THE EFFECT OF WAREHOUSE RECEIPT SYSTEM ON CASHEW NUTS PRODUCTION IN TANZANIA

BY

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2010/HD06/305T

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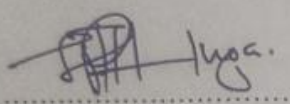
DECEMBER 2025

DECLARATION

I, **MWAKALINGA YASSIN**, hereby declare that the work contained in this dissertation entitled "*The Effect of Warehouse Receipt System on Cashew Nuts Production in Tanzania*" is an original research work carried out by me. I declare, to the best of my knowledge, that no part of this thesis was presented or submitted anywhere for the award of any degree before.



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STATEMENT OF APPROVAL

This is to certify that **MWAKALINGA YASSIN** has carried out the research embodied in the present report entitled "*The Effect of Warehouse Receipt System on Cashew Nuts Production in Tanzania*" for the award of a Master of Arts degree in Economics (MAECON). The report has been submitted with my approval as Makerere University supervisor.

This dissertation has been submitted for examination with the approval of the following supervisors.

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DEDICATION

This dissertation is dedicated to my beloved kids, Gabriela Mwakalinga, Maranatha Mwakalinga, Lightness Mwakalinga. I also dedicate it to the mother of my kids Catherine Wapalila (R.I.P) and my mother, Joyce Msangi for up right parenting into a potential academician.

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Acronyms

CBT	Cashew nut Board of Tanzania
CDTF	Cashew nut Development Trust Fund
CFC	Common Funds for Commodities
CP	Certificate of Pledge
CT	Certificate of Title
FAO	Food and Agricultural Organization
GDP	Growth Domestic Product
MIT	Ministry of Industry and Trade
PO	Producer Organization
PHL	Post Harvest Losses
SACCOS	Saving and Credit Cooperative Societies
TWRLB	Tanzania Warehouse Receipt Licensing Board,
UNIDO	United Nations Industry Development Organization
UNICTAD	United Nation Conference on Trade and Development
USAID	United States Agency for International Development
WRS	Warehouse Receipt System

ABSTRACT

This study analyzed the effect of warehouse receipt system on cashew nuts production in Tanzania. The study used secondary time series data obtained from UNdata of the United Nations for model one and cross-sectional data was obtained from survey data of 2007/2008 agricultural survey conducted in Tanzania at village level for model two. Specific objectives were to analyze the effect of warehouse-regulated prices on cashew nuts production in Tanzania and to assess the effect of input accessibility under WRS on cashew nuts productivity in Tanzania. Logarithms of the variables were taken in order to determine the percentage rate of change in the dependent variable when one of the independent variables changes. The Autoregressive Distributed Lag (ARDL) model was used for objective one, and two models were estimated. But the second objective was analyzed using Ordinary Least Squares (OLS) technique. Prior to the econometric estimation, the study data was subjected to preliminary analysis, which involved presentation of descriptive statistics and normality, heteroscedasticity and serial correlation tests.

The ARDL results from the estimation reveal that, cashew nut prices, pesticides, cultivated area and their lagged values were the main significant factors affecting cashew nut production in Tanzania. Likewise, for objective two, fertilizer use, pesticides, herbicides, education of head of household, radio, cellphone, bicycle, and motorcycle ownership positively influenced the cashew nut productivity. While labor force had no significant effect on cashew nuts production, holding other factors constant. Based on the findings of the study, the conclusion is that warehouse-regulated prices positively affect cashew nuts production in Tanzania. Secondly, input accessibility under WRS positively affects cashew nuts productivity in Tanzania. This study recommends that the Tanzanian government should intervene in the cashew nuts sub-sector and provide subsidized inputs for the small farmers to reduce on the costs. Cheap funds should be availed to farmers to enable them pay for other key factors such as labor on their farms. Government should also encourage farmer cooperatives that may be engaged in processing of the crop before export.

