean varieties where it is 170 g. To ensure uniformity in size between produce in the same package, the following provisions should be applied:

- (a) For Antillean varieties

The weight of the smallest fruit shall be not less than 75 percent of the weight of the largest fruit in the same package.

- (b) For other varieties the following size scale applies: as presented (Table 1).

Table 1: Classification of avocado based on Sizes and weight

S/n	Size code	Weight Range(g)
1	4	781-1220
2	6	576-780
3	8	456-576
4	10	364-462
5	12	300-371
6	14	258-313
7	16	227-274
8	18	203-243
9	20	184-217
10	22	165-196
12	24	151-175
13	26	144-157
14	28	134-147
15	30	123-137
16	S*	80-123(hass variety)

Source: TANTRADE manual report, 2020

2.3.2 Seasons variation in avocado production in Tanzania

Fruits and vegetables are produced seasonally, and this tends to directly influence their marketing status. Normally, they have limited harvesting periods of more or less a year-

round demand. In fact, in some cases cultural and religious set ups of the society also render demand to be seasonal. The seasonality is also determined by inadequate storage facilities (Adugna, 2009).

Avocado fruits have specified periods of harvesting at given areas of production and differ depending on the location. Normally, it is termed as a limited period of harvest, or a year-round demand. This seasonality is normally influenced by some external factors which may lengthen or shorten the season (Berhanu, 2013). In this study the seasonality in avocado harvesting has a direct influence on international market of avocado, because of variation in the length of season from the giant producers of avocado in Peru and Mexico (Faostat, 2018). In the case of Tanzania, avocado production takes place in two main seasons, that's from March to September and then from December to January. This is regarded to be a competitive advantage to avocado farmers in the country compared with the countries from Latin America whose season starts from February to July only (Mwakalinga, 2014).

2.4 The Business of Horticultural-products in Tanzania

The horticulture industry in Tanzania is the most rising subsector within the agricultural sector; it has an average annual growth of nine to 12%. From the beginning of the year 2015 to 2016, the horticultural subsector had a contribution of 38% of the foreign income in the agricultural GDP. The subsector employs more than 2 million people, which makes the industry to be referred to as a major employer within the agricultural sector (MMA, 2017). The horticulture industry is mainly controlled by smallholder farmers, who account for about 70% to the total horticultural product producers. The majority of them do not have sufficient knowledge on international markets and therefore have limited chances to conduct export business on their own, especially on avocado. Therefore, they have to

work under exporting companies to have access to international market (MMA, 2017 and Juma, 2019).

2.5 Horticulture-policy in Tanzania

In Tanzania, there is good policy and an institutional framework for the horticultural subsector, which deals with fruits, vegetables and spices. The sector is guided by the Tanzania Horticultural Development Strategy (2012-2021). From 2009 the sector provides a room for private sectors to work with farmers in production and exportation of avocado from Tanzania. For instance, there are associations and companies like TAHA, Africado, Rungwe Avocado and Kuza-Africa which have been working with farmers in the form of contract farming under the umbrella of HODECT. Therefore, the avocado sub-sector benefits from an improved environment through efforts of the private sector and HODECT (MMA, 2017).

2.6 Global Avocado Production and Area under Avocado Farming

The results indicated in Fig. 2 show a positive trend of production and area under avocado production in the world, this reflecting the growth of the industry globally. As indicated in Fig. 1, starting from 2000 to 2006 there was impressive increase in avocado production relative to an increase of the area under cultivation. There was slightly drop in 2007 to 2008, which was due to some economic crises in 2008 in America, regarding that America is one the giant importers of avocado in the world (Shahbandeh, 2019). Then, starting from 2009, the results assumed a continuous increase of production up to 6.4 million Metric Tons. This promising trend of avocado production globally was assisted with increase of people's awareness on economic and health potentials (Fresh Plaza, 2019). Then, from 2017 to 2018, there was a remarkable growth of production, which marked a growth rate of 137%, while the reported increase in the area under cultivation

more than doubled; that's from 329 372 ha to 918 531 ha, equivalent to 178% calculated growth.

This reported sharp increase in the area under avocado production as indicated in the results reflected the expansion of production farms, mainly being done in big producing countries. The stated argument is well supported by a report of FAO-statistics of 2017 which stated that Peru, Mexico, South Africa, Kenya and Colombia, from 2016 to 2018, had commercial agreements of supplying avocado to a new market of China whose demand was increasing gradually from 25 127 Mt. to 43 859 Mt. This had a contribution of 68.4% of the total world production (Fresh Plaza, 2019). Secondly, a notable increase within the mentioned period was also characterised by increase in the export trade of the fruits, especially in the United States and in European countries.

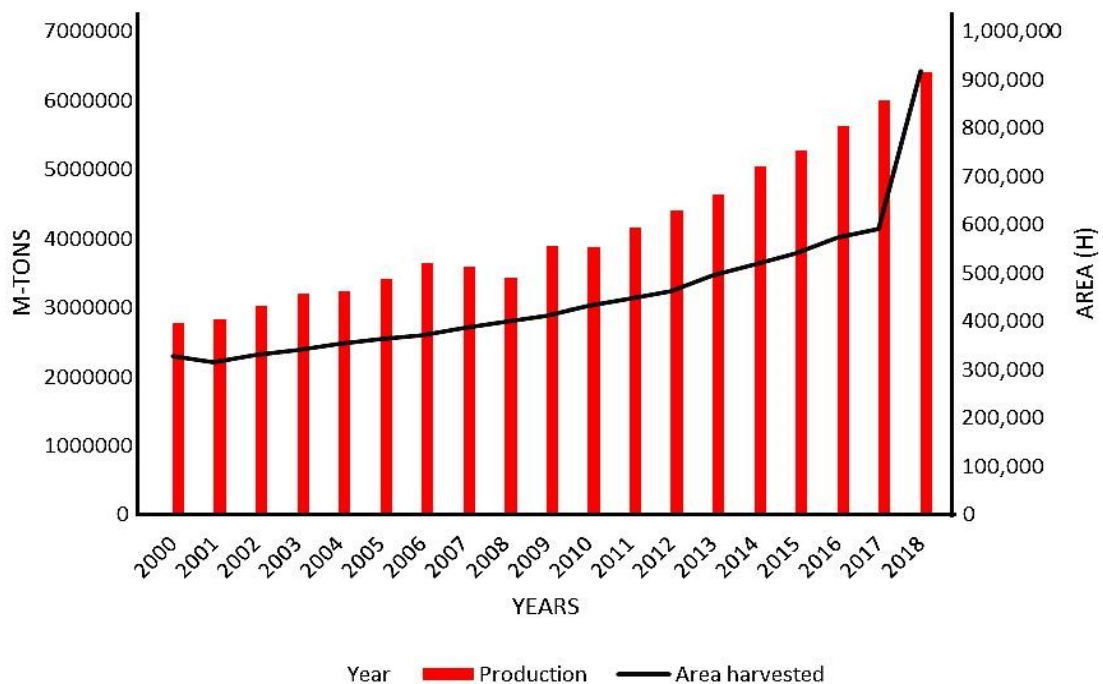


Figure 2: Global avocado production and area under cultivation

Source: FAOSTAT, 2018

2.6.1 Global avocado export trade

The results shown in Fig. 3 indicate the world avocado business which statistically increased with time, based on the potentiality of the business. This was basically contributed by the expansion of the avocado business in Latin America and Africa, regarding large contribution in the production and export business of the fruits from these continents. Fig. 3 also indicates that the world avocado business grew annually at the growth rates of 18% and 12% in terms of value and quantity exported in a range of five years. The results further show that, from 2014 to 2015, there was no remarkable different change in the exported volume but an increase in the traded value. This noted change on the traded value was basically influenced by an increase in the internal consumption of the avocado in the main exporting countries, like South Africa and Mexico, whose internal markets tend to compete with external markets. The stated argument is more supported by a report by Hakizimana (2014), which explained that there is an increase of consumption of avocado fruit for internal industry in South Africa by 44% of the produced avocado.

Furthermore, the results also indicated, in 2018 the world imported 2.43 million M-tons which were having a value of 5.5 million dollars, the traded volume gives an indication that the main world importers of avocado had been promoting avocado business by increasing the level of consumption. But, again in the period of 18 years (2000 to 2018), the export volume indicated from the results, reflected a significant growth, due to an increase of the exported volume, that's from 320 470 M-tons to 2 431 510 M-tons. This indicated that there was an average increase of 117 280 M-tons in each year which was plausible growth rate of the avocado business in the world. Figure 2, presenting Global exported quantities and monetary values of avocado trade

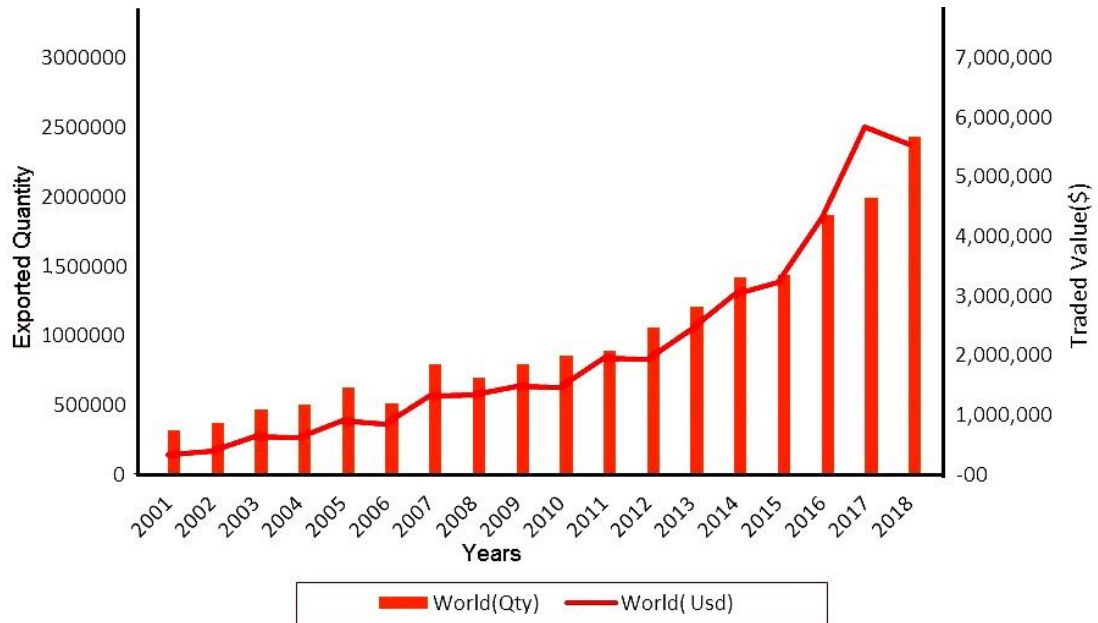


Figure 3: Avocado exported quantities and values globally from 2001 to 2018

Source: FAOSTAT, 2018

2.6.2 Global producers and exporter of avocado

Figure. 4 presents the countries having high production and export volumes in the world market, most of them are located in Latin America, indicating that still there is an opportunity in Africa to have high production and exportation to the world market due to avocado competitive advantage. From the results, it is indicated that, the leading country is Mexico with an export volume of 2 029 890 Mt. per year while the United States ranks the tenth by producing 132 730 Mt. per year. From Africa, Kenya ranks the seventh in the total global production, with a production quantity of 194 280 Mt. This result gives an indication that, still, there is an opportunity for East African countries to use Kenya as a good example of competitiveness. South Africa is the second runner in Africa for avocado production but mainly 56% of its production is used internally and only 44% is exported, the argument is supported by the report by FAOSTAT in 2018.

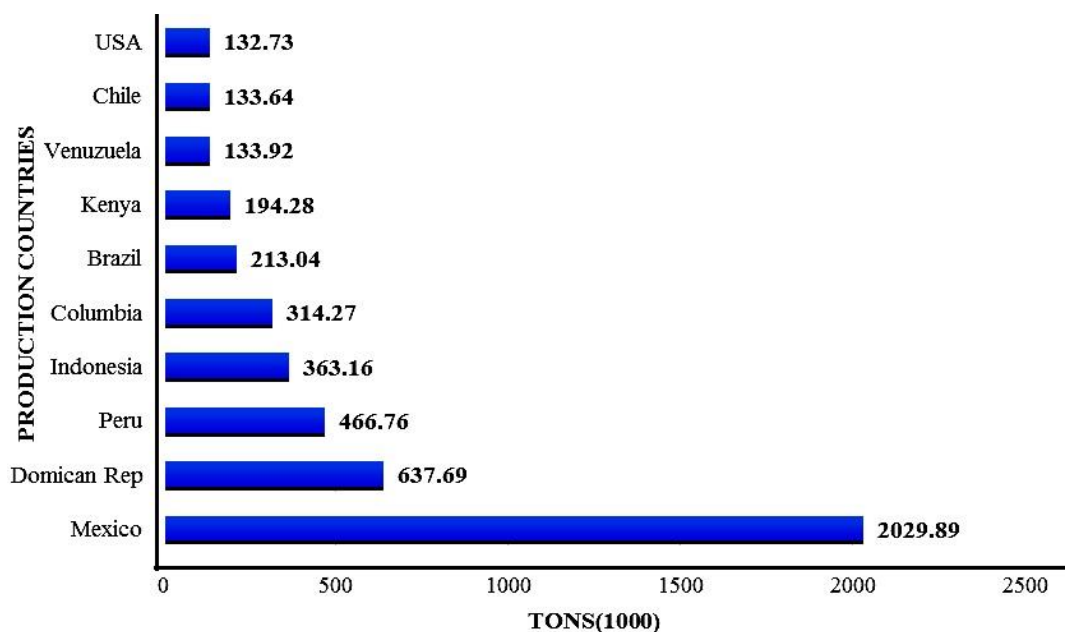


Figure 4: Main producers and exporters of avocado globally

Source: FAOSTAT 2018

2.7 Status of Avocado Business in Africa

2.7.1 Avocado production and area under cultivation in Africa

Results indicated in Fig. 5 represent the current situation of the avocado industry in Africa and the continent's initiatives in terms of increasing area of production that resulted into increased production of avocado at a time. The Computed results indicated that, from 2000 to 2017, the area under avocado production increased from 59 567 ha to 85 241 ha equivalent to an average increase of 43.1% as the growth. The production in the continent was shown to have an increase from 484 718 M-tons to 717 697 M-tons within the same range of time. Such increase of 232 979 M-tons, was equivalent to a 48.1 % growth indicating that there has been a positive growth of both production and area under avocado production.

Remarkably, the presented results have also shown that, there was a sharp increase in terms of area under avocado production in the continent from 2017 to 2018, which did not

have an effect on production depending on the nature of the crop, that is perennial. This was driven by increase of people's awareness on the potential of the fruits which altered the production area in the continent.

Specifically, the cultivated area increased from 85 241 ha to 385 249 ha which was more than 200% growth while the production itself increased from 717 697 M-tons to 802 016 M-tons equivalent to 11.7%. The key argument for the mentioned increases was explained in the report of Euro-statistics of 2018, as the supporting facts on the presented results. Thus, both increase in production and area in Africa, was due to increase of importing countries of avocado from Africa; these are Middle East, America and a new market in China whose demand has been increasing yearly. Secondly, the increase of the demand of avocado in European nations triggered interests of the production states in Africa to engage in the venture.

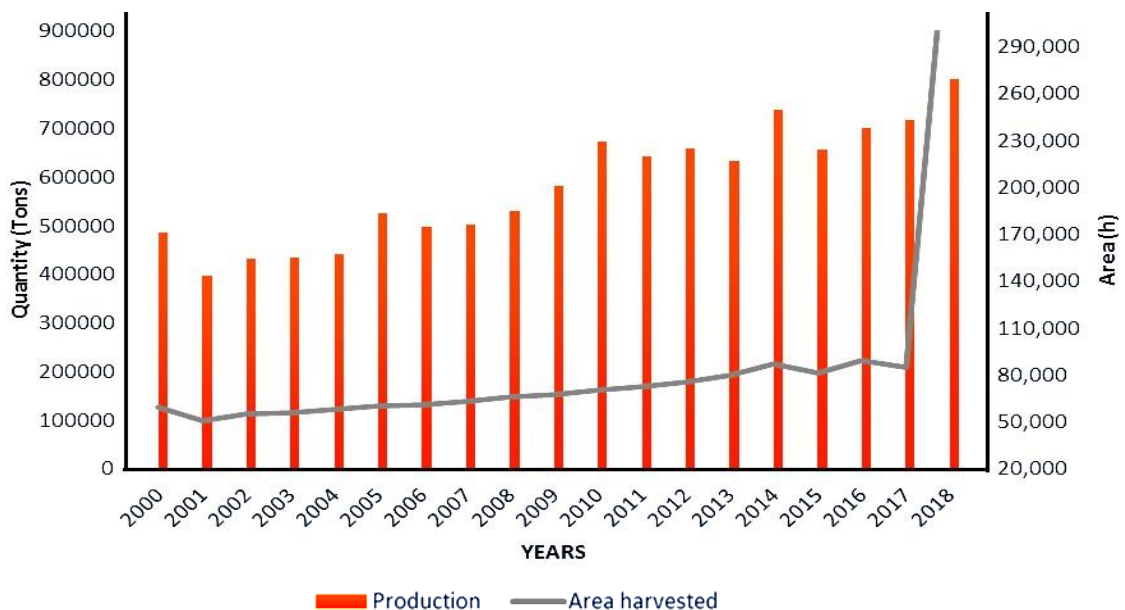


Figure 5: Africa: Avocado production and area under cultivation

Source: FAOSTAT, 2018

2.7.2 Avocado export trade in Africa

Presented result in Fig. 6, indicated the avocado business in one of the potential continents in production and export business of avocado in the world, that's Africa. The results shown that, there has been an increasing volume exported from Africa, through its respective countries. In two decades, time, that was from 2000 to 2018, results shown, the exported volume, had increased from 44 537M- tons to 196 995 M-tones, equivalent to 342% growth. Despite the increase in the traded quantity was not linear, yet the increase in exported volume was parallel with an increase in the export values from 19 845 000 dollars to 195 565 000 dollars. This indicated the good growth of the business in the continent.

However, from Africa, the pace of exportation is still low as compared to the pace of production. In relation to the production and export or traded volume, gives an indication that less has been done yet. Thus in 2001, the production which was reported in the previous results shown to be 484 718 tons but only 44 537 tons reported to be exported, equivalent to 9.18% of the total production. In 2018, the continent made a production of 802 016 tons but the exported volume was 196 995 tons equivalent to 24.6% of the produced avocado, still there is great mismatching between what is produced and what is exported.

Therefore, this reflects the current situation of the avocado business in Africa, that still there is more potential in the export business of avocado which has not been exploited yet, since little has been done to the rest of the countries in the continent including Tanzania as per the presented results. Fig. 5 shows exported quantities and monetary values of avocado from Africa.

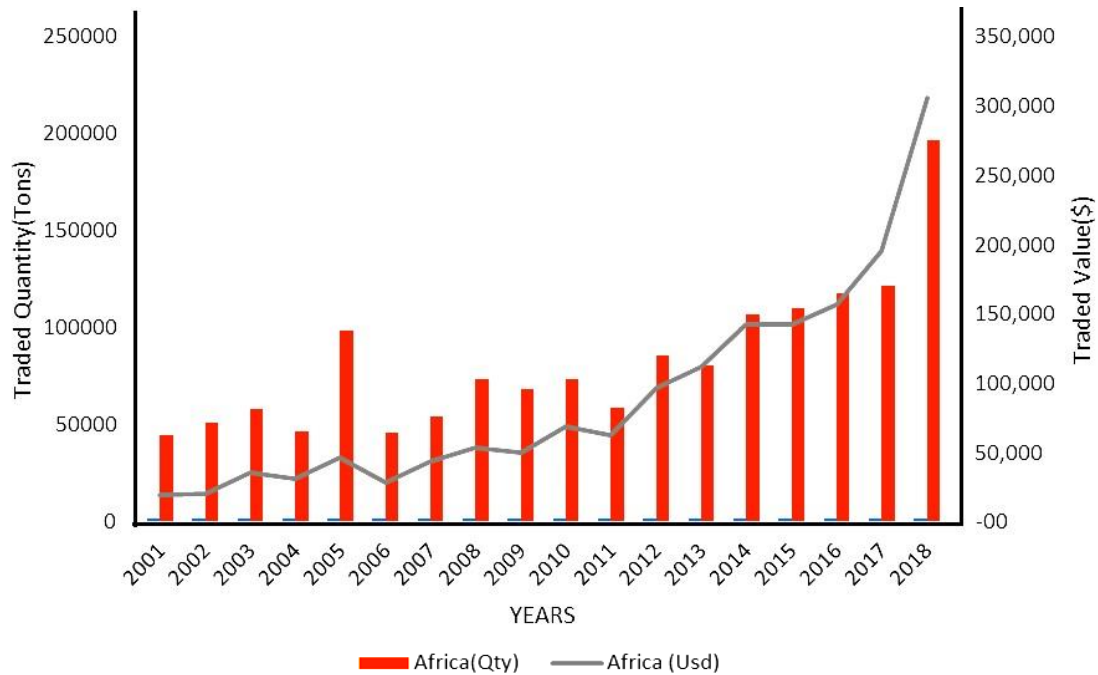


Figure 6: Avocado exported quantities and values Africa from 2001 to 2018

Source: FAOSTAT, 2018

2.7.3 Trend of avocado exports from main producing countries in Africa

The presented results indicate the trend of avocado exporting business in Africa, the top producing states in the continent were Kenya and South Africa whose production and export volumes were among the top producers in the world. In 2018, Kenya made a production of 194 280 metric tons with an export value of 118.3 million dollars being followed by South Africa whose exported volume was 88 000 metric tons, with an exports Worthing 116.7 million dollars. These two states covered more than 50% of the total production and export volume from the continent, but also, they are regarded to be importing countries from other African states. Morocco is running the third in production and exportation, following Tanzania as an emerging state in avocado industry with little volume in production and exportation as indicated in the results. Fig. 6 is showing the trend of exportation from 2000 to 2018 for these four top exporters from Africa, that's including Tanzania.