CHAPTER ONE

INTRODUCTION

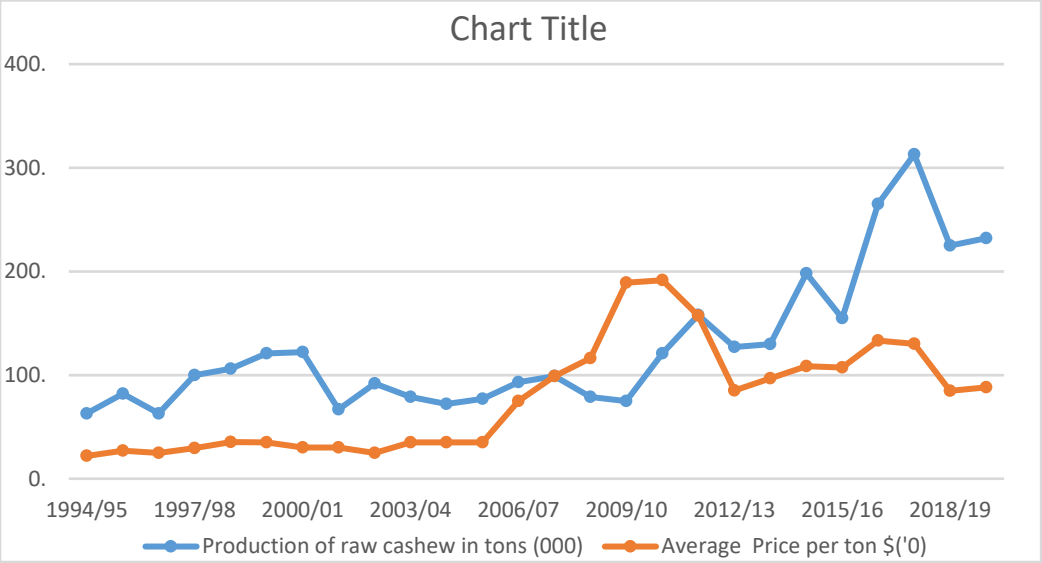
1.1Background to the study

Cashew (Anacardium occidentale L) is a native of South America with a likely center of origin in the corridors of central Brazil (Mitchell and Mori, 1987). It is thought to have been brought to East Africa and India by the Portuguese in the sixteenth century (Johnson, 1973). The first export of nuts occurred in 1938 when 210 tons of raw nuts were shipped to India (Northwood and Mayumbo, 1970) and widespread planting of cashew was carried out after 1945. In a relatively short time, it established itself as an important cash crop for smallholders and by 1960, 37,000 tons of nuts were being exported and it had become Tanzania's fourth most valuable export. Production increased steadily through the 1960s and reached a peak of 145,000 tons in 1973. Over the next 13 years there was a catastrophic decline to a low of 16,500 tons in 1986. According to Brown, Minja and Homad, (1984) it is generally agreed that a complex of socio-economic and biological factors was involved.

Tanzania currently is one of the largest producers of cashew nuts in Africa and in the world. It is one of the major cash crops grown in the country. The country holds the eighth position in the world and fourth in Africa in the production of cashew nuts. According to the International Nut and Dried Fruit Council, in 2020, cashew nut global output was 4.1 million metric tons, of which more than half came from Ivory Coast and Guinea-Bissau. India and Vietnam were the other main producers. By 2020, cashew nut crop has emerged to be the fourth most valuable Tanzanian export crop after coffee, cotton, and tea. Following a steady increase in production from the middle of this century, there was a dramatic decline from 145,000 tons in 1973 to 16,500 tons in 1986. This was caused by a complex of socio-economic (low producer prices, inefficient marketing, villagization) and biological factors (cashew powdery mildew disease, low tree yields, overcrowding of trees). Recently, higher cashew prices and liberalized marketing have created favorable conditions that have encouraged farmers to tackle several of the biological constraints on production. As a result, cashew production has risen steadily from 16,500 tons in 1986 to 70,320 tons in 1994, 82,000 tons in 1995, 63,000 tons in 1996, 100,000 tons in 1997, 106,000 tons in 1998, 121,000 tons in 1999, 122,000 tons in 2000. This was followed by 67,000 tons in 2001,

92,000 tons in 2002, 79,000 tons in 2003, 72,000 tons in 2004, 77,000tons in 2005, 93,000 tons in 2006, 99,000 tons in 2007, 79,000 tons in 2008, 75,000 tons in 2009, 121,000 tons in 2010 158,000 tons in 2011 127,000 tons, in 2012, 130,000 tons in 2013, 198,000 tons in 2014, 155,000 tons in 2015, 265,000 tons in 2016, 313,000 tons in 2017, 225,000 tons in 2018 and 232,000 tons in 2019. The Tanzania Cashew Market size is expected to grow from USD 661.34 million in 2023 to USD 823.36 million by 2028, at a CAGR of 4.48% during the forecast period (2023-2028).

Graph 1: Cashew Production level and average price per ton from 1994 to 2020 in Tanzania



***Sources**: TET (1993b and 113); Ellis (1980:40); CBT, 2020.*

The graph above shows the amount of cashew nuts production ten years back before introduction of Warehouse receipt system and ten years later after. Cashew nuts are grown in the coastal areas of southern Tanzania. This crop is the main cash crop in this region due to its ability to grow on poor soils and to be intercropped with food crops such as cassava, sesame, and cow/pigeon peas. Currently, the Mtwara region is the leading producer of cashew nuts with about 51.6 percent of the crop. Other notable regions producing cashew nuts are Lindi, Tanga, Ruvuma, Coast and Dar es Salaam. Recently, from 2000, some previously non-cashew growing areas (such as Singida, Mbarali and Suluti in Songea) started planting cashew. While other non-traditional cashew growing regions such as Dodoma, Kigoma and Musoma are planning to start cashew production (Cashew Research Report, 2001/2002).

The lack of markets and access to credit is a severe constraint for many farmers in many developing countries. The warehouse receipts system is an important and effective tool for creating liquidity and easing access to credit as well as the market answer to the farmers. Such schemes also offer additional benefits such as smoothing the supply and prices in the market, improving grower incomes, and reducing food losses. This research describes the role of warehouse receipt system in improving smallholder farmers' income which sets out the essential questions, and challenges to be asked regarding the critical conditions for its success and illustrates the ways of running such a system.

The development of Warehouse Receipt Systems (WRS) emerged as an important means of improving the performance of agricultural marketing systems in Africa following liberalization in the 1980s. Liberalization created significant space for local subsidiaries of international inspection companies to offer warehousing and commodity collateralization services without any regulatory oversight WRS in Africa was developed and emerged as an important means of improving the performance of agricultural marketing system in Africa following trade liberation in the 1980s. The counties which joined with this system are Kenya, Uganda, Ghana, Bukina Faso, Zambia, Malawi, South Africa, and Rwanda. These countries have strengthened their delivery system and boosted trade on the exchange floor.

Introduction of the Warehouse Receipt System (WRS) in Tanzania was targeted at facilitating the creation of conducive marketing environment. The system was meant to enable farmers to sell their farm produce directly at auctions to reduce the middle person's margins and increase farmers' incomes through price appreciation at auctions. However, the level of farmers' access to the WRS services is low and therefore the effectiveness of the WRS is questionable.

The WRS implementation strategies are to improve the marketing system and income for welfare and wellbeing of the farmers in Newala.

The extension of WRS to the cashew nut sub sector appears to have been boosted by the development of informal auction system. Though this evidence needs to be more robustly tested,

it is apparent that while a viable WRS contributes to the success of commodity exchange the converse relationship also holds.

1.2 Statement of the Problem

The government of Tanzania has been making efforts to boost the incomes of cashew nut farmers by ensuring that the farm-gate price adequately covers their production costs. One significant initiative in this regard was the introduction of the Warehouse Receipt System (WRS), aimed at addressing the inefficiencies in agricultural product markets. The WRS allows small farmers to aggregate their crops for deposit, ensuring compliance with quality standards and minimum quantity requirements. This assures the quality and quantity of stored commodities eligible for trade, facilitating sight-unseen transactions that expand the geographical scope for sellers and buyers beyond their immediate locations.

Despite the launch of WRS marketing in 2006 in Mtwara, the productivity of farmers remains a critical economic issue annually, even with the continued operation of the WRS marketing channel. Challenges within the system include unfavorable modes of payment (two to three trenches in cash to farmers), weak cooperative unions, regulatory roles retained by the CBT, depressed returns for farmers, lack of transparency in auction information, and difficulties in obtaining prices and export data. Additionally, the government's ability to address issues promptly in the cashew nut industry is limited, and there is ineffective interaction between farmers and cooperative unions. These issues may explain why the WRS has not had a significant impact on productivity. The present study aims to determine the extent to which the WRS has contributed to these challenges.