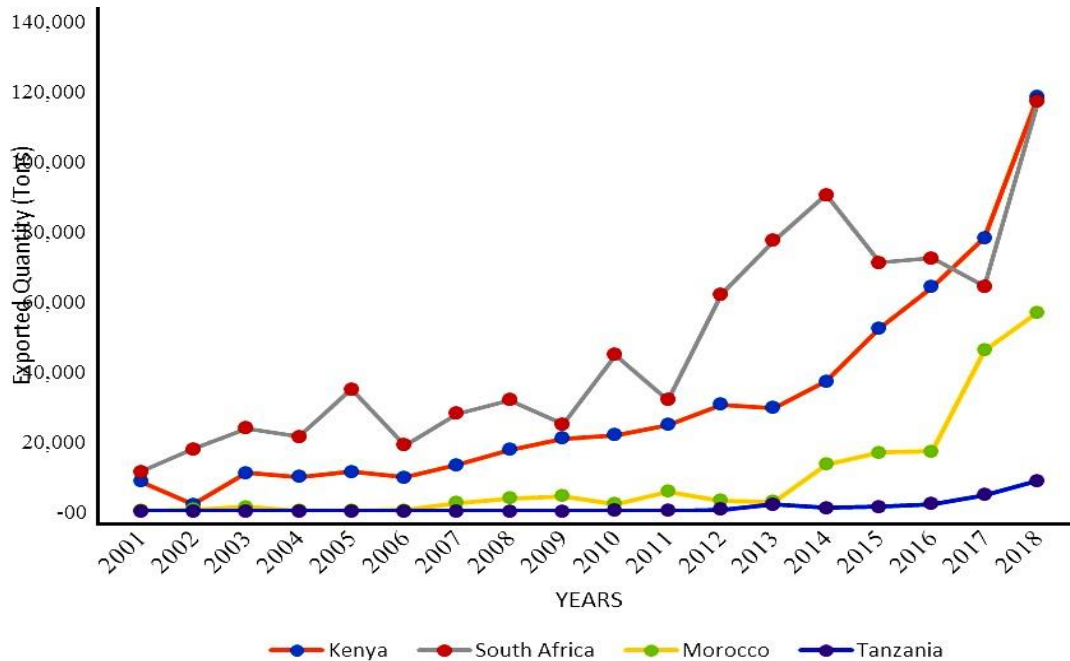


Figure 7: Avocado exported quantities from main exporting countries, from 2001 to 2018

Source: FAOSTAT, 2018

2.7.4 Status of avocado business in Tanzania

There are two distinct avocado market segments in Tanzania, the domestic and export markets. Out of these categories of markets, Hass-avocado is more favourable in export market but not preferred mostly in the domestic market, whereas Fuertes and other local varieties are more preferred in domestic market with little attention in export market (REPOA, 2019).

The avocado business chain involves key players who facilitate the entire chain of the business. These include: farmers, exporting companies, Local government authority (Rungwe District Office), Ministry of agriculture, transporters, and clearing agencies at the borders or at exporting points (airports and harbours). The length of the chain depends on the number of key players participating and also on the market segment. The local market involves few players, since it doesn't involve any process of crossing the border,

thus the major players in this type of segment are farmers, crop agencies, local transporters and whole buyers and final consumers (Tan-trade Report, 2020).

Generally, Tanzania has been gaining access to the world market share and increasing the export volume and monetary value due to increase in production and export capacity from individual farmers to exporting companies (Shirima, 2019). It is claimed that, out of thirty avocado exporting countries in the world, Tanzania is now marked number 21 as a new world exporting country from Africa (Shirima, 2019). It is growing at the potential rate of 78% with the contribution of 0.2% of the total share of world exported quantity of avocado in 2017 (Comtrade, 2017). In Africa, Tanzania is now ranked number four (4) in terms of production capacity and export market share, with the export volume contribution of 3.8% from Africa to the world market, while in East Africa Tanzania features number two (2) behind Kenya, with an export volume contribution of 9.2% per annum (Shirima, 2019). Kenya has been ahead of Tanzania due to several competitive factors, one of which is international market contracts at national and individual company's level. Moreover, there are facilities and proper infrastructure like plenty of pack houses and cold rooms which both have been catalysts for increasing exported volumes of avocado in the world market and meeting the required standards (Mwakalinga, 2014). These facts provide empirical evidence that Tanzania is still standing as a potential zone or hub in both production and exportation of the avocado fruits in East Africa. This is due to unexploited potential available such as supportive climatic conditions for production of the fruits in most of its agricultural zones, availability of exporting facilities like international airports (KIA and Julius Nyerere Airports) and existence of international and local ports like Dar-es-Salaam, Tanga, Mtwara and other ports in Zanzibar (Tan-trade Report, 2019). All these positions the

country in a better status of having sustainable and reliable exportation facilities of the fruit (avocado).

2.8 Empirical Framework

2.8.1 Review of empirical studies on avocado production potentials

Few available studies have justified that the avocado fruit is an economic viable fruit of high production and market potential, which can stimulate rural development in most of developing countries (FAO, 2000; Van Wijk, 2006). However, the direct focus and strength on the production and marketing of this fruit in developing countries, especially in Africa, is still an issue of debate, despite the available potentials found in these areas (Hakizimana, 2018). Van wijk (2006) argues that avocado production may represent an economic opportunity as diversification of the agricultural sector from smallholder farmers who are used to other commercial crops like coffee, tea and cocoa. Hikizimana (2011), in his study, indicated that the avocado industry in Burundi as the area of the study, presents many opportunities to income generation and food security to most smallholder farmers. Hakizamana (2018) also suggested, on the same view of potentiality, that avocado farming gives economic, market and health potentials to indigenous farmers and positively contributes to viability and sustainability of the rural economy through both internal and external market. This, therefore, should catalyse the household and national economy at once, and hence reducing levels of poverty and malnutrition in those areas.

Garedew and Tsegaye (2011), in their study, argued that, although avocado was a new fruit crop to the agricultural research system in Ethiopia, but it widely spread in the country and created an influence to the farmers to deal with it. The spread created a great demand for avocado fruits in the South-Western part of the country (Edossa, 1997). The

demand continued increasing particularly at Mana Woreda, which is located in the vicinity of Jimma town. Its present market value is continuously increasing much better than other available fruits. This indicated that avocado is a potential fruit crop not only for solving the problem of balanced diet but also for fetching sizable income for producers. It thus has become a potential fruit crop for diversification where farmers' income has highly been limited to coffee as the Woreda is well known as a major coffee producing area in Jimma Zone. However, there is no clearly documented information about the trends of avocado production and its market at the Woreda level though many farmers have been engaged in the production of the crop (Seifu, 2003).

On the same line of potentiality in avocado production, Juma *et al.* (2019) argued that avocado is now a vital fruit in international trade. This is because of increased volume of avocado consumption. Due to great consciousness of the people for eating healthy foods, there is increased avocado popularity in the growing and existing cities and the enhanced accessibility of ready-to-eat delicious avocados. But the most interesting importance of avocado for health is its content of monounsaturated fatty acids that are potential for decreasing the risk of “*coronary heart disease, cataracts, diabetes, benign prostatic hypertrophy, prostate and other cancers and macular degeneration*”.

According to Mwakalinga (2014), avocado, especially Hass-avocado, is an emerging commercial fruit in the horticultural subsector in Tanzania. It promises as a reliable business venture to most smallholders within the agricultural sector. But it is limited in some potentials and prominent areas in the country in which any interesting farmers can do better. These include: the regions of Mbeya, Njombe, Songwe and Iringa in the Southern part of Tanzania, then Kilimanjaro, Arusha and Tanga in the North-Eastern part of Tanzania. The other regions are Kigoma and Kagera in the North-West, and Morogoro

in the East of Tanzania. All these are regarded to be potential places in which the growth of avocado for commercial purpose can be done.

Juma *et al.* (2019), explained out that information related to avocado production and trade in Tanzania is still limited in terms of literature, then the little available information about avocado growing and trade in Tanzania mostly comes from exporting companies that's Africado, RAC and Kuza Africa. All this information reveals that the avocado fruit is gaining popularity in the horticultural industry in Tanzania and making the industry the fastest growing subsector within the agricultural sector with an annual average growth of about 9% to 12% (MMA, 2017). Furthermore, it has been observed that avocado is emerging to be the main export fruit, followed by mango (MMA, 2017).

REPOA (2019), through its paper policy issues, revealed that still, there is unexploited opportunities of avocado production in Tanzania. In a similar vein of discussion of the potential of Hass-avocado, research-based results by Slater *et al.* (1973) showed that the Hass-avocado is referred to as a high potential variety of avocado, which contains substantial nutrients which are highly needed by children under 10. In addition, Knight (2002) quoted in Perez-Jimenez (2008) reports that avocado oil is highly required in different cosmetic industry such as cleansing cream, make-up, sun screen, lipstick, bath-oil, skin moisturizing and hair conditioning (Bergh, 1992).

Shakoor (2001) explained in his study conducted in kinnow, the systematic way for the analysis of economic viability of long-term investment projects (SAEVIP) in fixed assets. In his literature, it was possible to identify the fundamental elements to evaluate the merit of the investment project of such kind (IP), to assess the dimension of return and investment- indicators of the analysis which are: net present value (NPV), CBA, return on

investment annualized (ROIA) and return on investment (ROI). Then indicator analysis for dimension 'risk' is performed by internal rate of return (IRR), Payback period, and Fisher point. In addition, a joint assessment of indicator of risk and return is performed through sensitivity analysis.

In 2006 there was a study, conducted at Social Sciences Institute, National Agricultural Research Centre, Islamabad, based on the analysis of financial viability of long-term investment in citrus orchard. The study was carried out to generate valuable information for citrus growers, market traders and policy makers to enhance investment in citrus orchards. Then results indicated, citrus production starts at 5 years age of citrus orchard and it reaches maximum level during 21st year and remains constant up to 30th year. Return in investment of citrus orchard was found 33 % against current rate of interest on agricultural loan. The payback period of citrus orchard was observed as 7th year with non-intercropping and 5th and 6th year when intercropped with wheat and berseem, respectively. Moreover, analysis indicates that 20 years is optimum economic life of citrus orchard, after that there is a declining trend of citrus production potential.

2.8.2 In Avocado export market potentials and related constraints

CBI Annual Report (2019) pointed out the great export market potential available in the European countries, which increased their avocado importation volume by 600Mil tones in 2018, which were supplied by Peru, Mexico and South Africa. Accordingly, in recent years, avocado is referred to as a fruit whose popularity is increasing fastest. Not only that, but also, the report explained that Europe was able to absorb 25% of the total exported volume in the world. Then supply volumes from the producing countries have been a major influence in stimulating European imports (ITC, 2018).

Comtrade (2019) and CBI Reports (2019) released out reports indicating that there was a continuous increase in consumption of avocados in Europe by 8% in the period of 2017-2018 in comparison with the year 2016 to 2017. Since 2012 to 2017, consumption has increased by 110%. The differences in consumption within Europe and the gap with developed consumer countries such as the United States and Canada show that there is much potential for growth. However, with current growth rates, market maturity could be reached within five to eight years, and consumption will become more stable.

Garedew and Tsegaye (2011) argued that the production of avocado in most of the developing countries for export purpose seems not to be efficient in terms of both the exported volume and quality due to the production constraints, which are regarded to be very important for further improvement and promotion of the crop. Rola-Rubzen *et al.* (2017) examined the farming systems of selected fruits in the horticulture industry including avocado and assessed challenges and constraints in production and marketing of those fruits in Timor, looking into challenges and constraints faced by individual farmers in their endeavours to increase production and household incomes. They did so because having a clear understanding on the bottlenecks faced by farmers that will provide insights as to what is needed to support the development of a sustainable horticultural subsector in Timor Leste to increase production and income of farmers.

Mwakalinga (2019), through a research project he conducted in all potential's areas for horticulture production in Tanzania, pointed out some challenges in the avocado value chain in Tanzania that's starting from farm level, processing and packaging up to the market level. Through his research project, information about avocado production constraints and international trade were identified. Therefore, the study had to explore the

intensity or severity of each constraint and come up with reliable and sustainable solution to the farmers and its contribution to improving their lives.

Andrew, Jacob and Pawelzik (2016) conducted a study, essentially to examine existing opportunities and prevailing constraints to organic fruit growers in Madeke, Kiwangwa and Mwanambaya, which were located in Njombe, Bagamoyo and Mkuranga Districts respectively. From these villages, the smallholder farmers were producing various organic fruits, including mango, pineapple and passion fruits as sources of household income. The study revealed that farmers could achieve twice as much return per acre on pineapple compared to mango and passion fruits production. High organic certification cost, lack of capital and post-harvest losses was mentioned to be the major constraining factors to the farmers in organic production.

Leonidou (1995) identified export constraints as: *“The attitudinal, structural, operational, and other constraints that hinder the firm’s ability to imitate, develop, or sustain international operations.”* Export challenges are defined as those constraints that hinder the ability of a firm to initiate, develop or maintain export marketing activities of the firm. Different researchers have characterized export marketing challenges into different categories. Some of them have grouped export problems into “internal” and “external” barriers.

Delgado (2006) identified export challenges as: production related to production, processing, marketing related, economic and political environment. While Clarke (2013) generated a list of export obstacles and grouped them into *“generic”, “product specific” and “market specific”*.

Karelakis (2008) classified export trade problems into four groups: “internal-domestic”, “internal-foreign”, “external-domestic”, and “external-foreign”. Bezabih and Hadera (2007) identified the major constraints of marketing as lack of markets to absorb the production, low price for the products, large number of middlemen in the marketing system, lack of marketing institutions safeguarding farmers’ interest and rights over their marketable produce (e.g., cooperatives), lack of coordination among producers to increase their bargaining power, poor product handling and packaging, imperfect pricing system, and lack of transparency in market information system, mainly in the export market.

World Bank (2004) identified the major constraints in the Ethiopian high value export products as: high freight cost and insufficient cargo space, lack of railway transport system, insufficient airport facilities, existence of illegal traders, poor packaging systems, lack of skilled manpower, insufficient pre- and post-harvest infrastructure facilities, access to bank loan, and lack of comprehensive market studies. Moreover, severe production seasonality, seasonal price fluctuations, poor pre- and post-harvest handling, prevalence of pests and diseases, lack of storage are some of the critical problems encountered by vegetable and fruit producers in Ethiopia.

2.9 Research /Literature Gap

The present study was undertaken for making in-depth analysis on economics of avocado production as perennial crops relative to unexploited potential in the avocado industry. This could bridge the literature gap on addressing the analytical technique on assessing return on avocado production and its potentials, specifically in Rungwe District. Essentially the study appreciates the existing works in the area of value chain of avocado production, especially on the local varieties (Mwakilinga, 2014). However, the study acknowledges the work done by TAHA in collaboration with USAID in 2014 which

addressed the component of value chain of avocado industry in two regions of Kilimanjaro and Njombe but without linking the farmers under contract farming with exporting companies. REPOA (2019), explained in their study on policy issues in the avocado industry looked into the potential of avocado farming in Njombe and Kilimanjaro. This also did not explore any issue related to economic of avocado production, by looking the future economic viability on investing in avocado farming. Therefore, the entire package of previous research works, done on avocado specifically in Tanzania justified a gap to be filled by this study, particularly in Rungwe District.

Secondly, the concept on which this thesis is based on; was to disclose additional knowledge and promotion of the horticulture industry to the public and policy makers because there is little support to this industry which governs production and marketing of horticultural products. This situation gives more sufficient ground for the study to be undertaken, with the aim of bridging the gap of knowledge to the farmers, policy makers and other stakeholders.

Thus, more attention is required in this industry because of its competitive advantage in the international market. Therefore, the study was also aimed at alerting research institutions like Uyole and Tengeru on the need for further research on production of avocado seedlings and controlling diseases considering avocado as a new business in horticulture industry. It should highly be regarded as a new emerging cash crop which will have a multiplier effect to farmers up to the government by earning foreign income.

2.10 Conceptual Framework

Regarding the main objective of this study, the economics on avocado production relative to the available potentials in both production and export market in avocado farming in Rungwe District. The study indicated to have a direct positive effect to the actors in the main chain from production (smallholder farmers) to the buyer (investors) in Rungwe

District. This little response to the available potential leads to little volume of production realised by out-growers being exported through various logistic segments, depending on the end point of the consignments and requirements of customers.

The production process of avocado is influenced by various input factors such as farm inputs characteristics and socio-economic characteristics of the farmers in the study area. Both of these are regarded as input variables in production of the avocado in the study area. However, the entire process of production and exportation is characterized by some constraints/challenges on the key actors in the chain. These constraints have an impact on the performance of farmers and exporting companies. They tend to affect utilization of the available potential in both production and available export market (Burke, 2014).

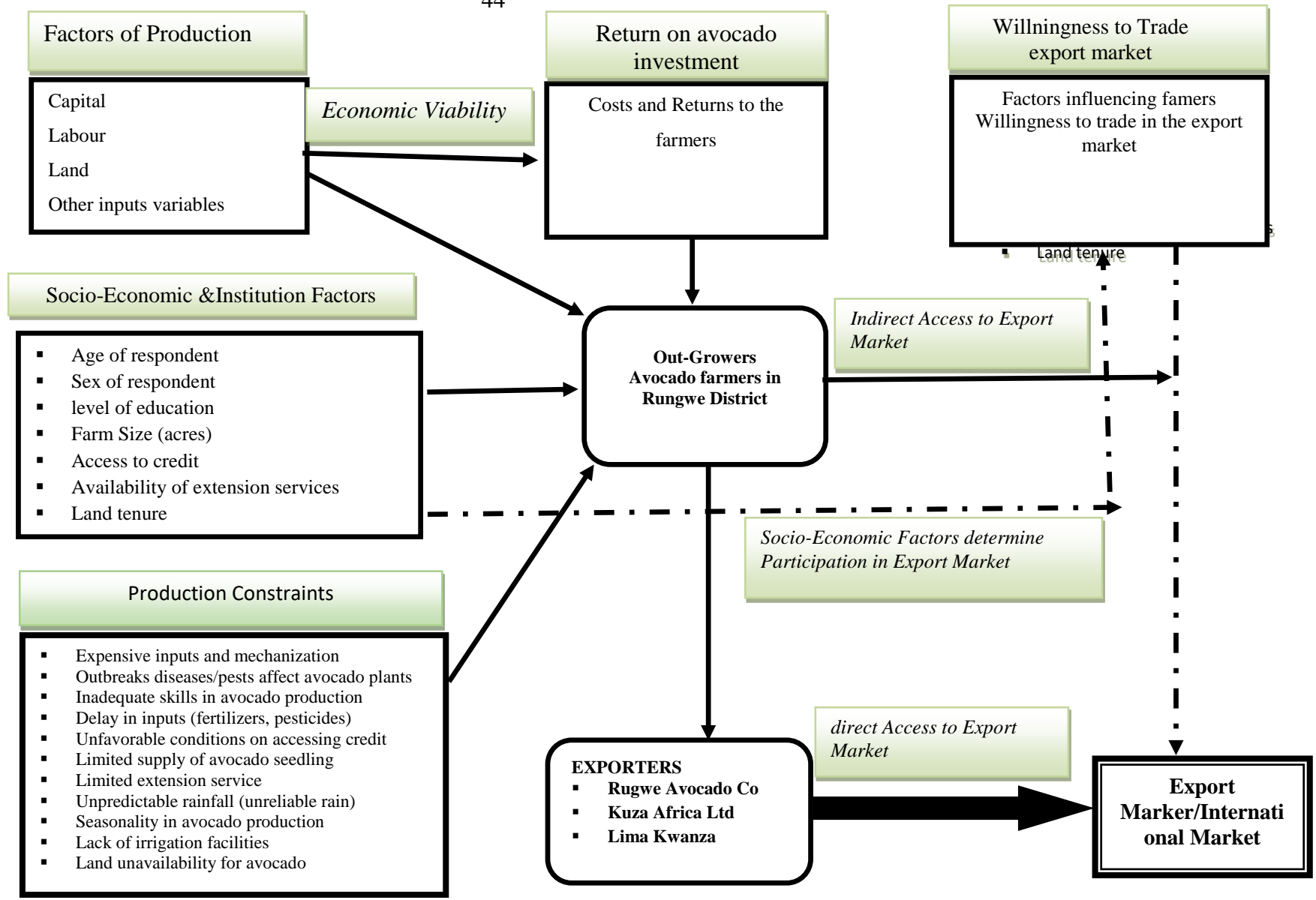


Figure 8: Conceptual Frame Work
Source: Modified from Burke, 2014

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geographical location, topography, and climatic condition of the study area

The study was conducted in the southern highland in Mbeya Region specifically in Rungwe District, which lies between Latitude 8 030 and 9 030 South of Equator and Longitudes 330 and 340 East of Greenwich Meridian. The Rungwe District is bordered with Kyela District in the South, Ileje District in the West, Makete District (Njombe Region) in the East and Mbeya District in the North.