Despite the acknowledged positive impacts of the warehouse receipt system in improving farmers' welfare, it faces operational challenges in both exporting cashew nuts abroad and purchasing from smallholder farmers. The system has not achieved its expected objectives, as evidenced by persistently low production levels and consistently low prices, leading to reduced farmers' income, and hindering the overall development of the crop. Surprisingly, no study has been conducted to precisely assess the role of the warehouse receipt system in cashew nut production and explore the

challenges it encounters in implementing its activities. Therefore, this study seeks to identify the effects of the Warehouse Receipt System on cashew nuts production in Tanzania.

1.3 Purpose of the study

To find out how the Warehouse Receipt System price affects cashew nuts production in Tanzania.

1.4 General objective

The overall objective of this study was to assess the effect of Warehouse Receipt System on cashew nuts production in Tanzania from 2007 to 2020.

1.4 Specific objective

i. Analyze the effect of warehouse regulated prices on cashew nuts production in Tanzania.
ii. Assess the effect of input accessibility under WRS on cashew nuts productivity in Tanzania.

1.5 Research questions

1. What is the effect of warehouse-regulated prices on cashew nuts production in Tanzania?
2. What is the effect of input accessibility under WRS on cashew nuts productivity in Tanzania?

1.6 Scope of the study

The study investigated the effect of Warehouse Receipt System on cashew nuts production in Tanzania.

This study was conducted in Mtwara region Tanzania. This region has been a leader in cashew nuts production for the past 20 years. Availability of data, cost and time are the major constraints that limited my study to focus on one region. Time series data spanned between 1990-2020.

1.7 Significance of the study.

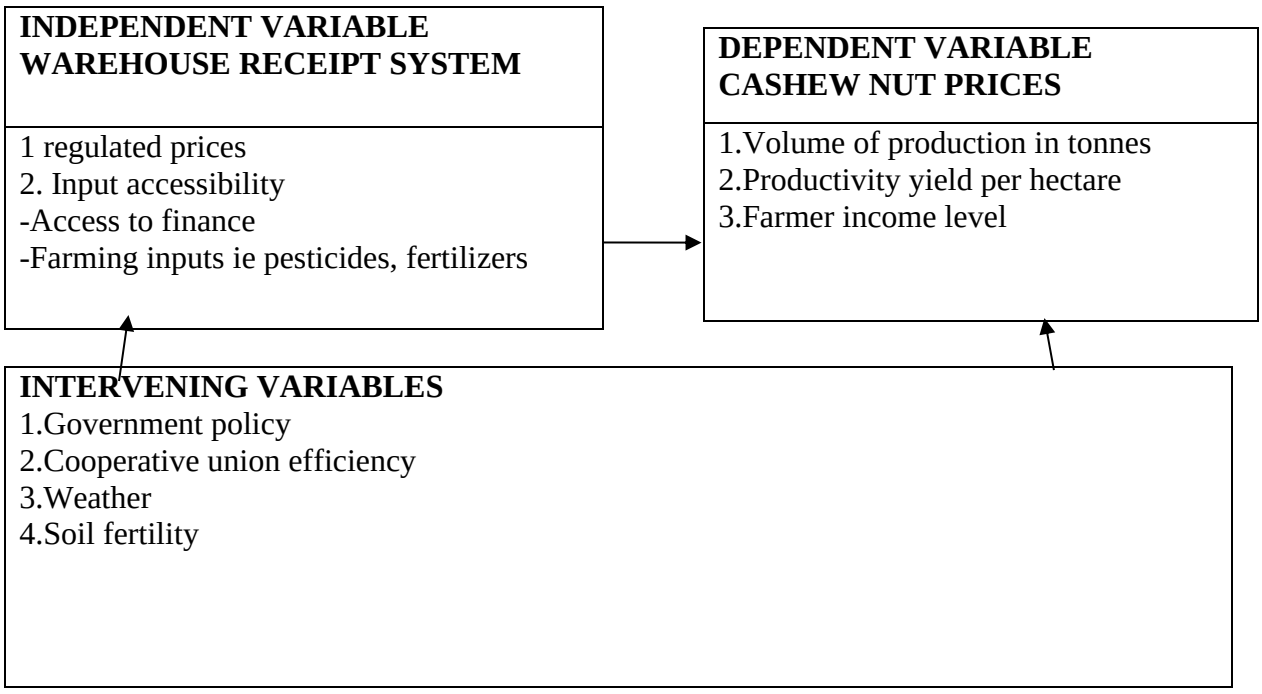
This study contributes significantly to the limited literature on the importance of the Warehouse Receipt System (WRS) to cashew nut production for farmers in Tanzania. While numerous studies have explored the adoption of WRS in different cash crops, few have delved into the causal relationship between the introduction of WRS and cashew nut production. Therefore, this study serves as a valuable reference point for future researchers interested in assessing the impact of WRS in Tanzania.

Additionally, the study enhances our understanding of cashew nut production and its implications for agricultural development. By shedding light on various socio-economic variables influencing the variation in cashew nut production in Tanzania, the research identifies key economic factors that drive cashew nut productivity in the country, particularly in terms of higher volume-for-acreage. This insight can inform policymakers, agricultural practitioners, and researchers seeking to optimize cashew nut production and enhance the overall agricultural landscape in Tanzania.

1.8 Motivation for the Study

The Warehouse Receipt System (WRS) has been credited to enable small scale cashew nut farmers be more productive. However, despite the WRS's introduction to enhance marketing efficiency, access to credit, and price stability, its effectiveness has been compromised by weak cooperatives, and market inefficiencies. By analyzing the WRS's role, the research seeks to identify both its strengths and weaknesses. This ultimately provides insights and recommendations for policymakers and agricultural stakeholders to enhance the system's effectiveness and bolster the cashew industry's contribution to Tanzania's economic development.

1.9 Conceptual framework



The study investigates the impact of the Warehouse Receipt System (WRS) on cashew nut production in Tanzania, specifically in the Mtwara region. The WRS, acting as the independent variable, aims to improve farmers' market access, regulate prices, and facilitate access to credit for essential inputs. This intervention is hypothesized to incentivize farmers to increase production by providing better economic incentives and resources.

The dependent variable in this study is cashew nut production, measured by total tonnage and yield efficiency. The research seeks to determine the extent to which the WRS, through its mechanisms of price regulation and input accessibility, influences these production outcomes. The study acknowledged that the WRS's success is affected by several factors.

Intervening variables, such as institutional efficiency, regulatory roles, and environmental factors, are also considered. These factors may moderate the relationship between the WRS and production levels. The study aims to understand how these variables interact to affect the overall impact of the WRS on cashew nut production, providing insights for policy adjustments.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter has reviewed and discussed the literature presented by various scholars or authors that relate to the research study. The information was obtained from textbooks, journals, online sources, websites, and magazines. The information extracted is aligned to the study objectives in a bid to understand the core concepts of the effect of Warehouse Receipt System on cashew nuts production in Tanzania.

2.1 Theoretical review

In a production process, any rational producer seeks to obtain the maximum possible output from a given quantity of input. So, performance and resource allocation can be analyzed based on the relationship between inputs and outputs. Besides the concept of productivity that expresses the ratio between outputs and inputs, one refers in economic analysis to the concept of efficiency to stress the possibility of maximal output from minimal inputs (Ellis, 1993; Colli et al., 2001).

2.1.1 Production Theory

Production theory in economics refers to how businesses decide the quantities of outputs to produce in response to demand. The firm produces goods or commodities with limited resources, and this means that even if it somehow knows people are willing to buy whatever quantity of goods it produces, it just can't instantly make an unlimited quantity of goods. THE theory when applied to the cashew not small farm outlines output per unit input supplied depends on the factor inputs used. That means the level of output per input depends on how a farmer is transforming a given physical input into physical output. The physical input includes fertilizers, improved seeds/seedlings, pesticides obtained through WRS, while holding other factors constant (Anyaegbunam et al., 2010).

2.1.2 The Solow growth model (1956, 1957)

The Solow growth model (1956) relates production to inputs and argues that growth in output is caused by; increase in capital through savings and investment, increase in labour quantity and quality through population growth and education respectively and technological change. It relates production to two sources; inputs and factor productivity, where output level is a result of both physical and human capital, as well as labour productivity. Transforming the specific link between input and output growth assuming constant returns to scale gives the growth accounting equation. The model highlights the need to increase factor productivity through improvement of human capital (Solow, 1956). The model predicts that human capital development should stimulate growth, whereas the population growth rate should affect growth negatively. The inflow of huge capital and industrialization is expected to foster economic growth and increase modernization. The model assumes that output is produced using a production function in which output depends upon capital and labour inputs as well as a technological efficiency parameter. This model well informs the cashew nuts production study as it looks at the available inputs for cashew nut production such as fertilizers, herbicides, tools such as bicycle, radio, or phone ownership.