The District is the mountainous one, with Rungwe Mountain and the Livingstone ranges of mountains rising from an altitude of 770 meters to 2 265 meters above sea level. The mountainous form makes the climatic condition to experience cold and rainy seasons throughout the year, with an average rainfall range from 900mm in the lowland zone to 2 700mm in the highland zone. The temperatures are the modest one, ranges from 18⁰C to 25⁰C all the year round. This condition is favorable for fruits and vegetable growth particularly the avocado production (Mbeya Regional Profile, 2018).

Essentially avocado farming is suitably done in the altitude ranging 1200-2200 m from the sea level, average rainfall of 1000mm to 1200mm annually, with the temperature of 15⁰C to 25⁰C. All these are optimal ecological requirements for avocado farming, which also found in Rungwe District. Therefore, made Rungwe District to the appropriate district for avocado production and for the study as well (Mbeya Regional Profile, 2014). Moreover, the choice of Rungwe District as the study area was grounded by several fundamental reasons, one; it is an historical District in terms of hass-avocado production

in the southern Highland, at first in 2008, the hass avocado variety was introduced by Rungwe avocado company (RAC) as the first trial of the said variety in the district (MMA, 2017). In addition, the contract farming in avocado farming industry was also initiated for the first time in southern highland in Rungwe District under Rungwe avocado company and Kuza Africa (Rungwe District Report 2016/17). This made most of the farmers to involve easily in the production of hass-avocado variety because of the direct support provided by the companies. The fundamental support provided directly from company, was avocado seedlings, extension service and other technical support like provision of pesticide and inorganic manure, all these were the fundamental ground for the choice of district.

Likewise, the geographical location and other logistic factors seem to be supporting factor for Rungwe District to the hub for avocado production in southern-highland. The presence of Songwe Airport in Mbeya Region, serve the purpose for quick transport and storage of avocado from Rungwe district (Cold rooms). The Tazara Railway is one the potential means of transport avocado from Mbeya to Dar-Es-Salaam port for export purpose. Then tarmac road from Rungwe to Dar-Es-Salaam Port and Rungwe to Kenya-Mombasa port justifies the Rungwe district to be appropriate place for commercial farming of avocado in the southern highland of Tanzania.

3.1.2 Land area in Rungwe District

Rungwe District Council has a total land area of 123 186 sq. km out of which 123 154 sq.km equivalents to 99.97% of the total area is covered with land area while the remaining portion of 0.3243 sq.km equivalent to 0.02% is covered with water. Kiwira is regarded to be the largest ward with the land share of 8.9% of the total area in the district council, followed by Ilima Ward (7.3%) and Ikuti Ward (6.9 %). However, Ndanto Ward

has the smallest share (2.4%) of total land area followed by Mpuguso and Lufingo wards each has 1.8 % share in the total land area of the district (Rungwe district profile, 2018).

Furthermore, Rungwe District Council has a total land area 123 186.0 ha, out of that 83 613.6-ha equivalent 67.9% is suitable for agriculture production. This large proportion of land-use being in agriculture gave promise and assurance of avocado investment since land is one of determinant factor of production in agricultural investment (Mwakalinga, 2019). However, the remaining areas of 39 572.40 ha equivalent to 32.1% of total land area is covered by mountains with forests, hills, valleys, rivers, streams, small crater lakes and residential areas of total land.

3.1.3 Land use in the district

Out of the total area in Rungwe District Council (123 186.05 ha) the highest proportional of the land (74.9 %) is used for cultivation, followed by residential area and open land (21.4 %). Below is Fig. 8 indicating the land use in Rungwe district (Fig. 9).

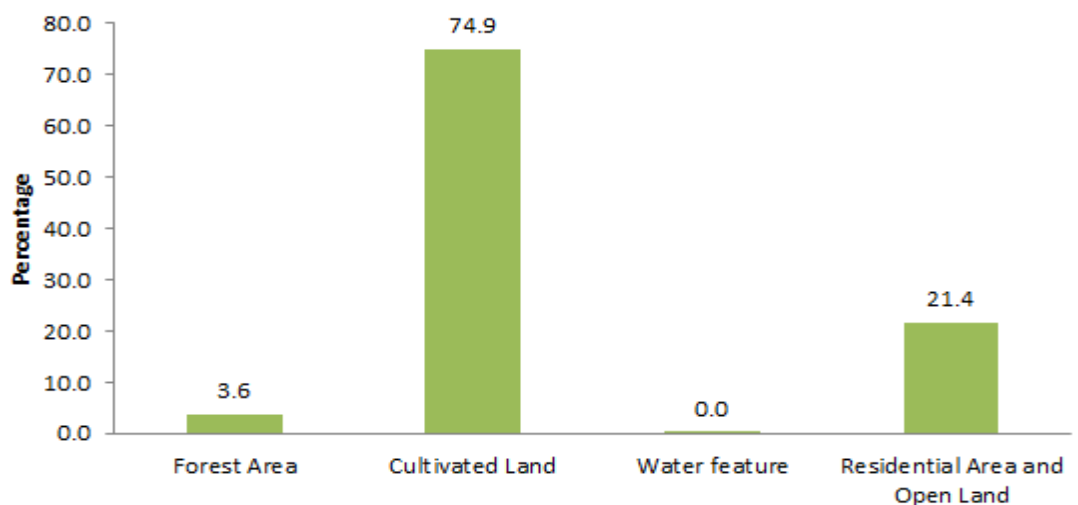


Figure 9: Percentage distribution of land use in Rungwe District Council

Source: Rungwe District Council report 2018

3.1.4 Population size and growth

According to the 2002 and 2012 population and housing censuses, the population of Rungwe District increased from 220 949 persons (104 997 males and 115 901 females) in 2002 to 242 809 persons (115 510 are males and 127 299 are females) in 2012. The average annual growth rate for Rungwe District Council is 1.0 percent during intercensal period as shown in Figure 10, which shows comparison with other district council. The most populous ward in 2012 is Kiwira with 25 244 people (10.4 %), followed by Isongole with 18 689 persons (7.7 %) and Lufingo with 17 166 persons (7.1 %). The least populous ward according to the 2012 census is Bagamoyo having 3 207 persons (1.3 %) and Matwebe with 3 303 peoples (1.4 %).

Furthermore, the results shown that Isongole Ward has the highest average annual growth rate of 2.7% followed by Kiwira Ward (2.3%), Ikuti and Kyimo Ward (1.4 %). Moreover, the results had shown also, a negative population growth rate for the ward of Bagamoyo (9.2%), Malindo (7.7%), Suma (6.0%), Masukulu (5.0%) and Kinyala (3.7%).

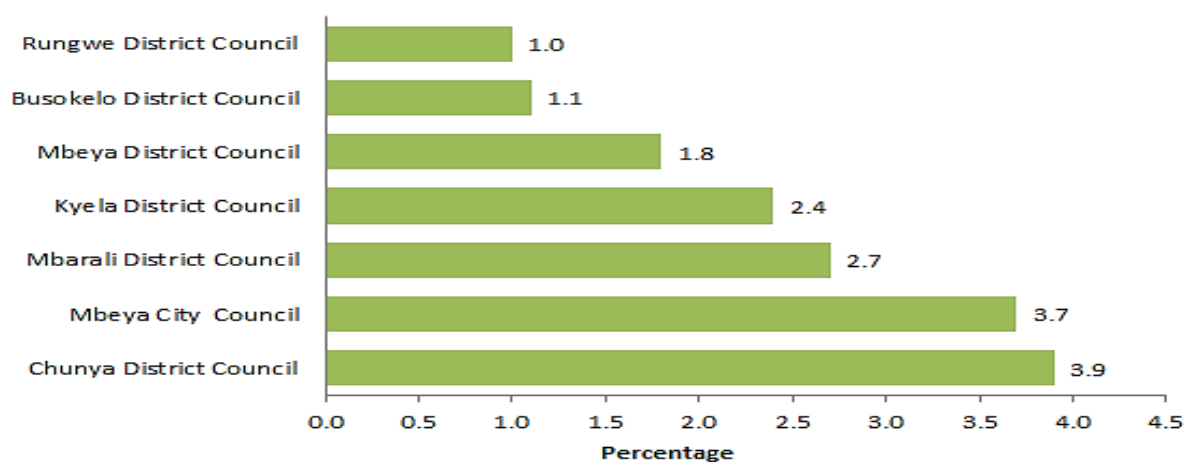


Figure 10: Average annual intercensal population growth rate by District Council, Mbeya Region, 2002 – 2012 PHC

Source: NBS, 2012

The population increase in Rungwe District, that's from 220 949 people to 242 809 people as an increment of 22 000 people in average, indicated the increase in demand of food and increase of the economic activities in the district. This situation called upon the strategies on investment in agriculture which would have an impact to food insecurity and economic growth to individual farmers and district at large (Repoa, 2019). Thus Hass-avocado production was an appropriate commercial fruit in Rungwe district for the serving the mentioned factors. First; for health and food security and second; for commercial purpose for revenue generation to the farmers engaged in production in the district. The Figure 11, is the map of Rungwe district, where the study was conducted.

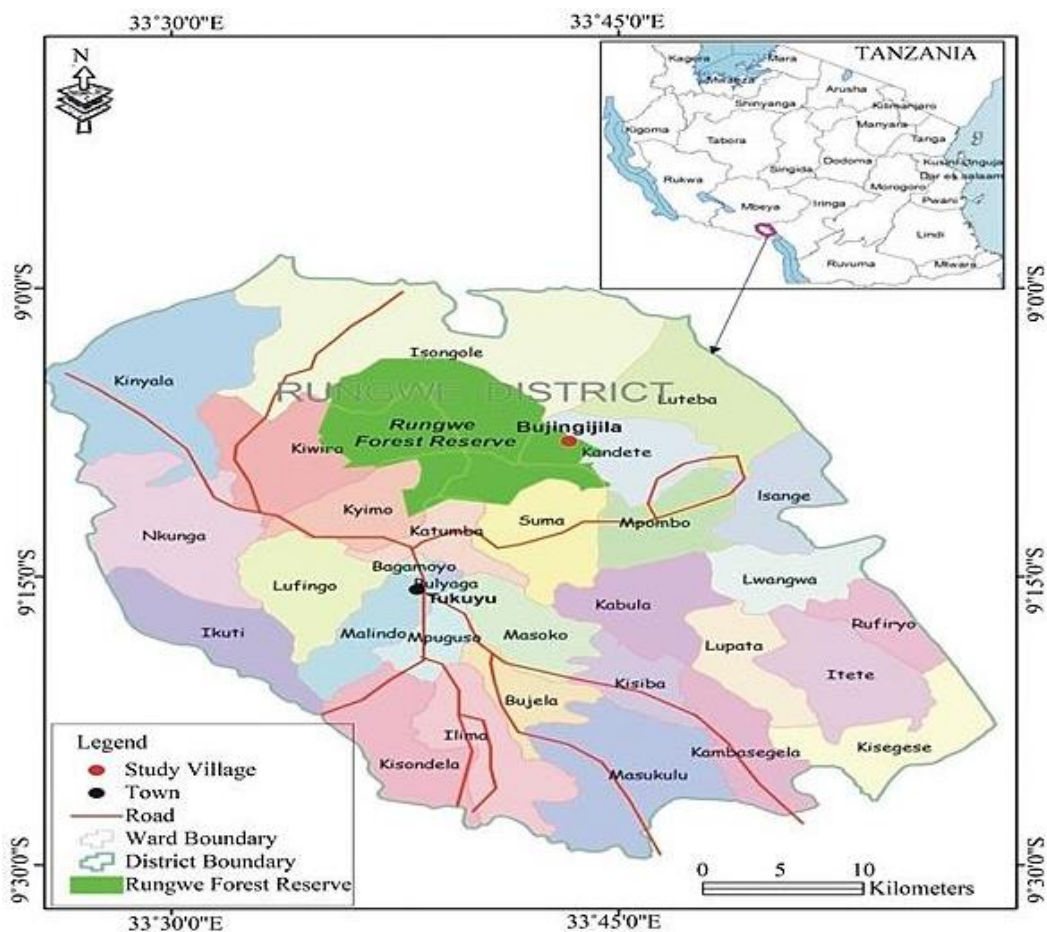


Figure 11: Rungwe District map

Source: Rungwe district profile, 2018

3.2 Research Design

The study employed a non-experimental design; specifically, a cross-sectional research design was used. This kind of research design allowed data collection process from Rungwe households farmers engaged in avocado production. The process of data collection was done at once (single point in time) that was in 2018 (Bryman and Bell, 2007) likewise, the design referred to have high degree of accuracy in social science studies for determination of the relationship between and among variables (Deaton, 1997; Bailey, 1998). The questionnaire and an interview guide were used for collecting data from avocado farmers (out-growers) and from key informants who were involved in the study. The study made an interview with key informants, such as; Technical Farm managers, Extension Officers from the company (Rungwe Avocado co. ltd) and one Director from Rungwe avocado company (Myers *et al.*, 2010).

3.3 Data Sources and Instruments for Data Collection

Both primary and secondary data were used for this study to serve the purpose of analysis of the underlined objectives. The primary data were collected from different sources in the study area. The primary data were collected from the sampled avocado out-growers from Rungwe district, the extension officers from Rungwe Avocado company and two key informants from exporting company (Rungwe avocado company).

The secondary data were obtained from different secondary sources depending on the needs of the study and objective intended for analysis. Most these secondary data were technically used on objective one and objective three. Sources of the collected secondary data; FAO Annual reports on avocado production, area, yield and exported volume from Tanzania and other part of the world. Research Taha reports on the

challenges on exportation procedures from Tanzania, Faostatic Report on the main avocado producing countries and exporting in Africa and the world. Other report used were: Field-Report on Certification process East Africa, TRA report on revenue generated in avocado business Tanzania, Rungwe avocado report on the cost of production of avocado, Feed the future report and mwakalinga's project report on the value chain of avocado in Njombe, Rungwe and Siha of 2014, Markup report of 2020 on the production and exportation of avocado from Tanzania and Kenya, Pest, disease and inputs management on fruits and Vegetable, 2019 Taha report. All these reports were the major sources secondary data, used on the analysis of Objective one to three.

Primary data collection tools were questionnaires and interview-guide in the study area, these two applied on collecting the primary data from both; farmers and key informants. The semi-structured questionnaire was given to each avocado out-grower while the semi- structured interview guide was developed for carrying out an interview with key informants from Exporting company.

The interviews were recorded and regular contact has been maintained with the respondents in order to extract and clarify more details from them. The format of the interview guide was semi-structured where, there was a chance of requesting other additional information from the respondents.

Table 2: Description of the data and procedure of data collection

SN	Types of Data	Source	Data collection Tool	Intended Objective
1	Primary Data	a) Avocado farmers b) Key Informants	a) Semi-structured questionnaire b) Semi-structured interview guide	Objective I,2 &3 Objective 3
2	Secondary data	books, research reports and journals from internet and Sokoine National Agricultural Library (SNAL)	Observation and reading of the material source	Objective 1 and 3

Sources: Data from the field**3.4 Sampling Procedure and Sample size****Sampling procedure**

The intended population for this study was 4 000 small scale avocado farmers, who were operating under contract farming as out-growers under Rungwe avocado company. However, for meaningful analysis; the survey also included other actors along the avocado industry as key informants, such as extension officers from both Rungwe District council and Rungwe avocado company. Multistage sampling techniques were adopted in this study. Aiming at selecting the sample size of avocado farmers out of the given list of 4 000 out-growers from Rungwe Avocado company (Msabila and Nalaila, 2013). The purposive sampling technique was used to select Mbeya as the Region of the study, since it was the first region, in which avocado fruit was introduced in the Southern Highlands of Tanzania (Taherdoost, 2016). Likewise, the purposive sampling technique was again applied on selecting Rungwe District as a prominent district in Hass- avocado production in the region (RDR, 2015). 10 wards out of 33 wards found in Rungwe district were purposely selected. These wards comprised the first batch of avocado out-growers who contracted with Rungwe avocado company from 2009 (RAC Report, 2015).

After obtaining the required proportional numbers of farmers from each ward, 36 farmers were randomly selected from 10 selected wards to make a total 360 respondents who were sufficient for statistical analysis. (Sudman, 1976) affirmed that a minimum of 100 respondents is enough for each group when comparative study is conducted. On obtaining a sample size, the selection criteria were applied to obtain qualified respondents as per requirement of the study. One, the farm surveyed had to have avocado trees which were under production. Second, the number of trees found in the sampled farm, should not be less than 20 trees, meaning a quarter of an acre. Third, the sampled farmer should be under contract with Rungwe avocado company. In addition, the Key informants were purposely selected based on their knowledge and experience in avocado production in the study area; this involved District Extension Officers, Technical Farm Manager from Kuza Africa (Mr. Samwel) and the former Operations Director of Rungwe Avocado Company (Mr. Robert).

3.5 Sample Size

The sample size in the present study has been estimated by using the formula proposed by Yamane (1967). According to Rungwe Avocado Company production report of the year 2015, the number of avocado out growers who produced hass avocado for export purposes were approximately 4 000.

Therefore, as per Yamane's formula the sample size was estimated as follows:

$$n = \frac{N}{(1+N*e^2)} \dots\dots\dots(9)$$

Whereby: n = sample

size, N = population size,

e= sampling error to determine the sample size. Based on the available data,

e=0.05

number out-growers = 4 000,

$$\textit{Therefore, } n = \frac{4000}{1+4000(0.05)^2} = \mathbf{363.6 \approx 360} \dots\dots\dots (10)$$

The sample size of 360 farmers involved the all farmers whose trees were producing fruits during the process of data collection, which was among the criteria. Then out of 360 farmers as a sample size from avocado out-growers, 36 farmers were taken out of each selected ward.

Therefore: The intended population of 4 000 out-growers within 33 wards, the computed Sample size was 360 farmers. Then after obtaining the sample size of 360, the mechanism of getting individual farmers from each ward , Is when the probability proportional to size was applied and therefore, Probability of selection for each sample ward was P_1 Probability of selection for an individual in each sampled was presented as P_2 and the overall weight of each selection was presented as an inverse of probabilities of each farmer being sampled in the population.

$$\textit{Thus; given } P(1) = \frac{a*d}{b} \dots\dots\dots(11)$$

$$P(2) = \frac{c}{a} \dots\dots\dots(12)$$

Whereby: **a**: *Number of farmers in each selected ward*; **b**: *Sum of famers in all wards (Population)* **c**: *Number of farmers sampled per wards* **d**: *Number of sampled wards.*

Note: The details of the method and selection of wards and out-growers was presented in the appendix.

3.6 Data Processing and Analysis

3.6.1 Analytical framework for objective one, which was intended by the study to assess the current situation of Hass-avocado production and export market trade in Tanzania

Descriptive analysis was used for analysing objective one, which mainly used both primary and secondary data obtained from avocado out-growers and various Electronic agricultural data sets on avocado production and export trade (*Faostatic, Comtrade, International Trade Centre and NBS 2018*) respectively. *Microsoft Excel and SPSS as the software were applied to process the data and as the results, presented the outputs which gives logical meaning in the form of tables, graphs and histogram.*

In examining the rates and trends of growth of avocado production, and exported volume in Rungwe District and Tanzania at large, then the following methods were applied for computation of such growth rates and trends. That's growth rates and the growth trend which were expressed in percentages.

3.6.2 Growth rate

Growth rate was computed by determining the percentage increase in the volume of production of hass-avocado and percentage increase in the exported volume of the same product. Some key parameters used in the analysis such as production and exported volumes at given periods of time. Then the growth trend was computed as a percentage for the entire period of analysis as expressed in equation 6.

$$GR = \left(\frac{X_N - X_{N-1}}{X_N} \right) 100\% \dots\dots\dots (13)$$

Where:

GR=Growth rate

$X_N = \text{Original value}$

$X_{N-1} = \text{Subsequent value}$

3.7 Growth Trend in Percentages

This was computed to express the increased volume (increment) of production, exported volume and area under cultivation in percentage to have a growth trend, hence it was calculated against the original volume respectively. This was applied in all cases, thus from Rungwe District as well as Tanzania at large. All the computed variables were expressed in percentage to check differences in growth and trend for the sake of making comparison at different periods of analysis.

$$P = \left(\frac{n}{N_i} \right) 100\% \dots\dots\dots (14)$$

Where:

$P = \text{Percentages}$

$n = \text{Calculated difference (increment)}$

$N_i = \text{Original value}$

3.8 Analytical Framework for Objective Two, Which Was Intended by the Study to Analyse the Economic Viability of Producing Hass-avocado in Rungwe District

3.8.1 Production analysis of Hass-avocado

Production analysis was done based on the life cycle of Hass-avocado tree to analyse the viability of investing in avocado production for export purpose. The following basic assumptions were undertaken towards the farmers who aimed at maximizing the benefits from avocado production.

3.8.2 The underlying working assumptions adopted

- a) The price used for revenue projection of 1 kg of avocado was 1 000 TZS. This was the market selling price from 2018 to 2019, when data were collected. The idea behind of using this price was to avoid uncertainties of the calculated average price of previous years, which could be influenced by Inflations and other financial risks to make it not stable. This is a normal assumption in finance and economics used to avoid complications arising from future uncertainties like inflation and other factors influencing the prices.
- b) The output per tree and per acre was determined from the life cycle of the tree (production circle of the tree), whose yield was obtained due to the biological life cycle of the tree itself, that each stage of growth had its own yield. (to mention number of stages).
- c) The discounting rate used was 10% for obtaining NPV, BCR and IRR and 30% was for sensitivity analysis. (Clarification of these rate).
- d) The price used for the future return was constant throughout the life cycle of the avocado tree, uncertainties on the fluctuation of the future prices was settled by conducting sensitivity analysis.
- e) It was undertaken that the replacement period of a Hass-avocado tree is when the out-put starts declining and that when the trees attained 35 years old and above.
- f) Undertaken assumption for projections to be hold; Farmers continued to produce avocado for export market; the technology remained constant; the export market continued to be a perfect market, then demand for avocado continued increasing gradually; market interest rate remained constant, then quantity of production continued increasing and externalities remained constant throughout the projection period.

3.8.4 The production life cycle of a hass-avocado tree

In examining the economic viability of one acre of an avocado farm (orchard), the production cost and return depended on the life cycle of avocado trees found in the farm. The information stipulated in the Table 3 indicates different growth stages of avocado tree, and at each stage different levels of yield are shown up to the replacement year, which covered 35 years. This was regarded as an economic life span of a Hass-avocado tree. This is supported by literature from the basis of analysis of different reports on reasonable estimates of years of useful life of an avocado tree. Different writers have posed their arguments and findings that the length of the life of the tree depends on the impact of horticultural, pathological and economic factors affecting the tree or orchard (Goodall *et al.*, 1970). On this aspect, the useful-life of the tree is grouped into two distinguished periods: development or non-bearing period which ranges from 0 to 3 years depending on the nature of the variety, and the bearing period which ranges from 4 to 35 years in risky areas up to 20 to 30 years (Markerson *et al.*, 1970/1). Both of these two periods make the entire life span of the tree. Below are the stages of life-span of a Hass-avocado tree.

The early stage: No production is obtained, and it is referred to as an infant stage of two up the three years when the first yield is likely to start being obtained. The production starts and increases gradually at maturity and stability levels of the tree where even the risk of the tree to die is minimum.

The adult stage: The production of the tree starts stabilizing and approaching the maximum level production of the tree. After attaining the age of 15 years, which is termed as the maximum level of production, the production of the tree remains almost static with advancement up to 25 years. Hence, from 25 years of age the tree starts experiencing

decline in production up to the 35th year. Thereafter, the tree is regarded not to be economically viable due to drop down in production and therefore it is economically plausible to make replacement in the farm for commercial purposes (Doyle, 2021).

Table 3: Out-put as per life cycle of Hass-avocado tree

Biological life cycle (years)	(Stage-levels)	Min. No. of Trees/acre	Average Output/acre (tonnes)	Average Output/tree (kg)
1 st to 2 nd	Infant stage	80	0.0	0.0
3 rd	First yield	80	0.8	10.0
4 th	Maturity stage	80	2	25.0
5 th to 7 th	Stability stage	80	4.8	60.0
8 th to 14 st	Adult stage	80	10.5	131.0
15th to 25th	Full production level (pick stage)	80	12.8	156.0
26 th -35 th	Declining stage	80	7.6	95.0
36 th and above	Replacement stage	80	0.0	0.0

Source: Doyle (2021) & Expertise’ opinion; Maerere (2019)

Note: The analysed biological cycle is only for the Hass-variety of avocado; other varieties might have a different life cycle.

3.8.5 Output and return of an avocado farm (Unit of Analysis is One Acre)

From the biological science of Hass-avocado trees, the output of an avocado tree depends on the life-cycle of the tree itself; each stage of the tree has different output and return as well. Thus, the output and return per acre were calculated based on the number of trees within an acre. In this study the least number of trees (*plant population*) which could be accommodated within an acre was 80 trees, and this was used as the benchmark of calculating the return. The results indicated that the output per tree in the first year of

production of the avocado tree was approximated to be 10 kg per tree and for an acre the estimated production was estimated to be 0.8 tonnes. At the pick-point of the cycle, that's in the 15th year, the output per tree was marked as 156 kg per tree and 12.8 tonnes per acre. This production was said to remain static for the next 10 years up 25th year, which was determined to start declining. Upon having the estimated outputs from the biological science of the tree and acre at large, then the economic benefit on the avocado production to the farmers in Rungwe District was analysed by using three cost benefit analysis indicators (NPV, CB-Ratio and IRR) in order to determine the viability of investing in avocado production, specifically in Rungwe District.

3.8.6 Methods of analysis

3.8.6.1 Cost Benefit Analysis (CBA)

Cost-benefit analysis was mainly used as an economic analytical method for analysing objective two, which needed to look into viability of investing in avocado production venture. The analysis was regarded as the process or procedure by which the streams of individual benefits and costs were measured in monetary terms in order to provide a room for comparison over life time of investment. In this regard, it was the life time of avocado trees.

This method is one of the popular and potential methods in analysis of long term financial and economic projects; it has been detailed by three main authors: Gittinger (1982), Nas (1996) and Boardman (2011). These three authors defined CBA as an analytical tool in different literal meanings but all remained with the common context meaning on its analytical application.

This study focused on Gittinger (1982) who provided comprehensive knowledge about CBA at different angles; he referred to CBA as an assessing tool for existing or upcoming agricultural projects in a financial manner, specifically by looking into project format, structure and set of activities. He was interested in knowing if at all they are using the resources available to obtain the stream of benefit against its cost.

In practice CBA is categorized into four main types based on the time duration of the project undertaken: *Ex-ante CBA*, which is used for analysis of a project which is about to take off in order to assist on proper decision making; *Ex-post CBA*, which is applied on a finished project, aiming at making evaluation of the project; *medias res CBA*, which is conducted on an on-going project to make an assessment of whether the project should continue or not, as well as costs and benefits to predict the future. The last type of CBA is *Comparative CBA*, which is a type of CBA that is used in comparing an ex-ante CBA with an ex-post CBA on the same project for decision making purpose.

Despite the importance of CBA in assessing the existing and non-existing projects, still it has some shortcomings. The major shortcoming is that application of money as an evaluation unit of all costs and benefits is not realistic because in some economic concepts this does not always hold, for example one is an opportunity cost (Senkondo, 1992). Therefore, based on that argument, the study chose the appropriate CBA, termed as *medias-res CBA* as investment appraisal tool on determining the economic viability of the project: using Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) as indicators of the analysis. The reason of using *medias-res CBA* was due to the fact that the avocado production at individual level in Rungwe District started early in 2009 and during the research on which this thesis is based it was on the move with old and new entrants. The application of this method in the study was based on historical

costs and benefits (meaning price) of 2018 as the establishment base for projection of the future costs and benefits for the entire economic life span of the Hass-avocado tree, and this was done at different levels with regard to the growth of the tree itself (Gerald, 2011).

3.8.6.2 Net Present Value (NPV)

NPV was used as a discounting measure for a non-uniform or uniform series of payments to value the projected cash flows for each investment alternative at one point in time. The sign and Value of NPV determine its ranking and acceptability for decision making. In this study, the NPV was computed by finding the difference between the present values of the sales done for the entire economic life of the tree less the present value of the establishment and operating costs. Then the time duration, denoted as t , was determined from the life cycle of the avocado tree while the discounting factor used in the study was chosen basing on relevant literature.

Mathematically,

NPV was presented as:

$$NPV = (PV(B) - PV(C)) \dots \dots \dots (15)$$

$$PV(B) = \sum_t^N \frac{\beta_t}{(1+r)^n} \dots \dots \dots (16)$$

$$PV(C) = \sum_t^N \frac{C_t}{(1+r)^n} \dots \dots \dots (17)$$

Where:

NPV = Net Present Value,

Bt = benefit per acre in each year,

Ct = cost of production per acre in each year,

$PV(B)$ = Present Value of the benefit

$PV(C)$ = Present value of the cost

$t = 1, 2, 3, \dots, n$,

n = the respective time in the series of discounting years

N = Number of years,

r = Interest rate or discounting rate, and

Σ = Summation sign

3.8.6.3 Benefit –Cost Ratio (BCR)

BCR basically was the ratio of all discounted incremental benefits, obtained annually and discounted costs of an investment, whereby, for the case of this study, the incremental benefits were obtained from the sales of produce (avocado fruits) and costs related with establishment and other operation costs on each farmer in the field, at each given year.

Then this ratio was obtained by using the following formula:

$$\frac{B}{C} = \sum_t^N \frac{PV(B)}{PV(C)} \dots \dots \dots (18)$$

$$\frac{B}{C} = \sum_t^N \frac{\frac{\beta_t}{(1+r)^n}}{\frac{C_t}{(1+r)^n}} \dots \dots \dots (19)$$

Where:

NPV = Net Present Value,

Bt = benefit per acre in each year,

Ct = cost of production per acre in each year,

$PV(B)$ = Present Value of the benefit

$PV(C)$ = Present value of the cost

$t = 1, 2, 3, \dots, n$,

n = the respective time in the series of discounting years

N = Number of years,

r = Interest rate or discounting rate, and

Σ = Summation sign

3.8.6.4 Internal Rate of Return (IRR)

IRR is the rate of interest that equates the NPV of the projected series of cash flow payments to zero. Practically, it is considered as the rate at which the invested capital is returned back to the investors or is the rate which determines the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. It represents the maximum interest that a project/investment could pay for the resources used if the investment is to recover its investment and operating costs and still breaks even (Gittinger, 1982).

$$IRR = \sum_{t=1}^N \frac{INB}{(1+r)^t} \dots\dots\dots (20)$$

Where:

INB = Benefit per acre in each year of production,

N = Number of years,

r = Interest rate or discounting rate, and

Σ = Summation sign.

Mathematically:

Then

$$IRR = \begin{array}{l} \text{Lower discount} \\ \text{rate} \end{array} + \begin{array}{l} \text{Difference between} \\ \text{the two discount rates} \end{array} \left\{ \begin{array}{l} \text{NPV at a lower discount rate} \\ \text{absolute difference between} \\ \text{NPVs at the two discount rates} \end{array} \right\}$$

Table 4: Decision making framework

Financial analysis Tool	Decision Criteria		
	Accept if	Indifference	Reject
B/C Ratio	> 1	Equal to 1	< 1
NPV	> 0	Equal to 0	< 0
IRR	> Cost of capital i.e., i.e., Interest Rate (I)	Equal to I	< I

3.8.6.5 Costs and benefits analysis at different levels of growth of avocado trees

Streams of costs and benefits were used to calculate the key indicators of the analysis (NPV, BCR and IRR) at different levels of the growth of avocado trees. Then, the life cycle of each avocado tree in the farm indicated by the number of years starting from the year of planting up to the replacement year which was 36 years as per the case of this study was established. The discounting factors for several “n” years along the growth of the trees were determined from the discounting factors table with respective discounting coefficient of 10% as the chosen discounting factor for analysis. At each level of the growth of an avocado tree, the numbers of years were indicated for determining the output of the fruits and the benefit accrued from the sales of those fruits as well as the costs embedded on, with that context, at each level where the tree did not show remarkable difference in terms of outputs. The years were grouped to show equal ranges of time, and then respective discounted values were summed up to make a single value. The discounted benefits and costs were computed depending on the level of output at each range of time with respect to corresponding discounting factors.

3.8.7 Sensitivity analysis

Sensitivity analysis was carried out to test the volatility/robustness of NPV, CBR and IRR, those were calculated by making variations/alterations in the input variables. The ground of conducting this process was to capture the effects on risks and uncertainties on

the future prices for both inputs and outputs which were not considered before in the analysis process. The first tests were done on the following input variables: prices of the outputs, establishment costs and on the discounting, factors used in analysis. Then the results were observed on indicative variables to determine whether they were still viable or not to support the decisions of smallholder farmers.

In addition, another influential factor was also applied in the sensitivity analysis; this was a different commercial variety (Fuertes), which was introduced in the analysis, and observation was done on its output to test the output-effect on the dependent variables (NPV, CBR and IRR). However, no more literature was found to support the argument on the differences in terms of yield for the entire life of the tree; rather most differences were based on favourable tests and size of each given variety (AVPM, 2019).

3.9 Analytical Framework for Objective Three, Which Was Intended by the Study to Analyse the Factors to Hass-avocado Farmers' willingness to Participate Directly in the Export Market

3.9.1 Binary logistic model

In this section the study intended to analyse the determinants of avocado farmers' willingness to participate in the avocado export market in Tanzania. To achieve this objective, a binary logit model was used to estimate the likelihood of a farmer's willingness to participate in the export market. The binary logit model helped to identify the significant factors that explain the farmer's willingness to participate in the avocado export market. The dependent variable in this model was a binary variable, where 1 indicates that the farmer is willing to participate in the export market and 0 indicates otherwise. The independent variables will include the socio-economic characteristics of

the farmers, their attitudes towards avocado production and marketing, and their experience in the export market.

The binary logit model was specified under the random utility framework with the assumption that farmers are rational who strive to maximize utility subject to their budget constraints (McFadden, 1972). In the context of this study, farmers are assumed to be willing to participate in the avocado export market only if participation maximizes their perceived benefits. The perceived benefit of participation is represented by a latent variable Y_i^* which is a function of a set of farmer's socio-economic and plot characteristics.

3.9.2 Binary logistic question

This can be expressed as;

$$Y_i^* = \beta_k x_{ik} + \epsilon \dots \dots \dots (20)$$

From the above expression, the probability that i^{th} farmer is willing to participate in avocado export market is given as follows;

$$\Pr(Y_i = 1|x_i) = p_i$$

Given the above specification the logit model can be specified as follows:

$$\text{logit}(p_i) = \log\left(\frac{p_i}{1-p_i}\right) = (\beta_0 + \beta_1 x_i + \beta_1 x_i + \dots \dots \beta_k x_{ik} + e \dots \dots \dots (21)$$

Where:

$\Pr(Y_i = 1|x_i)$ = is the probability that farmer i is willing to participate in the export market.

β_0 = is the intercept term

$\beta_1, \beta_2, \beta_3, \dots \beta_k$ = are the coefficients of the independent variables $X_1 X_2 X_3 \dots X_K$

$X_1, X_2, X_3, \dots \dots X_k =$ are the values of the independent variables for farmer i .

On the other hands, the coefficients of the independent variables in the model represent the change in the log odds of a farmer's willingness to participate in the export market associated with a one-unit increase in the corresponding independent variable, holding all other independent variables constant.

The statistical significance of the coefficients was to be tested using the Wald test. A significant coefficient indicates that the corresponding independent variable has a significant effect on the farmer's willingness to participate in the export market.

3.10 Analytical Framework for Objective Four which Analysed the Severity Level towards Avocado Farmer's Perception on the Stated Constraints in Rungwe District

3.10.1 Severity index analysis

Descriptive analysis was employed purposely for this objective, to analyse the qualitative data obtained through key informant interviews. Then descriptive statistics analysis such as frequency distribution tables and percentages were used to present results obtained from the farmers and data relating to the constraints facing smallholder avocado producers. Ranking the constraints based on five-point Likert scale "*from 1; "Strongly challenging/constraining", 2; "challenging/constraining" 3; "Neutral". 4; "Not challenging". 5; "Strongly Not challenging"*".

Likewise, the study applied the severity index (SI) to complement the descriptive analysis, aforementioned above, by examining the perception of the avocado farmers towards the existing challenges/constraints in avocado production in the study area. According to Majid and McCaffer (1997), Isa *et al.* (2005), Longe *et al.* (2009), and

Masud *et al.* (2017), argued the Severity Index (SI) is basically employed as a tool of analysis that measures the strength of farmers' perspectives on the existing constraints in production. In the case of this study, farmers were provided with stated challenges or constraints, and they were required to rate the constraints on 0 to 4 points Likert scale, that's; strongly challenging (0), challenging (1), neutral (2), not challenging (3), and strongly not challenging (4). Then data were gathered for the study and analyzed to the severity index level of each stated constraint in avocado production.

3.10.2 Severity index question

$$\text{Severity index(SI)} = \left(\frac{\sum_{i=0}^4 b_i x_i}{4 \sum_{i=0}^4 x_i} \right) * 100\% \dots \dots \dots (22)$$

whereby:

bi represents the index of a class; constant indicates the weight given to the class, whereas *xi* shows the frequency of response, that is, for $i = 0, 1, 2, 3, 4$, as shown below. In addition, *b₁ b₂ b₃ b₄*, denote the response frequencies corresponding to $X_0=0, X=1, X=2, X=3, X=4$ respectively. This is based on the valuation agreement postulated by Majid and McCaffer (1997), is indicated as follows;

X_0 = <i>strongly not challenging</i>	$0.00 \leq SI < 12.5$
X_1 = <i>Not challenging</i>	$12.5 \leq SI < 37.5$
X_2 = <i>Neutral</i>	$37.5 \leq SI < 62.5$
X_3 = <i>Challenging</i>	$62.5 \leq SI < 87.5$
X_4 = <i>strongly challenging</i>	$87.5 \leq SI < 100.0$

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of the Surveyed Avocado Farmers in Rungwe District

4.1.1 Age of household heads

The results in Table 5 show that, out of the interviewed farmers'/household heads, the adult group with age ranging from 35 to 60 years were 195, equivalent to 54.2% of the total surveyed farmers. Two-fifths (40%) of the household heads were above 60 years old, and only 5.8% were below 35 years old. Household heads of middle age ranging from 35 years to 60 years were more active and forming part of production group which can grab opportunities in hass-avocado production. Considering, that members of this age group are regarded to be an influential in decision making, especially on adopting new technologies. This argument was supported by Babangida (2016), who reported that members of the middle age group of farmers normally have great influence on decision making, especially on innovation and creativity decisions. Then Regnard (2006) urges that, in general the growth of individual wealthy is highly depending on age of an individual, thus in most cases, there is direct relationship between wealth and age. Likewise, age of an individual can determine individual maturity and ability to make rational decisions.

4.1.2 Sex of respondents

Sex attribute of the respondents was also shown in Table 5, revealing the results that, male household-heads among the sampled farmers were 88.3% in avocado production, against 11.7% female; the huge variation was statistically significant as compared to women household-heads. This implied that, men had more initiatives in investing in

avocado in the study area compared to women, secondly, men were regarded to be more risk-takers when it comes to long term-investments whose returns take a long time, especially in perennial crops like avocado. Moreover, men had opportunity of owning land, that influenced them to engage more in avocado production and other crops related. Likewise, males were expected to be dominant in avocado production in the study, since they are the ones participating more in such decisions compared with females.

4.1.3 Level of education of household heads

Education level is regarded to be one of the influencing factors in crop farming and other related economic activities especially on growth and productivity (Ibrahim *et al.*, 2019). The findings in Table 5 indicate that 30 (8.3%) of the farmers interviewed had not attended any formal kind of education; 271 (75.3%) of them had completed primary education level, while 38 (10.6%) of them had completed secondary education and only 21 (5.8%) of them had college and University levels education. This implies that the level of literacy among avocado farmers was high. Since majority of them, had completed primary education, thus they can read and write, this could assist them to cope with the need's new technology, especially on new avocado varieties like hass-avocado. This argument was supported by Gichangi *et al.* (2012) who reported that education has a positive impact on adopting new agricultural technologies that can influence farmers to use improved varieties leading to productivity increase.