The Solow growth model can be specified using a Cobb-Douglas production function, which illustrates the relationship between output (Y), capital (K), and labor (L) with constant returns to scale. The general form of the model is as follows:

Y = A K^\\alpha L^{1-\alpha}

Where:

(Y) is the total output (production of cashew nuts).

(A) represents the level of technology (technological efficiency).

(K) is the amount of physical capital (e.g., machinery, tools, fertilizers).

(L) represents labor input (number of workers).

(\alpha) is the output elasticity of capital, where (0 < \alpha < 1), indicating that capital and labor contribute to production, with diminishing returns to capital.

In this model, growth in output can be driven by:

Increase in Capital: Through savings and investments, represented by changes in (K).

Increase in Labor Quality and Quantity: Through population growth (increased (L)) and improvements in human capital (education and training).

Technological Change: Captured by changes in the parameter (A), which enhances productivity regardless of labor or capital input.

The model can further incorporate the effects of population growth, which impacts labor supply positively but can negatively affect productivity per worker due to capital dilution. The steady state output per worker is given by:

$$Y^* = A \left(\frac{s}{n + \delta}\right)^{\frac{\alpha}{1 - \alpha}}$$

Where:

(s) is the savings rate.

(n) is the population growth rate.

(\delta) is the depreciation rate of capital.

This specification captures the fundamental relationships outlined in the Solow model and allows for the analysis of how varying inputs such as capital, labor, and technology affect the output of cashew nuts in Tanzania. It exemplifies the model's utility in investigating factor productivity improvements, especially through human capital development, while also considering the implications of population growth on productivity.

According to the model therefore, there are two distinct effects of inputs on the output growth. It assumes that adding capital and labour raises output. In his opinion, on the one hand, an increase

in the population growth rate will increase the amount of labor and thus both the absolute level of output and the steady state output growth rate. On the other hand, it will also reduce physical capital stock per worker; therefore, a decrease in productivity and in the steady state output per worker. However, the model also assumes there are diminishing marginal returns to capital accumulation. In other words, adding extra amounts of capital gives progressively smaller and smaller increases in output. For example, a firm with ten workers would probably like to have at least ten computers. It might even be helpful to have a few more; perhaps a few laptops for work from home or some spare computers in case others break down. But at some point, just adding more computers doesn't help so much.

This study thus will use the Solow growth model, with constant returns, this is because it is easy to extend and estimate, compared with a variety of endogenous growth models which need more complicated non-linear dynamic specifications and estimation of unobservable parameters like the inter-temporal elasticity of consumption substitution and the risk aversion rate.

2.1.3 Participation Theory

Firstly, the participation theory explains a choice for involvement in programs from a set of mutual exclusive alternatives, j = 1, 2... k, for rural people in most of the developing countries (Ajzen and Fishben, 1980; Ajzen, 2001). The theory, sometimes known as margin theory stales that decision whether to participate in the defined as the "self and social demands by a person to maintain a minimum level of autonomy" and power is described as "resources such as abilities, possessions, position, allies, etc. which a person can command in coping with the load" (Byrka, 2009). In other words, the higher the margin between load and power, the lesser the participation in the program (Ajzen, 2001). The theory expounds on factors and behavioral attributes that affect smallholder farmers' participation in the given program. The attributes include expected returns and expected costs of participation, attitudes, values, and skills of people, design and other characteristics of the program, and the legal, political, and institutional environment prevailing at the time (Green, 2000; Glasman and Dolores, 2006). The attributes of the smallholder farmer such as age, coffee market information, education level, sex, farm size and distance from coffee farms to the nearest market centers determined the level of participation in WRS.