4.1.4 Primary occupations of household heads

Crop farming was said to be the most common primary economic activity done by avocado farmers in Rungwe District. The results in Table 5 indicate that 341 (94.7%) of surveyed farmers were doing crop production as their primary activity; 5 (1.4%) farmers considered livestock and poultry keeping as their key economic activity despite the fact

that they were also growing avocado; and 10 (2%) had formal employment while formal and informal trade business was the last economic activity done by a minority of the surveyed farmers in the district, which counted 4 (1.1%) out of the total (360) surveyed farmers. From the results, there was an implication that farming is taken as the core source of income for most of the people in the study area; this argument reflects or justifies the quick response of the farmers on Hass-avocado farming, when it was introduced in the district by Rungwe Avocado Company in 2008.

4.1.5 Farm size of avocado farmers involved in the study

Farm size was determined as the size of the farms cultivated by avocado out-growers in Rungwe District. The findings from the analysis were indicated in Table 5, showing that 305 (84.7%) of the surveyed avocado farmers owned farms of one and below one acre. These ranges of acres are insignificant compared to the available potential land for avocado production in the district. Other 46 (12.8%) of the surveyed farmers had farms between 1 and 3 acres, and only 9 (2.5%) out of the 360 surveyed farmers had the farms above 3 acres. This gives an indication that the capacity of the surveyed farmers in terms of production of Hass-avocado for export purpose was still low, regarding the size of farms owned by most avocado farmers.

Table 5: Farmers' socio-economic and farm inputs-characteristics of the avocado out-growers

Category	Description	N	Percentage	Minimum	Maximum
<i>Household characteristics</i>	Age of HH				
	(Age < 35 yrs)	21	(5.8)	22	93
	(35yrs < Age < 60)	195	(54.2)		
	(60 < Age)	144	(40)		
	Sex of HH				
	(1 if Male)	318	(88.3)		
	(0 Female)	42	(11.7)		
	Education Level for HH				
	Non-Formal Education	30	(8.3)		
	Primary education	271	(75.3)		
<i>Farm Features/structure</i>	Farm size –Avocado				
	0 < Fsize ≤ 1	305	(84.7)	0.25	5.5
	1 < Fsize ≤ 3	46	(12.8)		
	3 < Fsize ≤ 5.5	9	(2.5)		
	<i>Land tenure (1 P, 0 L, 2 F)</i>	Privately Owned	70	(19.5)	
	Leased land	0	(0.0)		
	Family land	290	(80.5)		
<i>Inputs use (1 Yes, 0 No)</i>	Fertilizers/Manure	360	(100)		
	Insecticides/Pesticides	171	(47.5)		
	Seedlings	360	(100)		
<i>Economic activity (1 Yes, 0 No)</i>	Crop farming	341	(94.7)		
	Livestock Keeping	5	(1.4)		
	Formal Employment	10	(2.8)		
	Business trade	4	(1.1)		

Source: Field Data; Modified by Author 2019.

4.2 Objective one: Examining the Current Situation of Hass-avocado Production and Export Market Trade in Tanzania

4.2.1 Status of commercial crops grown by different age groups of households - heads in Rungwe District

The results of the study indicated that, apart from avocado farming as an emerging cash crop in Rungwe district, farmers have been involving themselves in different types of cash production as presented in Table 6 the intensity of each cash-crop grown depended on the return of the crop, nature of the crop, land ownership, political will of the government and the age group of the farmers involving in. From the table below, the results shown, there was slightly variation in percentage for each cash grown in the

district based on the age group involved, these other cash were the back up for sustaining their life before the production of avocado. But also avocado had shown an interesting results when all the age groups from the youth to elders indicated full interest on growing it, this observation could be due to different factors, first; being an emerging cash crop coming up with attractive or promising price especially in the international market, secondly there was an initial support from the Rungwe avocado in-term of seedlings, fertilizers and other technical supports for free, all these might be the reason as to why all age groups responded equally.

Moreover; Rungwe avocado company and Kuza Africa made intensives campaign to the farmers by the time they were introducing the crop itself, this created a self-awareness to most of the farmers in the extent that these farmers were motivated to think of investing in avocado despite of having their former cash crops since.

Table 6: Commercial Crops grown by different age groups of households' heads

Cash crops grown (%)	Age of household head			Total (n=360)
	Youth (Less than or equal to 35 years) (n=21)	(Adult) More than 35 to 60 years (n=195)	(Old) Above 60 years (n=144)	
Avocado	100	100	100	100
Tea	38.1	69.7	63.9	65.6
Coffee	33.3	29.2	32.6	30.8
Cocoa	9.5	3.1	2.8	3.3
Banana	9.5	21	20.1	20
Irish potatoes	19	12.8	12.5	13.1
Beans	4.8	1.5	2.1	1.9
Maize	2.0	3.6	2.1	2.8

Source: Data from the field 2018

4.2.2 Status of years of farmers in avocado production and current farm sizes

The size of the farm is one of the determinant factors of production and the in this study the size of the farm was cross tabulated against farming experience of avocado producers within the district. The results from the Table 7, indicated that the smallest farm involved in the study was quarter an acre (0.25) while the largest farm surveyed was six and half acre (6.5). This was still significantly small as compared to the requirement and for the case of experience of the farmers in avocado production; the results indicated to have a problem since most of the farmers are new on this variety which make most of the farmers to fall into less experienced group. Therefore, the minimum experience of most of farmers with mean value of 5.27 while those with high experience of 9 years were having the mean value of 0.79, this revealed that majority of these farmer were confronted with the challenge of dealing this kind of variety of avocado (Hass).

Table 7: Years in avocado production and current farm sizes

Variable	Statistics				
	N	Minimum	Maximum	Mean	Std. Deviation
Current avocado farm size in acres	360	.25	6.50	.7917	.87761
Number of years involved in avocado production	360	3	9	5.27	1.357

Source: Data from the field 2018

4.2.3 The Status of avocado production, productivity, and area used for avocado farming in Rungwe District

The production and area under avocado farming in Rungwe district were the key variables in the analysis of this study. From 2010 to 2018, the area under avocado farming had increased from 2.6 hectors to 103.6 hectors for 360 sampled farmers in the study area. The production was reflected due to the expansion and involvement of new farmers in

production thus, there was an increase from 6.1 tons to 945.2 tons in the range of eight years. The average quantity per increased also from 0.8 tons to 2.6 tons per year, that was reasonable growth in production to the farmers. The yield per hector increased from 1 ton per hector to 3.6 tons per hector, this was also a good trend for commercial production in the district.

The significant increase in production from 2010 to 2018, was influenced by number factors, but mainly, was an impressive increase of avocado price per kg, that from 250 TZS to 1 200 TZS in range of eight years. This was reasonably attractive compared with existing commercial crop like tea, which had an average price of 250 to 300 TZS for those years (Rungwe report, 2018). The attractive price of the fruit made an influx of farmers to engage in production, which increased the area and production in the district. Table 8 is showing the trend of production and cultivated area from 2010 to 2018 for 360 respondents who were sampled from the study area.

Table 8: Production, productivity, and area under cultivation of hass-avocado for sampled farmers in Rungwe District

Years of production	Analysis		
	Average Production (Tons)	Area covered by sampled farmers (acre)	Productivity per acre for sampled farmers
2018	945.21	258	3.66
2017	699.39	251.25	2.78
2016	543.14	247.75	2.19
2015	392.54	231.25	1.70
2014	253.34	180.50	1.40
2013	130.94	108.00	2.52
2012	63.36	52.00	0.59
2011	23.82	25.25	0.94
2010	6.11	6.50	0.94

Source: Data from the field 2018

4.2.4 The Status of quantity produced, exported for the sampled famers in Rungwe District

The results from the analysis as indicated in Table 9 shown that, the production of avocado was increasing at the growth rate 31.05% each year, this was impressive rate on meeting the demand of the international market at a given period. But still the production increased from 23.M-tones in 2010 up to 945 M-tone in 2018, this was an increase of 31.05% each year for the entire period of analysis. This is significantly improvement for the out-growers and the exporting company (Rungwe avocado company). This also gives an indication that, the quantity of volume exported in 2010 from Rungwe district was equivalent to 1 container of 23 M-tone and in 2018, the quantity of volume exported was equivalent with 43 containers. These were impressive growth in-terms of production and exportation of the intended commercial variety of hass-avocado in Rungwe District. Despite the fact there is more improvement in the production and exported volume, but still more emphasize is needed in production to meet the demand in the export market. Therefore, more stakeholders are needed to embark in the entire chain of production of avocado.

Table 9: Production, and quantity exported of hass-avocado for sampled farmers from Rungwe District

S/N	Year	Exported Volume (Mt)	Growth Rate (%)	No. Container
1	2017	945.21	0	43
2	2016	699.39	35.14	32
3	2015	543.14	28.76	25
4	2014	392.54	38.36	18
5	2013	253.34	35.46	12
6	2012	130.94	48.31	6
7	2011	63.36	106.6	3
8	2010	23.82	165.9	1

Source: Data from the field 2018

To complement on the argument of the status of avocado production and export market of the product, the key informants were also consulted to give their opinion on the matter. Hence below is the response received from extension officer from Rungwe District.

Response: Rungwe District Agricultural officer:

“...The district’s avocado production is based on three main varieties: Hass, Fuertes, and local ones. The most exported variety is Hass, whose production has been increasing relative to an increase in the area under cultivation. In 2008 the area under Hass-avocado production was approximately 60 ha, while in 2019 the area increased up to 1 136.7 ha. Out of these 1 136.7 ha under avocado production, it is only 673.7 ha equivalent to 59.3% that are managed by the out-growers and 463 ha equivalent to 40.7% is under Rungwe Avocado Company and Kuza Africa as main producers and exporters in the district. The production of local avocado varieties in the district is done on 371.3 ha only, which makes a total of 1 508 ha as the total area of avocado production in the district. The numbers of out-growers and non-out-growers have been increasing steadily from 100 farmers in 2008 to approximately 12 000 farmers in 2019. This is a great potential in terms of manpower in the industry. The trend of avocado production in the district for both local and improved varieties was on average of 29 158 tons per year for the period of five years from 2014 to 2019 ...”.

4.3 Objective two: Economic Viability of Producing Hass-avocado in Rungwe District

4.3.1 Establishment Cost of One Acre of Avocado Farm

The total establishment cost was calculated based on the piece of land of an acre of avocado orchard or farm cultivated in Rungwe District. The total establishment costs involved two main components which were initially found to be investment costs, and operation costs. The initial investment costs included land purchase, seedlings purchase, cost of fertilizer both organic and industrial (Manure and NPK) which amounted to 1 431 000 (72.5%), and labour costs which were initially involved in land cultivation, digging of holes, application of manure into dug holes, seedlings planting and mulching.

Additional costs were incurred from the following activities: weeding in both subsequent years before yield, pesticide application for fruits flies control both in years two and three, fertilizer application especially borex for boosting, and finally deflowering and pruning. All these agronomic practices were mostly applied in year two and three before yield. Both components of costs were summarized and are presented in Table 10, with a total amount of TZS 1 974 431(100%) as an establishment cost for an avocado production project on one acre.

Table 10: Establishment costs of avocado Production in Rungwe district (TZS/Acre)

Particulars	Value	Per cent
Costs per acre	TZS	%
Initial establishment cost (year 1)	1 431 000	72.5
Total establishment cost	1 431 000	72.5
Farm management cost/Orchard management cost		
Weeding (Years 1 to 3)	186 259	9.4
Fertilizer applications (Years 2 to 3)	107 166	5.4
Pesticide cost and application (Years 2 to 3)	53 622	2.7
Cost of fertilizers (Years 2 to 3)	196 384	10.0
Total management cost	543 431	27.5
Total Establishment Cost	1 974 431	100.0

Source: Data from the field

4.3.2 The avocado price trend per kg, 2011-2020

Table 11 indicates price trend used in this study in determining the future benefit obtained from the yield of a Hass-avocado tree, which farmers were obtaining from Rungwe Avocado Company. The trend of this price increased yearly depending on the uncovered world demand for Hass-avocado and differences in seasonality between East Africa and other main producers of Hass-avocado worldwide—Peru, Mexico, South Africa and other countries from Latin America (MMA, 2017).

Therefore, the trend of these prices from 2010 to 2020 were taken, and the farm-gate price of 1 000TZS per Kg was taken as the initial price for the future projection, which was used for calculating the Net Present Values (NPVs), Cost Benefit Ratios (CB ratio) and Internal Rate of Return (IRR) of Hass-avocado regarding the life span of the tree.

The concept of using constant price as the constant predictable future price for the entire life of avocado tree, lied on the following arguments or assumptions. One, the given trend for ten years did not show very remarkable difference as compared to the number of years. Moreover, the trends of prices of other commercial crops grown in Tanzania, such maize, rice, coffee etc., have been determined with relatively constant prices for the number of years having some slight changes in the local and international markets (FAO, 2017). Lastly, the nature of the method of analysis used in this study (CBA) is scientifically advisable not to make variations of both prices and outputs in determining the future benefit of avocado production. Therefore, for the sake of this study, variation was made on the outputs of avocado produced based on growth stages of the tree, while assuming a constant price used on determining the future analysis of the product.

Table 11: Price trend (farm-gate prices) (TZS/kg)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Price (TZS)	250	300	340	340	400	400	607	800	1000	1000	1200

Source: Rungwe avocado sales reports per year (2010-2020)

Note: The price taken was 1 000 TZS of 2018/19, as the starting point price for the analysis of future projection.

4.3.2.1 Net Present Value (NPV) of an avocado farm

Net present value was computed as illustrated in Table 7, which indicates that the NPV for one acre among sampled avocado farmers in Rungwe was TZS 55 075 088 for the entire economic life of avocado trees in the farm (35 years). The observed positive NPV from the avocado farm indicated the acceptable sign of the project, since the calculated NPVs exceeded zero value as per the general rule of thumb; hence the production business of avocado seems to be viable and profitable for smallholder farmers in Rungwe District to be undertaken.

4.3.2.2 Benefit–cost ratio of an avocado farm

Benefit cost ratio was employed to establish the viability of avocado farming in Rungwe District (Nas, 1996). In this study the benefit-cost ratio was computed under the chosen discounting rate 10%, and the calculated ratio was equal to 1:9. The obtained results indicated that one shilling invested in avocado farming gave returns of 9 TZS as the benefit, and since the ratio obtained is greater than one, investment in production of avocado by smallholder farmers in Rungwe District was economically viable (NOU, 1997).

4.3.2.3 Internal Rate of Return (IRR) of an avocado farm

The results obtained from the analysis in Table 12 indicated that the IRR of this study was marked as 63.7834%. It was relatively greater than the given discounting rate of 10%

which is more acceptable as per the rule of thumb. Therefore, the obtained output in Table 12 expresses the viability of cultivating avocado in Rungwe, and it was a reliable venture to the farmers to be taken (Boardman, 2011). Table 12 indicated the computed values of NPV, BC-Ratio and the IRR of the avocado production in Rungwe district as a new business venture to the farmers in the district.

Table 12: NPV, Benefit Cost Ratio and IRR (Using Doyle Model)**NPV and BC-Ratio Computations**

DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	TOTAL
Gross Benefit (TZS) per Year	-	-	800 000	2 000 000	4 800 000	10 480 000	12 480 000	7 600 000	
Total cost (TZS) Per year	1 974 000	543 431	543 431	873 000	634 310	629 143	503 091	219 259	
Discount-Factor (10% discount) based on yrs.	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted-Benefit (PV(B))	-	-	601 052	1 366 027	8 153 056	26 181 855	21 345 200	4 310 104	61 957 294
Discounted Cost (PV(C))	1 794 545	449 117	408 288	596 271	1 077 409	1 571 768	860 463	124 346	6 882 207
NPV =PV(B)- PV(C)	- 1 794 545	- 449 117	192 764	769 756	7 075 647	24 610 087	20 484 737	4 185 758	55 075 088
Net Present Value	55 075 088								55 075 088
B/C ratio	9.00								9.00
IRR	63.7834%								

Discount Factors based on Years		10%	20%	30%	40%	50%	60%	65%
NP Value	55 075 088	55 075 088	17 171 885	6 708 932	2 803 955	1 066 488	205 805	(56 547)
BC-Ratio	9.00	9.00	5.07	3.15	2.11	1.50	1.11	0.97
Internal Rate of Return (IRR)	63.7840%							

These are graphs presenting the trend of NPV and BC-Ratio against the Discounting Factors

Source: Computed by the Author

Table 13: NPV, Benefit Cost Ratio and IRR (Using the Primary Data collected from the field)

NPV and BC-Ratio Computations											
DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year7	Year 8	Year 9	Year 10	TOTAL
Gross Benefit (TZS) per Year	20,952,953.33	15,714,715	67,581,670	117,799,289	169,235,834	169,235,834	226,239,921.40	175,003,688	115,854,780	94,196,890	1,171,815,576.59
Discount-Factor (10% discount) based on yrs.	0.90909	0.82645	0.75131	0.68301	0.6209	0.5645	0.5132	0.4665	0.4240	0.3855	
Discounted-Benefit (PV(B))	19,046,234.58	12,986,640	50,774,109.12	80,456,914.9	105,078,529	95,533,628	116,106,327.6	81,639,220	49,122,426	36,312,901.33	647,056,932.71
Initial Investment Cost	73,725,502.00										73,725,502.00
NPV =PV(B)- Initial Invest Cost	64,705,693.27										64,705,693.27
	(7,372,550.20)										7,372,550.20
Net Present Value	57,333,143.07										57,333,143.07
B/C ratio	8.78										8.78
IRR	70.0145%										70.0145%

To determine the value of IRR

Discount Factors based on Years		10%	20%	60%	70%	70.02%	70.2%	70.5%	72%
NP Value	57,333,143.07	57,333,143.07	31,674,506.34	2,091,761.59	11,881.66	(5,392.55)	(9,276.9)	(58,698.54)	(308,029.34)
BC-Ratio	8.78	8.78	5.29	1.3	1.002	0.9992	0.998	0.9927	0.9582
Internal Rate of Return (IRR)	70.0145%								

Source: Computed by the Author

4.3.2.4 Comparative analysis of the results from Doyle Model and Primary data

collected from the field: Indicators; NPV, Benefit-Cost Ratio and IRR

Based on the analysis of the NPV, Benefit Cost Ratio, and IRR for the avocado project in Rungwe District, it appears that the Doyle model was a valid tool for determining the economic viability of the project. The simulated results obtained from the Doyle model as indicated in Table 12 were relatively consistent with the results obtained from the primary data collected from the field as indicated in Table 13, but with slight variations.

The Doyle model used a standard plant population of 80 avocado trees per acre, with 7m by 7m between the trees. However, the field data revealed that farmers used a varying plant population, ranging from 80 trees to 100 trees per acre, with distances between trees ranging from 7m by 7m to 5m by 7m. Additionally, some farmers had slightly more than one acre of land for their avocado production. These variations in plant population and farm size could explain the slight differences in the computed indicators (NPV, BC-ratio and IRR) between the two sets of results.

Overall, the use of the Doyle model to determine the economic viability of the avocado project in Rungwe District appears to be appropriate. The model's simulated results were relatively consistent with the field data, and any variations could be explained by differences in plant population and farm size among the farmers. Still use of the Doyle model appears also to be a valid approach for analyzing the economic viability of the avocado production project in Rungwe District, because the model provides a useful tool for assessing the feasibility and profitability of business projects and can help decision-makers to make informed investment decisions.

4.3.3 Results for Profit and loss analysis

The results indicated from the analysis in Table 14, on the return on investment in Hass-avocado production depended on the life cycle of the tree itself, which is 35 years as an economic life span. Generally, the results indicated the first two years (Gestation Period). the investment in avocado experienced a negative return of TZS 1 974 000 and TZS 543 431 consecutively, meaning that, for those years, the investment costs were higher than the revenue from sales of the fruits, but with time, the production increased to recover the investment costs. Starting from third year, the investments started attaining the positive return against the investment and operation cost. Then from year 8 to year 14, the investment had shown a growth towards attaining the pick points of output, for both total revenue and total discounted revenue. The plateau- return was attained from year 15 to 25 amounting a total of TZS 131 747 000 discounted value. Essentially, this trend of cash-flows gave a positive indication on entire investment in Hass-avocado practically on one acre of an avocado farm (orchard) which was used as a unit of analysis in this study. In this case of analysis, the plant population in one acre of avocado farm in Rungwe district was 80 number trees as the minimum plant population, against 100 trees as maximum plant population as recommended in the agricultural practise of avocado farming globally. Therefore, the results indicated, with an investment of 80 trees as minimum plant population in one acre of avocado farm, the expected profit will be 285 872 618 TZS for the economic life of the planted avocado trees.

Table 14: Profit and loss analysis for one acre of avocado farm

DETAILS	ANALYSIS								TOTAL
	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	
Crop-Life cycle									
Average yield/tree	0	0	10	25	60	131	156	95	477.0
Average yield//tree in yrs. (Kg)	0	0	10	25	180	917	1716	950	3798.0
Average price (<i>2017 as reference year</i>)	1000	1000	1000	1000	1000	1000	1000	1000	
Total income per tree	-	-	10 000	25 000	180 000	917 000	1 716 000	950 000	3 798 000.0
Min -Plant population/Acre	80	80	80	80	80	80	80	80	
Max-Plant Population/Acre	100	100	100	100	100	100	100	100	
Total Revenue-with Min Plant pop (80)/Acre	-	-	800 000	2 000 000	14 400 000	73 360 000	137 280 000	76 000 000	303 840 000.0
Total Revenue-with Max Plant pop (100)/Acre	-	-	1 000 000	2 500 000	18 000 000	91 700 000	171 600 000	95 000 000	379 800 000.0
Total Cost	1 974 000	543 431	543 431	873 000	1 902 930	4 404 000	5 534 000	2 192 590	17 967 382.0
Net Profit (Min Plant pop 80)	- 1 974 000	- 543 431	256 569	1 127 000	12 497 070	68 956 000	131 746 000	73 807 410	285 872 618.0
In average profit each year (80 plants)			256 569	1 127 000	4 165 690	9 850 857.14	11 976 909.09	7 380 741	

Source: Computed by the Author

4.3.4 Sensitivity analysis

4.3.4.1 To determine the effect on NPV, CB-Ratio and IRR when price of 1 Kg of avocado was reduced by 30%

The results in Table 15 portray the effect on the decrease of price of 1 kg of avocado by 30%, which led to the decrease of the gross benefit by 30% too. The following were the observed effects on NPV, CB-Ratio and IRR. The Net Present value decreased from 55 075 088 TZS to 36 487 900 TZS, which was equivalent to 33.8% from the original value, then CB-Ratio dropped from 9.0 to 6.3, while the IRR decreased from 63.78% to 51.499% as an effect of reduced price from 1 000 TZS to 700 TZS. Then, from the computed results, it was observed that the effects on variables-indicators (NPV, BCR and IRR) provided an acceptable indication that the farm-business on avocado production was still a valid business to be undertaken in Rungwe District.

The supporting argument behind the results indicates that, with the shock of one of the measurement-input variables (price), yet all, tested financial indicators remained positive. This is ruling out that, business, or investment on avocado production in Rungwe is still worth to be taken, because it will give an intended return even if the price will be decrease up to the level of 30%.

Table 15: Sensitivity analysis when total benefit decreases by 30%

Effect on the NPV and B/C Ratio									
Details	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	Total
Gross Benefit (TZS) per Year	-	-	800 000	2 000 000	4 800 000	10 480 000	12 480 000	7 600 000	
Gross Benefit (TZS) with decrease of price by 30% per Year	-	-	560 000	1 400 000	3 360 000	7 336 000	8 736 000	5 320 000	
Total cost (TZS) Per year	1 974 000	543 431	543 431	873 000	634,310	629 143	503 091	219 259	
Discount Factor (10% discount) based on yrs	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted Benefit (PV(B))	-	-	420 736	956 219	5 707 139	18 327 299	14 941 640	3 017 073	43 370 106
Discounted Cost (PV(C))	1 794 545	449 117	408 288	596 271	1 077 409	1 571 768	860 463	124 346	6 882 207
NPV =PV(B)-PV C	- 1 794 545	- 449 117	12 449	359 948	4 629 730	16 755 531	14 081 177	2 892 727	36 487 900
Net Present Value	36 487 900								36 487 900
B/C ratio	6.30								6.30
IRR	51.4999%								

Source: Computed by the Author

4.3.4.2 Effect on NPV, CBR when establishment and operation cost are increased by 30%

The findings in Table 16 indicate that when the inputs variable like establishment costs and operation cost are altered by 30%, such changes on the inputs tend to cause more changes on NPV, BC-Ratio and IRR at different magnitude levels.

Therefore, the alteration of 30% in the total cost of production of avocado, led Net present value to drop from its original value of 55 075 088 TZS to 53 010 426 TZS, which is equivalent to a 3.7% decrease in NPV, then benefit cost ratio was affected due to the changes of the production cost, it decreased from the original ratio of 1:9 to 1: 6.9. The changes indicate that the decrease of returns when costs of production were increased by 30%, then 1 TZS invested in avocado business would give back a return of 6.9 TZS instead of 9 TZS as the effect of such changes on cost of production.

Then the Internal Rate of Return (IRR) was also affected by alteration on the production cost by 30%. Such changes in production cost led to a decrease in IRR from its original value of 63.784% to 54.419%. This signifies that the rate at which the capital invested in avocado will be returned is going to decrease to 54.419 % when the cost of production increases by 30%.

Table 16: Sensitivity analysis when total cost increases by 30%

Details	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	Total
Gross Benefit (TZS) per Year	-	-	800 000	2 000 000	4 800 000	10 480 000	12 480 000	7 600 000	
Total cost (TZS) Per year	1 974 000	543 431	543 431	873 000	634 310	629 143	503 091	219 259	
Total cost (TZS) Increased by 30% Per year	2 566 200	706 460	706 460	1 134 900	824 603	817 886	654 018	285 037	
Discount Factor (10% discount) based on yrs	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted Benefit (PV(B))	-	-	601 052	1 366 027	8 153 056	26 181 855	21 345 200	4 310 104	61 957 294
Discounted Cost (PV(C))	2 332 909	583 851	530 774	775 152	1 400 632	2 043 298	1 118 602	161 650	8 946 868
NPV =PV(B)-PV C	- 2 332 909	- 583 851	70 278	590 875	6 752 424	24 138 557	20 226 598	4 148 454	53 010 426
Net Present Value	53 010 426								53 010 426
B/C ratio	6.93								6.93
IRR	54.74999%								

Source: Computed by the Author

4.3.4.3 To determine the effect on NPV, CBR and IRR when price was decreased by 30% and total establishment cost was increased by 30%

Table 17 specifically indicates the results acquired from the observed effect when the price of one 1 kg of avocado was reduced by 30%, while the total production cost was also increased by 30%.

The following were the observed results from the changes on price and costs; The Net Present Value (NPV), was reduced from the original value of 55 075 088 TZS up to 34 423 238 TZS as indicated in the table. This was parallel with changes on CBR, which was changed from 1:9 to 1:4.9, which was less by 40%. This indicated that, return on one shilling invested in avocado production was reduced up to 4.9 Tanzania shilling.

The Internal Rate of Return was also affected with the given changes on the price and cost of production, the IRR was reduced from its original percentage of 63.78, up to 43.6%, showing that, the rate at which the capital invested in production of avocado was changed up to the given rate of 43.6%.

Thus these variations on NPV, BCR and IRR from their original values to the new values indicated in the results, they still show the positive outcome and the future validity of the avocado business in Rungwe District.

Table 17: Sensitivity analysis when total cost increases by 30% and total benefit decreases by 30%

Details	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	Total
Gross Benefit (TZS) per Year	-	-	800 000	2 000 000	4 800 000	10 480 000	12 480 000	7 600 000	
Total cost (TZS) Per year	1 974 000	543 431	543 431	873 000	634 310	629 143	503 091	219 259	
Gross Benefit (TZS) Decreased by 30% per Year	-	-	560 000	1 400 000	3 360 000	7 336 000	8 736 000	5 320 000	
Total cost (TZS) Increased by 30% Per year	2 566 200	706 460	706 460	1 134 900	824 603	817 886	654 018	285 037	
Discount Factor (10% discount) based on yrs	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted Benefit (PV(B))	-	-	420 736	956 219	5 707 139	18 327 299	14 941 640	3 017 073	43 370 106
Discounted Cost (PV(C))	2 332 909	583 851	530 774	775 152	1 400 632	2 043 298	1 118 602	161 650	8 946 868
NPV =PV(B)-PV C	- 2 332 909	- 583 851	- 110 038	181 067	4 306 507	16 284 001	13 823 038	2 855 423	34 423 238
Net Present Value	34 423 238								34 423 238
B/C ratio	4.85								4.85
IRR	43.5999%								

Source: Computed by the Author

4.3.4.4 Effect on NPV, CBR when yield or output reduced by 40%

The results in Table 18, indicates the figures obtained from the effect of reduction of the avocado production output by 40%, this might be due to different external factors like, Diseases, Pest and improper management in avocado farming. This argument is supported by findings of a study by KILIMO Trust (2013) that diseases and pests may lead practically the reduction of the output up to 40% to 50% each year (Kimaru, 2020).

Then, the given reduction of 40% in the output of avocado, led to an effect on the value of NPV, BCR and IRR as indicated in the given table. That's, the Net Present Value was decreased from the original value of 55 075 088 TZS to 30 292 170 TZS but was still positive, and Benefit cost ratio was reduced from the 1:9 to 1:5.4, this was also above one, indicating that, is an acceptable ratio.

Then the IRR, was also affected from the changes in the output, which led to the Internal Rate of return value to be reduced from 63.78% as an on original value for this analysis up to 45.99%. This indicates the negative effect of the out-put reduction towards the IRR as an indicator in the sensitivity analysis.

Table 18: Sensitivity analysis when yield decreases by 40% due to some diseases and pests

Details	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year 15-25	Year 26-35	Total
Gross Benefit (TZS) per Year	-	-	800 000	2 000 000	4 800 000	10 480 000	12 480 000	7 600 000	
Gross Benefit (TZS) when output decreases by 40% per Year	-	-	480 000	1 200 000	2 880 000	6 288 000	7 488 000	4 560 000	
Total cost (TZS) Per year	1 974 000	543 431	543 431	873 000	634 310	629 143	503 091	219 259	
Discount Factor (10% discount) based on yrs.	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted Benefit (PV(B))	-	-	360 631	819 616	4 891 834	15 709 113	12 807 120	2 586 062	37 174 377
Discounted Cost (PV(C))	1 794 545	449 117	408 288	596 271	1,077 409	1 571 768	860 463	124 346	6 882 207
NPV =PV(B)-PV C	-1 794 545	-449 117	- 47 657	223 345	3 814 424	14 137 345	11 946 657	2 461 716	30 292 170
Net Present Value	30 292 170								30 292 170
B/C ratio	5.40								5.40
IRR	45.999%								

Source: Computed by the Author

4.4 Results for Objective Three, Which was Intended by the Study to Analyse the Factors to Hass- Avocado Farmers' Willingness to Participate Directly in the Export Market.

Binary logistic model results were applied for the analysis for the severity index analysis

The results of this study would provide insights into the factors that influence farmers' participation in the export market and inform policies that can improve farmers' participation in the market.

Table 19: Logit results of the determinants of farmers' willingness to participate in avocado export market in Rungwe.

Willingness to participate In the export Market	Coefficient	Robust Std. Err	z	P>z	[95% Conf. Interval]	
Education (above form 4)	0.8708	0.4631	1.8800	0.0600	-0.0370	1.7785
Farm size	0.2645	0.0510	5.1900	0.0000	0.1645	0.3645
Non-farm income	-0.6193	0.1935	-3.2000	0.0010	-0.9985	-0.2401
Extension access	0.5219	0.2581	2.0200	0.0430	0.0161	1.0278
Years in community	-0.0020	0.0019	-1.0700	0.2860	-0.0056	0.0017
Head's age	0.0161	0.0052	3.1100	0.0020	0.0060	0.0263
Formal employment	1.6003	0.7540	2.1200	0.0340	0.1224	3.0781
Credit access	0.8586	0.2744	3.1300	0.0020	0.3207	1.3965
Road- farm distance	0.1895	0.0648	2.9300	0.0030	0.0625	0.3164
Transport cost to centre	-0.0442	0.0180	-2.4600	0.0140	-0.0001	0.0000
Constant	1.9100	0.5519	3.4600	0.0010	0.8282	2.9917
Number of obs.					325	
Wald chi2(12)					78.55	
Prob > Chi ²					0.0000	
Pseudo R ²					0.2799	
Log pseudo-likelihood					-573.60	

Source: Field data ;Computed by the Author 2018

The logistic regression analysis conducted on the determinants of farmers' willingness to participate in avocado export market in Rungwe revealed important coefficients that are relevant to the study's title. The significant Wald Chi-squared statistic of 78.55 at 1% indicates that the variables included in the model are jointly significant in explaining the

variation in farmers' willingness to participate in the export market. This implies that the variables have a significant effect on the outcome variable. The log-pseudo likelihood of -573 indicates that the model has a good fit in predicting farmers' willingness to participate in the export market. This implies that the variables included in the model adequately capture the variation in farmers' willingness to participate in the avocado export market. The high Pseudo R-squared value of 0.2799 suggests that the variables included in the model account for approximately 28% of the total variation in farmers' willingness to participate in the export market.

The Marginal effects results of the determinants of farmers' willingness to participate in avocado export market are discussed below:

Education: The findings show that education plays a crucial role in determining farmers' willingness to participate in the avocado export market in Rungwe. Specifically, the study found that farmers with higher levels of education, above ordinary secondary school, are more likely to participate in the market than those with lower levels of education. The reason for this could be that farmers with higher levels of education are better equipped to access information and resources necessary to participate in the export market. These farmers are more likely to have access to formal sources of information such as government agencies, non-governmental organizations, and other formal education channels. This information may include market trends, requirements for export, and necessary regulations. Therefore, farmers with higher levels of education are better positioned to make informed decisions and take necessary steps to participate in the export market. Additionally, farmers with higher levels of education may have other sources of reliable income that can help them navigate the complicated procedures and processes required to access the export market. For instance, they may have formal jobs or other reliable sources of income that can provide them with the necessary capital to invest

in their farms or to meet the stringent requirements of the export market. Consequently, these farmers are more likely to take the risks associated with participating in the export market. However, it is worth noting although education level above secondary school is positive and significant on farmers' willingness to participation in export market, majority of farmers especially in rural areas are less educated. Therefore, efforts to promote education should go hand in hand with other initiatives such as information campaigns, export business related trainings and other support systems to enhance the capacity of less educated farmers to participate in export markets that education level is just one of the many factors that influence farmers' willingness to participate in the export market.

Farm size: The finding that farm size under avocado production significantly increases farmers' willingness to participate in avocado export markets in Rungwe is an important observation. It suggests that farmers with larger farms are more likely to be interested in participating in the export market than those with smaller farms. One possible explanation for this finding is that larger farms have greater economies of scale, which makes it easier for farmers to meet the quantity and quality standards required by export markets. Additionally, larger farms may have greater resources available to invest in the infrastructure and equipment necessary to meet these standards. Another possible explanation is that farmers with larger farms may have more experience and knowledge of avocado production, which may make it easier for them to navigate the complex processes and procedures involved in accessing export markets. Furthermore, they may have established relationships with exporters or other key players in the industry, which could provide them with additional support and resources to enter the export market.

Non-farm employment: The findings show that access to non-farm income decreases farmers' willingness to participate in the avocado export market in Rungwe which

highlights that the complex nature of export oriented avocado production and marketing. This finding suggests that farmers who have access to non-farm employment are less likely to participate in the export market due to various reasons. One possible reason is that farmers who have access to non-farm employment may have limited time and resources to devote to avocado production and marketing. For instance, they may have to split their time between their non-farm jobs and avocado farming, which may affect their ability to meet the necessary export volumes and standards. Consequently, they may not be able to participate in the export market as they may not be able to meet the necessary requirements. Additionally, farmers who have access to non-farm income may not perceive avocado farming as a profitable venture. This is because they may be earning more income from their non-farm jobs than from their avocado farms. As a result, they may not see the need to invest in avocado production and marketing or to take the risks associated with participating in the export market. Moreover, farmers who have access to non-farm income may lack the necessary skills and knowledge to participate in the export market. This is because they may not have experience in avocado production and marketing or may not have access to the necessary information and resources needed to participate in the export market.

Household head's Age: The results presented in Table 19 show that the age of the household head has a positive and significant effect on farmers' willingness to participate in the avocado export market in Rungwe. These findings suggest that older farmers are more likely to participate in the export market than younger farmers due to various reasons. One possible explanation is that older farmers are more experienced and have established connections that may help them access the necessary resources needed for avocado production and marketing. For example, they may have established relationships with suppliers, buyers, and other stakeholders in the value chain, which may help them

access financing, market information, and other critical resources. Additionally, they may have access to larger plots of land that may allow them to increase their avocado production and meet the export market's demands. Furthermore, older farmers are more likely to be wealthier than younger farmers, which may enable them to afford the costs associated with avocado production, marketing, and export compliance. For instance, they may have more resources to invest in irrigation, fertilizers, and other inputs that may improve the quality and quantity of their avocado yields. Moreover, they may have access to better storage facilities and transportation, which may enable them to meet the export market's requirements for quality and timely delivery. Overall, the findings highlight the need for policies and programs that support older farmers' participation in the export market. This may include initiatives to improve access to financing, market information, and other critical resources needed for avocado production and marketing. Additionally, there may be a need to provide targeted training and capacity-building programs to help older farmers acquire the necessary skills and knowledge needed to participate in the export market.

Credit access: The finding that access to credit has a positive and significant effect on farmers' willingness to participate in the avocado export market in Rungwe provides valuable insights into the importance of credit access in promoting commercial investments in agriculture. The results suggest that farmers who have access to credit are more likely to participate in the export market than those who do not have access to credit. The possible explanation for this finding is that access to credit enables farmers to finance investments needed for avocado production and marketing. For example, farmers who have access to credit can purchase land for avocado production, hire additional labour, purchase inputs such as fertilizers and pesticides, and invest in infrastructure like irrigation systems and storage facilities. These investments can increase the quantity and

quality of their avocado yields and help them meet the export market's demands. Moreover, access to credit can also help farmers manage the risks associated with avocado production and export. For instance, farmers who have access to credit can purchase crop insurance to protect against crop failure, market volatility, and other risks. This can help them to mitigate losses and maintain their financial stability, which may encourage them to continue participating in the export market.

Farmers with Formal employment: The finding that farmers' access to formal employment increases their willingness to participate in the avocado export market in Rungwe provides valuable insights into the role of employment in promoting commercial investments in agriculture. The results suggest that farmers who have access to formal employment are more likely to participate in the export market than those who do not have access to formal employment. These findings could be explained by the fact that farmers with formal employment are more likely to have more reliable income sources and may have more financial stability to invest in avocado production and marketing. Formal employment can provide a consistent income stream that farmers can use to finance investments in avocado production and marketing, such as purchasing inputs like fertilizers and pesticides, hiring labour, and investing in infrastructure like irrigation systems and storage facilities. Moreover, farmers with formal employment may also have better access to information, knowledge, and skills necessary for avocado production and marketing. For example, they may have more opportunities to learn about market demand, quality standards, and export procedures through their employment or professional networks. This can help them to better understand the requirements and standards of the export market, which may increase their willingness to participate. Furthermore, farmers with formal employment may have access to additional resources such as credit, which can help them to finance investments and manage risks associated with avocado

production and export. They may also have access to networks of professionals who can provide them with advice and support on avocado production and marketing.

Extension services: The finding that farmers' access to extension services has a positive and significant effect on their willingness to participate in the avocado export market in Rungwe provides important insights into the role of extension services in promoting commercial agriculture. Extension services play a critical role in providing farmers with the necessary knowledge, skills, and resources to improve their agricultural practices and increase their productivity and profitability. The probable explanation for the positive effect of extension services on farmers' willingness to participate in the avocado export market is that extension services can provide farmers with valuable information about the market demand, quality standards, and export procedures. Extension officers can help farmers to understand the requirements and standards of the export market and provide them with information on how to improve the quality of their products to meet those standards. This can help to increase farmers' confidence and motivation to participate in the export market. Moreover, extension services can also provide farmers with technical support and advice on how to improve their agricultural practices, such as crop management, pest and disease control, and post-harvest handling. This can help farmers to increase their productivity, reduce production costs, and improve the quality of their products, which are important factors in the competitiveness of the export market. Furthermore, extension services can help to improve farmers' access to inputs, credit, and other resources that are necessary for avocado production and marketing. Extension officers can provide farmers with information on how to access credit and other resources and help them to develop business plans and proposals to secure financing.

Farm-road distance: The logit analysis shows that the coefficient of distance from the main road to the avocado farm is positive and statistically significant at the 1% level ($p < 0.01$). This finding suggests that the further the farm is from the main road, the less likely the farmer is to participate in the avocado export market. Specifically, a one-unit increase in the distance from the main road is associated with a 0.190 increase in the probability of willingness to participate in the avocado export market, holding all other factors constant. The positive relationship between distance from the main road and farmers' willingness to participate in the avocado export market is contrary to the conventional wisdom that better road infrastructure promotes market access and facilitates trade. The plausible explanation for this finding is that farmers who are located further from the main road may face higher transportation costs and greater logistical challenges in accessing the market. As a result, these farmers may be more likely to seek out alternative markets or sell their produce domestically, where transportation costs are lower. Another possible explanation for the positive relationship between distance from the main road and farmers' willingness to participate in the avocado export market is that farmers who are located further from the main road may face less competition from other farmers. This may give them greater bargaining power with buyers and allow them to command higher prices for their produce.

Additionally, these farmers may have fewer alternative market options available to them. As a result, they may be more willing to participate in the avocado export market despite the logistical challenges associated with transportation and market access. Additionally, farmers located farther from the main road may have lower transaction costs, as they are likely to have fewer intermediaries involved in the marketing chain.

Transport cost to the centre: The regression results indicate that the coefficient of transport cost (-0.0442) the center is negative and statistically significant at the 1% level ($p < 0.01$). This finding implies that higher transport costs to the center are associated with a lower willingness of farmers to participate in the avocado export market. The negative relationship between transport costs to the centre and farmers' willingness to participate in the avocado export market is not surprising. Higher transport costs can result in lower profitability for farmers, reducing their motivation to participate in the export market. Higher transport costs can also affect the competitiveness of Rungwean avocados in international markets, potentially reducing demand and affecting the overall profitability of the sector.

The negative relationship between transport costs and farmers' willingness to participate in the avocado export market can also be explained by the impact of transport costs on market access. Higher transport costs can limit farmers' access to the market, reducing the availability of market information and creating barriers to entry. This can create a situation where farmers are less aware of the opportunities and risks associated with exporting their produce, reducing their willingness to participate in the market. Furthermore, higher transport costs can increase transaction costs, making it more difficult for farmers to sell their produce at a profit. This can make the export market less attractive to farmers, particularly small-scale farmers who may have limited resources to invest in the market. As a result, lower transport costs can increase the overall profitability of the avocado export market, making it more attractive to farmers and promoting sustainable growth in the sector.

4.5 Objective Four: In this Objective, the Study Intended to Examine the Hass-avocado Production Constraints to the Farmers and Ranking them based on their severity level perceived by the farmers in Rungwe District.

4.5.1 Description of the hass avocado production constraints to avocado farmers in Rungwe District

The most constraining factors in avocado production in Rungwe District were determined during the survey of the study. Thus, farmers had pointed out 11 constraints factors in their avocado production process and ranked them based on the degree of their severity. For analysis purpose.

4.5.2 Infestation of different insects, pests, and diseases in the crop

This was among the most challenging constraints to most of the surveyed farmers, that's (61.7%) of the surveyed farmers perceived it to be problem to them. Regarding that, Hass-avocado was a new variety to most of them in study area. Thus, prominent diseases found in study area, were Cercospora spot (*Cercosporin purpurea*) and Avocado scab (*Sphacelona perseae Jenkins*). The two mentioned diseases were dominant in different wards within the district depending on weather variation (Rungwe Report, 2018). For example, the Cercospora spot was mostly found in wards which were receiving more rain like Kisondele, Kyimo and Kiwira because the nature of the disease is a rainy season disease. But Avocado scab disease mostly featured in wards which had relatively hot weather like Kandete Ward, located in Busokelo where the weather is somehow hot compared to the other wards in the district. This ward borders with Kyela District, which is warmer than Rungwe District (Rungwe Report, 2018).

The symptoms for both diseases were different on attacked fruits, leaves, and roots. The *Cercospora spot* disease tends to create brownish spots on leaves which make to fall

early, while on fruits tend to change colour of the fruits into blackish at its early stage and finally falls before its maturity stage. This was contrary to the *Cercosporin* disease, the Avocado scab always attacks leaves, shoots and fruits and creates well defined spots on both leaves and fruits, later the spots tend to join and make the fruit to be totally rough or having cocky appearance.

Both diseases led to the reduction of yield on the farm level, quality of avocado fruits, and a shelf-life of the harvested fruits (Pernezny *et al.*, 2000). The diseases also lead to significant economic losses the farmers and hamper market accessibility (Freeman *et al.*, 1998). The effects of *Cercospora* spot disease (*Cercosporin purpurea*) on avocado fruits and leaves are shown in Plate 1.



Plate 1: Effects of *Cercospora* spot disease (*Cercosporin purpurea*) on avocado fruits and leaves

Source: Avocado profile in Tanzania, 2020

The insect pests were also found to be a technical challenge in avocado production to most of the surveyed farmers in the study area. The risk part of it, was the scales attacked the avocado trees by providing sticky honeydew on the cover of the fruit and leaves,

which later, created fungus infestation on the cover of the fruit. This reduces the ability of the tree to make the photosynthetic process, then hindered the flowering process of the tree. Economically, this was regarded to be a loss, reducing the required exported quantity and revenue by the company, despite the stated production potential available in the district (Kimaru, 2020). Fruit flies had the same effect on attacking the skin of fruits by laying eggs on it, then the hatched grub tends to feed on the fruit pulp and causing fruits to rot (Rodriguez and Creamer, 2014). To complement on the argument of the diseases as one among the challenge to the farmers, the key informants were also consulted to give their opinion on the matter. Hence below is the response received from the farm manager of Rungwe avocado company.

Response from the key Informant (Farm Manager- Rungwe Avocado)

“...The situation of diseases and pests’ management in avocado farms in Tanzania is a little bit cumbersome due to unaffordable and bureaucratic inputs registration systems. Basically, most of successful countries in the horticulture industry are those with flexible input regulatory systems. Rungwe avocado company and other exporters like Africado, Kuza- Africa and Lima have been facing serious challenges, especially in accessing agrochemical inputs that are preferred or allowable in international markets. The Tanzanian regulations require every chemical to be registered by TPRI at the charge of 10 000 dollars regardless of the volume of use. Since there are a series of chemicals needed, some of which must be formulated after the problem has been identified, the combined registration fee becomes a challenge for small farmers to afford. For fertilizers, it is even worse as one must pay USD 30 000 per type of fertilizer being registered....”

Lack of technical knowledge regarding the cultivation of the crop

This included lack of management skills and lack of fruits handling skills during harvesting period of avocado. All these lead into farmers to have large quantity of the

rejected harvest, which was not required in the world market. This created a mis matching of what was produced and what was delivered to the company for export. Regarding Hass-avocado fruit was a new variety to them, most of surveyed framers declared to have little skills on management and handling the of avocado farms and fruits as well. Therefore, these farmers had to rely on the extension officers from the Rungwe Avocado Company, who were often not sufficient to serve the farmers due to the increasing number of the farmers yearly and unfriendly geographical location of the farmers. Thus, statistically it was revealed, 60% of the surveyed farmers declared that they had not enough skills and knowledge on avocado production. Such situation became a hindering factor toward production progress and quality of their fruits from the district. Therefore, this was another reason of the low performance of the farmers in production and management of the avocado farms.

Inadequate supply of extension service from the company to the avocado farmers,

This was another serious constraint to Rungwe avocado farmers. It was a technical setback to avocado farmers in the district to meet the optimal and quality outputs. From 2008 to 2011, it was a time when Hass- avocado was introduced in Rungwe District. The number of out-growers was still low, in average of 100 farmers for the entire district (RAC report 2015). Therefore, deliverance of the extension services was not regarded to be a challenging aspect by then, since the demand was below the supply of extension officers and related services from the company (Rungwe Annual report, 2012). When the number of out-growers started increasing up to 4 000 farmers and above (Rungwe Annual report, 2019), it was reported that the management on provision of extension service became a challenge, especially from 2015 when most farmers decided to embark on growing avocado. This pushed on the demand of services to override the supply from the company. Thus, from the study findings, indicated that 69% of the surveyed farmers

acknowledged that, lack of timely service from the extension officer was basically a challenge to work on it immediately. Since it has a direct effect in the output of the plant and hence resulted into lower yield and income to the farmers and Exporting company.

Non availability of timely inputs supplied from the company (fertilizers and pesticides)

This had negative repercussions on the growth and yield of the plants. The situation had an economic impact of lowering down the fruit yield by 20% to 30% per year (Freeman *et al.*, 1998). This has been facing the Rungwe avocado farmers to a large extent, especially on the fertilizers and pesticides which were provided by the exporting company. 78.9% of the farmers argued that there was a delay in timely inputs application in their farms which raised the situation to be a challenge for the health of trees and orchard at large. In addition, the results obtained from in-depth interview with key informants complemented the argument of this challenge. To complement on the argument on the delay of inputs as one among the challenge to the farmers, the key informants were also consulted to give their opinion on the matter. Hence below is the response received from the farm manager of Rungwe avocado company.

Response from the key informant (Director of Rungwe Avocado Company)

“...Regarding the challenge of delay in supply of fertilizers and pesticides, the company has been going through the hard situation due to over regulation and trade barriers which mostly focus on imported inputs. These situations create a long process at the boarders and eventually create delays to the entire process of inputs supply to our farmers...”

Inadequate supply of recommended seedlings from the company,

Essentially supply of seedlings from 2008 to 2013 was not regarded to be a challenge the farmers, since the demand was low as compared with the supply from the company (Rungwe Annual Report, 2012). The farmers started experiencing the challenge from 2014, when the first and second harvests were obtained from the first growers. This acted as a catalyst to most of the farmers to embark on growing avocado which increased the demand to override the supply from the company. Basically, the expansion was done by both uprooting tea or coffee and planting avocado. This was revealed during the survey, 40.3% of the out-growers argued that this factor was a strong challenge to them, especially when they wanted to expand or start a new farm; seedlings ordered would take time to reach them, and 31.7% of the respondents argued that the limited supply of avocado seedlings was a challenging factor to them as compared with other famers.

High price of farm inputs supplied to out-growers from the company.

Inputs are essential factors in any kind of production (Mwakalinga, 2014) the higher price of inputs supplied was ranked number one among the stated challenges by the famers. Whereby 88.6% of the surveyed farmers in the district declared to be the most challenging factors, despite of its great importance on the production and quality of the fruits itself. Most of the farmers were using organic fertilizers at the initial stage for minimizing production costs, but during the process of flowering and bearing of fruits in subsequent years, the company was providing some of the fertilizers like Borax, *Mijingu* rock phosphate, copper, and bull-dock for enhancing the flowering process, controlling diseases, and maximizing productivity (Coetzer, 1993). The cost of all these fertilizers and pesticides were deducted from the sales of farmers' produce during harvesting time. From the cost analysis that was done as part of this thesis, the average cost per avocado tree in terms of inputs per year was TZS 18 000 (RAC Manual, 2015). That means that,

with an acre containing a minimum number of 80 avocado trees, the cost would be an average of TZS 1 440 000 to TZS 1 800 000 per acre. This was economically a burden on the side of the farmers, regarding the fact that most the farmers were economically poor and had no best alternative of getting the inputs at the lower cost. The argument was supported by MALF (2016), which reported that farmers in Tanzania are still forced to pay high prices on farm inputs, despite the initiatives posed by the government to provide exemptions of taxes on fertilizers and pesticides used.

High cost of irrigation facilities for avocado production

The high cost of irrigation facilities to the farmers in the study area was not found to be a constraining factor at all to most of the out-growers. This was said by 69.2% of the surveyed farmers who declared that this was not a challenging factor to them in avocado production. Since most of the farmers depended on the rain fed, due to geographical features and climatic conditions of Rungwe District, which do support the existence of rain throughout the year.

Variation in harvesting seasons or period (seasonality)

Seasonality was another factor which was considered in the survey of avocado production in the district for this thesis, and it was found that variation in the harvesting seasons was not a constraining factor to the farmers in Rungwe District. This is because the district has two main seasons of avocado production in a year, the higher and lower season, that's from April to September and from December to January respectively. These two seasons are referred to be a competitive advantage in the global market (Mwakalinga, 2014). This was further justified by farmers' perception, whereby 81.1.7% of the surveyed farmers declared that this was not a challenging factor to them. It was rather an advantage for

them, having more than one season of production in a year which differs from the giant suppliers of avocado in the world like Peru and Mexico.

4.6 Severity Index Results on Avocado Farmer's Perception on the Stated Constraints in Rungwe district

The smallholder Farmers' Perception on the challenges they face in production process of any kind crop, is an essential backbone on decision making to the stakeholders (Table 20). According to Leiserowitz (2007), perception is a crucial component in decision making, because they way how farmers perceive the associated risks or challenges in their usual production, forms the background within which policies can be made.

For this reason, respondents in the study area (Rungwe district) were asked how they perceive the existing challenges or constraints in their production of avocado for export market. They were requested to rank each constraint based on his/her perception. Thus, the study examined the level of their views of the stated constraints using severity index analysis, which gave the score of each constraint based on the results provided by the farmers. Then the severity indices obtained for the avocado farmers' views on the production constraint varied from 12.9 to 86.0. But the estimated higher severity indices were within the concurred opinion range of $62.5 \leq SI < 87.5$ based on the valuation agreement postulated by Majid and McCaffery (1997). Most surveyed avocado farmers perceived High inputs price to the farmers supplied by the company (SI = 86.0%) mostly challenging. The SI ranked the notion that "High inputs price to the farmers supplied by the company" (SI = 86.0%) first, followed by "infestation of different insects, pests and diseases in the crop" (SI = 85.1%), and "lack of technical knowledge regarding the cultivation of avocado fruits" (SI = 83.4). Also, the farmers perceived non-Availability of timely farm inputs, with the SI value of 78.3% taking the fourth position. This was closely

followed by “Inadequate supply of recommended seedlings from the company.” (SI = 70.4%) and “Inadequate supply of extension service from the company to the avocado farmers” scored (SI = 66.7%) in the order of farmers perception. Then Variation in harvesting Seasons of avocado in the district had the SI value 31.4%, followed by High cost of irrigation facilities to the avocado farmers with (SI=20%) this was the last constraints, perceived to have no serious effect to the avocado farmer in the district because most of these farmers were getting adequate rainfall though out the year. Thus, this study was consistent with Masud *et al.* (2017), who found that production is profoundly and severely affected by any related challenges and the assessment of how farmers perceive those challenges or constraints provides a suitable solution to them (Kim, 2008). It is, therefore, very important at the initial step of promoting avocado production to meet potential capacity in the district, there should a better understanding of the existing constraints to all stakeholder in the avocado industry, particularly in Rungwe district.

Table 20: Severity index results; towards avocado farmers' perceptions on the avocado production constraints

Stated Constraints		Frequency analysis					Severity Index (SI- %)	Rank order
		SNCH (0)	NCH (1)	N (2)	CH (3)	SCH (4)		
High inputs price to the farmers supplied by the company	NR	13	9	19	84	235	86.0	1
	PR	(3.6)	(2.5)	(5.3)	(23.3)	(65.3)		
infestation of different insects, pests and diseases in the crop	NR	9	13	35	81	222	85.1	2
	PR	(2.5)	(3.6)	(9.7)	(22.5)	(61.7)		
lack of technical knowledge regarding the cultivation of avocado fruits	NR	0	37	20	87	216	83.4	3
	PR	(0.0)	(10.3)	(5.6)	(24.2)	(60.0)		
Non-Availability of timely farm inputs	NR	11	25	39	115	170	78.3	4
	PR	(3.1)	(6.9)	(10.8)	(31.9)	(47.2)		
Inadequate supply of recommended seedlings from the company	NR	24	62	15	114	145	70.4	5
	PR	(6.7)	(17.2)	(4.2)	(31.7)	(40.3)		
Inadequate supply of extension service from the company to the avocado farmers,	NR	23	68	21	141	107	66.7	6
	PR	(6.4)	(18.9)	(5.8)	(39.2)	(29.7)		
Variation in harvesting Seasons of avocado in the district	NR	89	203	11	0	57	31.4	8
	PR	(24.7)	(56.4)	(3.1)	(0.0)	(15.8)		
High cost of irrigation facilities to the avocado farmers	NR	92	249	17	1	1	20.0	9
	PR	(25.6)	(69.2)	(4.7)	(0.3)	(0.3)		

$\sum_i^4 x_i = 360$, Note: *SNCH*=Strong Not challenging, *NCH*=Not challenging, *N*=Neutral, *CH*=Challenging, *SCH*= Strong Challenging, *NR*=Number of respondents, *PR*=% of respondent

Source: Computed by the Author

CHAPTER FIVE

5.0 CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND AREA OF FURTHER RESEARCH

5.1 Conclusions

The general focus of this study was to undertake the economic analysis of growing Hass-avocado fruit and its export market in Rungwe District. Regarding the small holders' farmers and exporting companies as key actors in the entire business of the hass-avocado in the district. Specifically, the study aimed at determining the current situation of Hass-avocado production and export market trade in Tanzania. But again, to undertake the analysis on examining economic viability of investing in Hass-avocado production in Rungwe District, moreover, to examine the severity level of the existing constrains in avocado production, and lastly to determine willingness of the farmers towards their direct participation in the export market.

Thus, available evidence from the results of the study and the literature, concluded that, the current situation in avocado production and its export business in international market, had remarkably increased from all potential zones of avocado production in Tanzania, particularly in Rungwe District, that's from 2000 to 2018. Such increase in production output was relative to the increase of respective cultivation areas.

Thus, from the analysis of the study, it was indicated that, Rungwe District was a potential area for avocado production, since big exporting companies such as Rungwe Avocado Company, Kuza Africa and Lima were operating in large scale farming in this district. This made the rise of production and expansion of avocado farms, due to involvement of small-holders' farmers as out-growers in the chain avocado production in the district. The

positive trend of production and export of avocado fruit, observed in the study area, was also observed in Tanzania at a national level, that's from 2000 to 2018. Thus, the study concluded that there was a notably improvement in three main aspects, area for production, production output and exported volume from this area of analysis that's Rungwe District.

Furthermore, the study determined that, the investment in avocado farm or orchard has provided a favourable return in a capital investment in Rungwe district. The return on investment in avocado production was found to be higher against the used discounting interest rate of 10 % per annum, for the entire period of the growth of the avocado tree.

Likewise, the study resolved that, despite the existing potentials for Rungwe avocado farmers to engage in avocado production as an investment portfolio. There were prevailing constraints both in production and export-market, which appeared to be the setback to the willingness of the farmers to participate directly in the avocado export market.

Lastly, the study reveals that farmers' willingness to participate in avocado export market is explained by factors such as education level, farm size, access to non-farm income, age of the household head, and access to credit.

5.2 Recommendations

In the light of the above results and conclusion, upon looking the economics of avocado production and export trade in Rungwe in Tanzania, the following are regarded to be the recommendations from the study:

- a) The findings indicate a significant improvement in the production and exportation of avocados from Tanzania; however, there is still room for improvement to catch

up with competitors from giant producers such as those in Latin America. Therefore, it is now necessary to implement effective policies in the horticulture sub-sector. One such policy should be to support and promote farmers and exporting companies to increase the production and export business of this fruit. Another policy should be to provide technical skills, inputs, and other facilities to support production and export logistics.

- b) The current setup of the avocado industry in Rungwe District is in the form of contract farming. The export is only done by a limited number of exporting companies, such as Rungwe, Kuza Africa, and Lima Kwanza. Therefore, all respective institutions, such as Tan-trade, TIC, and other government agencies dealing with investment issues, should take appropriate measures to promote the business and invite more international and local investors who can work with farmers in a contract farming system. The essence of this is to maximize the export volume in the international market and, secondly, to increase competition among buyers.
- c) Based on the economic analysis indicators, namely NPC, BC-ratio, and IRR, investment in avocado production has shown a positive return on capital investment for the sampled farmers. Therefore, the study recommends that local governments in countries with potential for avocado production, such as Rungwe District, promote the production of avocados to their full capacity, first to farmers and other stakeholders in the district. Avocado is a long-term investment and can be used as a strategic cash crop to complement other cash crops that are not performing well in the global market from Tanzania.

- d) Furthermore, the results obtained from analyzing NPV, BC-ratio, and IRR using the Doyle model and primary data have shown a slight difference. Therefore, the study recommends the application of the Doyle model as the appropriate model for analyzing returns on investment, particularly in perennial crops.
- e) At the farm level, the study recommends that farmers should channel their efforts by working together as associations or a team to mitigate export market constraining factors from their avocado production. This will not only improve the production of Hass avocado in the study area but also at the national level.
- f) In collaboration with the government, the export companies should specifically work with local government authorities in a better way to be capable of resolving the existing constraints to the farmers. That means for the constraining factors which need government support, they should be ready to work with the local government in giving solutions through extension officers to resolve farmer's problems, especially on the mentioned constraining factors.
- g) The government and development partners in the avocado industry should continue funding research works related to diseases and organic inputs to develop this avocado industry. Regarding that it is still an infant industry, but with great international market potential.
- h) There is also a need to strengthen the internal market of Hass avocado by involving stakeholders in the value addition of the fruits, thus opening more industries which will cover most of the important nodes in the value chain of avocado fruits, this will create an opportunity to use the rejected fruits that are not suitable for the international market, such as Avomeru company in Arusha, which processes cooking oil from avocado.

- i) The government should develop a one-stop center in which all the services related to exportation may be easily obtained and minimize the time of certifications and the process of exportation of food crops.

5.3 Limitations of the Study

The study had limitations in terms of coverage and analysis. It was conducted in Rungwe District, focusing on ten wards that produced Hass-avocado under contracts with exporting companies. However, the study could have been expanded to include Siha District, which has the potential for production and export of avocados by out-growers under the Africado company in the Northern zone of Tanzania. Unfortunately, due to financial constraints, the study was limited to the Mbeya region, specifically Rungwe District. In addition, the study could have investigated the economics of growing other avocado varieties such as Fuertes, Uweso, and local varieties, and their market potential internationally. This would have been an interesting area to cover in terms of expanding the coverage of commercial varieties in the avocado industry.

5.4 Suggested Area for Further Research

Additionally, the study was limited to analysing the economic benefits of avocado farming over a 36-year life cycle based on existing literature. However, investigating the entire biological life cycle of the avocado tree could have been an interesting area to research. Furthermore, the study used discounted methods of analysis (NPV, CBR, and IRR) and sensitivity analysis to determine the future benefits and potential shocks of investing in avocado farming. However, a more comprehensive model that considers all discounted factors and unpredictable events, such as inflation, climate change, disease outbreaks, and unforeseen events, could have been used. Unfortunately, due to a lack of data in these areas, the study had to rely on the stated method. Despite these limitations, the study provided valuable insights for avocado stakeholders, decision-makers, and policymakers, as outlined in the thesis.

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APPENDICES

Appendix 1: Questionnaire

1.0 BACKGROUND INFORMATION

1.1 District Council

1.2 Division Name

1.3 Ward Name

2.0 GENERAL HOUSE HOLD INFORMATION

ID	Names of the members of the given household.	Relationship to HH head (code a)	Gender (1 = Male) (2 = Female)	Age (years) (15-30) (31-45) (46-60) (61-Above)	Highest Level of Education (code b)	Primary activity (code c)	Home occupancy (code d)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
a) RELATIONSHIP TO HEAD		b) HIGHEST LEVEL OF EDUCATION		c) PRIMARY ACTIVITY			
<i>1 = Head</i> <i>2 = Spouse (wife)</i> <i>3 = Child</i> <i>4 = Sibling (sister or brother)</i> <i>5 = Parent</i> <i>6 = Grandchild</i> <i>7 = Other relative (including employees who live in house)</i> <i>8 = Non-relative (specify)</i>		<i>0=No formal and illiterate</i> <i>1=No formal but literate</i> <i>2= Primary school</i> <i>3= secondary school</i> <i>4= College</i> <i>5= University</i> <i>6= Other but (specify)</i>		<i>1 = Crop farming</i> <i>2 = Livestock & poultry keeping (including, sales)</i> <i>3 = Trading in livestock and livestock products (not own)</i> <i>4 = Trading in agricultural products (excluding livestock!) (not own produce)</i> <i>5 = Formal Salaried employee (e.g. civil servant, domestic work)</i> <i>6 = Business – trade / services (non-agriculture.)</i> <i>7 = Not working / unemployed</i> <i>8 = Old/Retired</i> <i>9 = Infant (<6 years)</i> <i>10 = Student/ pupil</i> <i>11 = Disabled</i> <i>12 = Other (specify)</i>			
		d) HOME OCCUPANCY					
		<i>1= Permanently resident</i> <i>2= Sometimes away (< 3 months/year away)</i> <i>3= Frequently away (3 – 9 months/year away)</i>					

3.0) PRODUCTION AND COSTS OF AVOCADO

3.1) what type of cash crops are you producing in your area?

.....

.....

.....

3.2) a) among the crop you have mentioned, which one is more reliable to you and b) Why?

3.3) when did you start growing the mentioned crops above?

.....

3.4)What kind of varieties (avocado) do you normally produce

.....

3.5) Reasons for producing the mentioned variety in above

- a) More marketable in the export market
- b) It has return compared to other cash crops
- c) It easy to grow and of less cost of production
- d) Durable and having attractive price in both local and export market
- e) others

4.0)What is the setup of avocado farm ownership?

- a) Self-owned b) leased c) Both self –owned and leased

5.0) If leased one how much does it cost for the entire leasing period.....

6.0) What are the terms of leasing regarding avocado is a perennial crop

.....

Farm Preparation

7.0) What are the main requirements in terms of equipments in Farm preparation for avocado production?

.....

8.0) List down the cost you incurred for the preparation of avocado farm in year one.

S/ No	Cost-Item/Activity	UNIT	Total Cost
1	Land purchase(Labour)		
2	Land Clearing		
	Ploughing (Labour)		
3	Digging of holes (Labour)		
4	Manure application into holes/(labour)		
	Seedlings (No of Seedlings)		
	Loading and offloading charges		

9) How long does it take from seedling planting to harvesting (time).....

10) Indicate the quantity and costs of items and activities required by avocado plants during its growth stage before first production.

SN	INPUTS/ACTIVITIES	QTY/UNIT	TOTAL COST
I	Weeding (labour)		
Ii	Irrigation		
	Water		
	Labour		
Iii	Fertilizer		
	Fertilizer application (Labour)		
Iv	Pesticides		

V	Herbicides		
Vi	Other (specify)		

7) Indicate the source of water for avocado production in each year

.....

a) rainfall b) irrigation c) both

8) If irrigation, then from which source, water for irrigation is obtained.....

a) pond b) river, c) lake d) others(specify)

9) What is the set-up of your capital for the Production of Hass- avocado?

a) Own source b) Rungwe Avocado Company c) Financial Institution d) others (specify)

10) If not from your own source, specify the model of payment for the others sources

.....

AVOCADO HARVESTING AND INFORMATION

1) How many times per annum the harvest is done from the avocado farm

a) Once in a year b) twice a year c) thrice a year

2) Indicate the average number fruits obtained per season

a) year one b) year two c) year three d) year four e) year 5

3) Average production avocado per acre

Year of production	Number of Tree per farm	Amount received in a seasonal	Number of Acres per farm	Total number of Kgs avocado per farm	Reject per year
Year 1					
Year 2					
Year 3					
Year 4					
Year 5					
Year 6					
Year 7					
Year 8					
Year 9					

4) What is the method you use normally in harvesting avocado.....

.....

6) What type of labor do you use mostly during harvesting process.....

a) Hired labor b) family labor c) others (specify)

7) Indicate the average costs you incur during the harvesting process of avocado

Cost of	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Harvesting per Acre						
Loading ready for transporting						
Transporting to the warehouse						
Offloading of avocado						
Packing and sorting						
Others (specify)						

8) What is the major facility you use for storing the harvested avocado.....

- a) *Locally made facility* b) *modern store* c) *warehouse* d) *other storage facility*

9) what is the method you normally you use in harvesting avocado.....

10) What do you do with the rejected

avocado.....

MARKETING AND PROCESSING OF NEW- VARIETY OF AVOCADO

1) What type of avocado do you sell in the market.....

- a) As the fruit b) In other form-processed one

2) If not please tick the major reasons for not processing the avocado (tick one)

- a) Inadequate processing facilities
 b) Its time consuming
 c) High processing cost
 d) Others (Specify)

3) Who are the main buyers of your harvested avocado.....

.....

4) Who is the most preferred among the buyers and why?

.....

5) Are you comfortable with the current buyer? If yes/no why.....

.....

4) Indicate the variety and quantity of avocado you are selling in a season

SN	VARIETY	QUANTITY

5) Indicate the current price per kg of both improved (high yield) and local variety of avocado?

Local/traditional.....

Improved (high yield)

6) Where do you get the price Information?

S/N	SOURCE	TICK
1	Other farmers	
2	Own experience	
3	Local traders	
4	Exporters	
5	Cooperative association	
6	Government	

7) Who sets the price of avocado during the harvesting season?

a) Seller b) buyer c) buyer and seller negotiation (market)

8) Are you comfortable with the modality of price setting?

Yes/no.....

9) If no what is your

option.....

10) Tick the most important marketing centre you used to sell your avocado

- a) At home/farm
- b) Local market within the village
- c) Urban market
- d) Rungwe avocado company
- e) Export market
- f) Others (specify)

11) Please give reason for the selected marketing channel for selling your avocado

.....

12) Are you willingly to participate trading directly in the export Market?

Yes/ No.....

If yes/no give explainable reasons

.....

13) what factors determine you to trade directly in the export market?

.....

14) What do you think are the benefits and challenges upon trading with an export market?

Benefits;

.....

Challenges

.....

15) Rank the challenges in terms of their severity in constraining avocado production and export marketing

Challenges	Degree of their severity				
	1	2	3	4	5
Land unavailability (cause of other commercial crops)					
Low and seasonal production (especially for out growers)					
Limited extension services (limited number of Extension officers)					
Limited supply of avocado seedling to the farmers					
Expensive inputs and mechanization (Fertilizers and machines)					
Delay in inputs (fertilizers, pesticides, etc.)					
Inadequate skills in avocado production and processing					
Lack of irrigation facilities					
Strict conditions for accessing credit from financial institutions (bank, Saccos and other financial institution)					
Unpredictable rainfall					
Outbreaks of diseases/pests/insects –affect avocado plants					

Code: 1= Mostly challenging 2= challenging, 3 =Neutral, 4=Not Challenging, 5= Mostly not challenging

16) Mention any other general critical challenges facing avocado - farmers in your area.

.....

OPPORTUNITIES AND SOLUTIONS

1. Suggest major solutions to improve Hass- avocado production, processing and marketing in your area:

.....

2. Mention key opportunities available in hass-avocado production, processing and marketing (e.g. land availability, market, government interventions, skills availability, irrigation schemes, availability of seedlings, growing export market, etc.)

.....

.....

.....

.....

.....

.....

.....

.....

Thank You for your Cooperation

Appendix 2: Exported Volume of Hass- avocado from Tanzania (2008-2018)

YEAR	Export Quantity (Tonnes)	Export Value (1000\$)
2008	100	7.00
2009	6	6.00
2010	50	25.00
2011	86	22.00
2012	628	418.00
2013	1 393	1 918.00
2014	1 877	899.00
2015	3 279	1 293.00
2016	3 764	2 085.00
2017	4 374	4 642.00
2018	7 551	8 577.00

Source: Faostat (2018) Computed by Author

Appendix 3: Avocado Production, Area and yield in Africa

Year	Production (Tonnes)	Area harvested (Hectares)	Yield(hg/ha)	Yield (T/ha)
2000	484 718	59 567	81 374	8.14
2001	397 573	50 507	78 717	7.87
2002	431 618	54 751	78 833	7.88
2003	433 324	55 484	78 098	7.81
2004	440 861	57 682	76 430	7.64
2005	525 623	59 962	87 659	8.77
2006	497 784	60 859	81 794	8.18
2007	502 703	62 769	80 088	8.01
2008	531 226	65 763	80 779	8.08
2009	581 796	67 222	86 548	8.65
2010	674 069	70 204	96 015	9.60
2011	642 817	72 455	88 719	8.87
2012	658 307	75 566	87 117	8.71
2013	633 265	79 893	79 264	7.93
2014	738 056	87 387	84 459	8.45
2015	656 646	81 448	80 622	8.06
2016	701 963	88 975	78 895	7.89
2017	717 697	85 241	84 196	8.42
2018	802 016	385 249	20 818	2.08

Source: Faostat (2018) Computed by Author

Appendix 4: Global Avocado Production, Area and yield

Year	Production (Tonnes)	Area harvested	Yield (hg/ha)	Yield (T/ha)
2000	2 783 400	329 372	84 506	8.4506
2001	2 839 704	316 827	89 629	8.9629
2002	3 019 862	331 393	91 126	9.1126
2003	3 197 199	342 058	93 470	9.347
2004	3 238 876	353 344	91 664	9.1664
2005	3 426 427	362 987	94 395	9.4395
2006	3 645 498	370 856	98 299	9.8299
2007	3 591 501	387 987	92 568	9.2568
2008	3 438 621	399 601	86 051	8.6051
2009	3 902 685	412 981	94 500	9.45
2010	3 871 140	433 000	89 403	8.9403
2011	4 161 262	446 841	93 126	9.3126
2012	4 405 855	462 305	95 302	9.5302
2013	4 632 934	496 208	93 367	9.3367
2014	5 044 382	519 660	97 071	9.7071
2015	5 284 135	542 072	97 480	9.748
2016	5 636 234	574 375	98 128	9.8128
2017	6 005 285	592 389	101 374	10.1374
2018	6 407 171	918 531	69 755	6.9755

Source: Faostat (2018) Computed by Author

Appendix 5: Avocado Exported quantity and Value Africa, from 2001-2018

Year	Africa (Qty Tonnes)	Africa (1000 Usd)
2001	44 537	19 842
2002	51 264	19 960
2003	57 924	35 743
2004	46 815	31 355
2005	98 874	46 326
2006	46 105	28 843
2007	54 428	43 901
2008	73 318	53 154
2009	68 416	50 078
2010	73 580	68 454
2011	59 119	62 921
2012	85 473	96 321
2013	80 929	112 329
2014	106 985	142 841
2015	110 207	142 363
2016	118 054	156 758
2017	121 623	195 565
2018	196 995	305 729

Source: ITC (2019) Computed by Author

Appendix 6: Global Avocado Exported quantity and Value, from 2001-2018

Year	World (Qty Tonnes)	World (1000 Usd)
2001	320 470	340 007
2002	371 628	398 098
2003	464 930	645 110
2004	506 030	615 646
2005	623 481	916 998
2006	513 763	847 361
2007	795 555	1 316 382
2008	699 250	1 336 454
2009	794 574	1 488 298
2010	858 884	1 462 921
2011	888 616	1 960 957
2012	1 058 663	1 932 856
2013	1 203 564	2 419 554
2014	1 414 788	3 021 422
2015	1 435 533	3 219 851
2016	1 868 283	4 326 089
2017	1 994 705	5 842 706
2018	2 431 510	5 551 017

Source: ITC (2019), *Computed by Author*

Appendix 7: Wards in Rungwe District

Wards	No of farmers in each ward	Cumulative sum	Wards sampled
Ikama	121	120	
Ikuti	221	341	
Ilama	21	362	
Isange	261	624	1
Isongole	155	779	
Itete	143	922	
Kabula	65	987	2
Kambasegela	171	1 158	
Kandete	109	1 268	3
Kawatele	33	1 301	
Kikole	187	1 488	
Kinyala	135	1 623	
Kisegese	164	1 788	
Kisiba	66	1 854	
Kisondela	211	2 065	4
Kiwira	218	2 283	5
Kyimo	91	2 374	6
Lufilyo	156	2 531	
Lufingo	210	2 741	7
Lupata	143	2 884	
Luteba	45	2 929	
Lwangwa	178	3 107	8
Makandana	76	3 184	
Malindo	154	3 338	
Masebe	67	3 405	
Masoko	144	3 549	9
Masukulu	22	3 572	
Mpombo	44	3 616	
Mpuguso	56	3 672	10
Msasani	143	3 815	
Nkunga	76	3 891	
Suma	77	3 969	
Swaya	31	4 000	

Source: RAC Report (2015)

Appendix 8: Challenges response from the Famers (n=360)

Factors	Strongly Challenging	Percent (%)	Challenging	Percent (%)	Neutral	Percent (%)	Not Challenging	Percent (%)	Strongly Not Challenging	Percent (%)
Expensive inputs and mechanization (Fertilizers and machines)	235	(65.3)	84	(23.3)	19	5.3	9	(2.5)	13	3.6
Outbreaks diseases/pests/insects affect avocado plants	222	(61.7)	81	(22.5)	35	9.7	13	(3.6)	9	2.5
Inadequate skills in avocado production	216	(60.0)	87	(24.2)	20	5.6	37	10.3	0	0.0
Delay in inputs (Fertilizers, pesticides)	170	(47.2)	115	(31.9)	39	10.8	25	6.9	11	3.1
Limited supply of avocado seedling to the farmers (out growers)	145	(40.3)	114	(31.7)	15	4.2	62	17.2	24	6.7
Limited extension services (limited number of extension officers)	107	(29.7)	141	(39.2)	21	5.8	68	18.9	23	6.4
Lack of R&D and weak link between exporters and R&D	61	(16.9)	117	(32.5)	28	7.8	153	42.5	0	0.0
Seasonality in avocado production (especially for out growers)	57	(15.8)	0	(0.0)	11	3.1	203	56.4	89	24.7
Unpredictable rainfall (unreliable rain)	40	(11.1)	35	(9.7)	282	78.3	0	0.0	0	0.0
Lack of irrigation facilities	1	(0.3)	1	(0.3)	17	4.7	249	69.2	92	25.6
Land unavailability for avocado (cause of other commercial crops)	0	(0.0)	41	(11.4)	2	0.6	59	16.4	258	71.7

FACTORS	Strongly Challenging	Percent (%)	Challenging	Percent (%)	Neutral	Percent (%)	Not Challenging	Percent (%)	Strongly Not Challenging	Percent (%)
Higher input certification fees	182	50.6	88	24.3	60	16.7	30	8.3	0	0.0
Multiplicity of certificates for export market	96	26.7	118	32.2	18	5.0	130	36.1	0	0.0
Poor quality of avocado for exporting	77	21.4	187	51.9	0	0.0	96	26.7	0	0.0
Lack of R&D and weak link between exporters and R&D	61	16.9	117	32.5	28	7.8	153	42.5	0	0.0

Appendix 9: IRR computation (Test was done on discounting factors of: 10%, 20%, 30%, 40%, 50%, and 60%)

DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	TOTAL
Discount Factor (10% discount)									
based on yrs	0.90909	0.82645	0.75131	0.68301	1.69855	2.49827	1.71035	0.56712	
Discounted-Benefit (PV(B))	-	-	601 051.84	1 366 026.91	8 153 056.18	26 181,855.34	21 345 199.96	4 310 104.05	61 957 294.29
Discounted-Cost (PV(C))	1 794 545.45	449 116.53	408 287.75	596 270.75	1 077 409.39	1 571 767.87	860 462.82	124 345.93	6 882 206.50
IRR When NPV =0	- 1 794 545.45	- 449 116.53	192 764.09	769 756.16	7 075 646.79	24 610 087.47	20 484 737.14	4 185 758.12	55 075 087.79
Net Present Value									55 075 088
Discount Factor (20% discount)									
based on yrs	0.8333	0.6944	0.5787	0.4823	1.0159	1.0060	0.3370	0.0439	
Discounted Benefit (PV(B))	-	-	462 962.96	964 506.17	4 876 114.54	10 542 622.27	4 206 007.72	334 004.73	21 386 218
Discounted Cost (PV(C))	1 645 000.0	377,382.6	314 485.5	421 006.9	644 368.4	632 902.2	169 551.6	9 636.0	4 214 333
IRR when NP=0									17 171 885
Net Present Value									17 171 885
Discount Factor (30% discount)									
based on yrs	0.769	0.592	0.455	0.350	0.636	0.447	0.080	0.004	
Discounted Benefit (PV(B))	-	-	364 132.91	700 255.59	3 052 183.69	4 679 973.02	997 587.62	33 296.96	9 827 429.79
Discounted Cost (PV(C))	1 518 461.54	321,556.80	247 351.39	305 661.57	403 339.72	280 951.49	40 214.52	960.61	118 497.64
Net-Present Value									6 708 932.15
Discount-Factor (40% discount)									
based on yrs	0.7143	0.5102	0.3644	0.2603	0.4136	0.2147	0.0219	0.0005	
Discounted Benefit (PV(B))	-	-	91 545.19	520 616.41	1 985 324.39	2 249 669.07	273 843.85	4 076.36	325 075.26
Discounted Cost (PV(C))	1 410 000	277 260	198 043	227 249	262 356	135 053	11 039	117	2 521 120.10

IRR when NPV =0									2 803 955.16
Net-Present Value									
DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	TOTAL
Discount Factor (50% discount) based on yrs	0.667	0.444	0.296	0.198	0.278	0.110	0.007	0.000	
Discounted Benefit (PV(B))	-	-	237 037	395 061	1 334 430	1 154 941.611	84 511.696	591.514	3 206 574.313
Discounted-Cost (PV(C))	1 316 000	241 524	161 016	172444	176 342	69 334	3406	17	2 140 086.33
IRR when NPV =0									1 066 487.98
Net Present Value									1 066 487.98
DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	TOTAL
Discount Factor (60% discount) based on yrs	0.625	0.391	0.244	0.153	0.192	0.060	0.002	0.000	
Discounted Benefit (PV(B))-		-	195 312.5	305 175.8	922 679.9	626 444.2	28 701.7	99.0	2 078 413.1
Discounted Cost (PV(C))	1 233 750.00	212 277.73	132 673.58	133 209.23	121 930.23	37 607.14	1 157.02	2.86	1 872 607.79
IRR-when-NPV =0									205 805.29
Net-Present Value									205 805.29
DETAILS	Year 1	Year 2	Year 3	Year 4	Year 5-7	Year 8-14	Year15-25	Year 26-35	TOTAL
Discount Factor (65% discount) based on yrs	0.606	0.367	0.223	0.135	0.161	0.045	0.001	0.000	
Discounted Benefit (PV(B))		-	178 089.43	269 832.48	774 515.39	469 695.99	17 248.95	42.45	1 709 424.69
Discounted Cost (PV(C))	1 196 363.64	199 607.35	120 974.15	117 781.88	102 350.60	28 197.13	695.34	1.22	1 765 971.29
IRR when NPV =0	-1 196 363.64	- 199 607.35	57 115.29	152 050.60	672 164.80	441 498.86	16 553.61	41.23	- 56 546.60
Net Present Value									-56 546.60
Therefore : IRR		63.7840%							