2.2 Empirical review

2.2.1 The effect of warehouse regulated prices on cashew nuts production.

Mpita (2014) explains that the Warehouse Receipt System (WRS) is one of the reform measures undertaken by the government of Tanzania in efforts to address the problems inefficient crops marketing systems. It is assumed that an improved efficiency of the marketing system through the WRP can help in poverty reduction by enhancing incomes of farmers via stable prices and reduced transactional risks. The study's objective was to examine the contribution of the WRS on the economic welfare of cashew nut farmers in Newala district. Data was collected in six villages from a representative sample of 200 farmers out of 403,356. The study applied a regression technique to analyze postulated relationships. The findings showed that income of the farmers has significant effect on poverty reduction. Output prices were negatively related to the income of the farmers using the Warehouse Receipt System. This happens due to decrease change of price of cashew nuts in the world market. The income of farmers improved slightly but did not exceed Tshs. 500,000/= per annum. This represents an increase of about 43% of the farmers' income. The levels of education of the farmers had positive impact with income and marketing on reduction of poverty. It was concluded that the WRS can be an important tool for alleviating cashew nut marketing problems. However, currently the significance of the WRS has not been felt much by farmers notably due to other distortions such as high taxes and levies.

Ngondo (2014), studied the Role of Warehouse Receipt System (WRS) in improving the small holder farmer's income (case study cashew nuts farmers in Mtwara Region). The specific objective was to analyze the relationship between production, price, storage, and cashew nuts farmers' income increase in Mtwara region and to analyze the relationship between policy made for Warehouse Receipt System in Mtwara region. The survey covered the cashew nuts farmers in MAMCU (Mtwara and Masasi Cooperative Union) and TANECU (Tandahimba and Newala Cooperative Union) various primary societies Mtwara District, Mtwara Rural, Nanyumbu, Masasi, Newala and Tandahimba. (Michiga, Chiungutwa, Lengo, Naliendele, Mtawanya and Nanguruwe) who make production of cashew nuts at Mtwara region were used, coaster and minibuses. The major finding from the study is that the price increase or set by Warehouse Receipt System is the

cause of the improving of smallholder farmers income thus is beneficial to farmers to adopt a better life.

Kashangaki (2015) conducted a study on the impact of price fluctuation on cashew nut production in Tanzania. The research aimed to identify the causes of price fluctuation in the cashew nut market, examine the extent of price fluctuations, explore the relationship between cashew nut prices and harvested quantities, and assess the government's role in addressing price fluctuation issues. The study utilized exploratory and descriptive research designs, employing methods such as questionnaires, interviews, and secondary data analysis. The findings revealed that factors such as cashew nut quality, government intervention in production, input costs, and technological improvements contribute to price fluctuations. Over the period from 1990 to 2014, the price of cashew nuts in Tanzania increased by 65.69%, with a minimum price of 137 TSH/KG in 1990 and a maximum of 1701 TSH/KG in 2011. The study established a significant influence of cashew nut prices on production levels. Additionally, it highlighted the government's role in regularly adjusting the taxation structure for agricultural equipment and products to alleviate financial burdens on both farmers and traders.

Mumi (2013), assessed the effectiveness of warehouse receipt system (WRS) in cashew marketing in Tandahimba district. The study used both primary and secondary data and analyzed using SPSS computer program. The study found that WRS had brought some small improvement in farmers' income. It was shown that what farmers were getting after introduction of WRS in cashew marketing was slightly higher than before. This was achieved by enabling farmers to get better prices for their produce and gain access to credit from commercial banks. It was also found that farmers were paid in installment basis although majority of them did not like the mode since it associated with loss of money and time on frequently chasing for their payments. It was also agreed that WRS was protecting farmers against price fluctuation. When prices fell warehouse(s) used to stock RCN till the time when prices go high and sell at better prices for the farmers to set high income. Lastly the study found that market constraint experienced by farmers due to introduction of WRS were minimum price setting, lack of transparency in the system, improper measurements of the RCN, and lack of sufficient storage facilities in warehouse.

Likwata & Venkatakrishnan (2014), analyzed the attitude of farmers towards warehouse receipt system in Newala District. The study sought to describe the warehouse receipt system that operates for small holder farmers in Newala. Secondly, to determine knowledge of the farmers on warehouse receipt system and to determine the contribution of cashew nuts to farmers livelihood. A cross-sectional research design was adopted; a sample size of 150 respondents was obtained through multistage sampling which involved simple random and purposive sampling techniques. To measure individual farmer's knowledge and attitude on Warehouse. Receipt System knowledge index and attitude index were used for data analysis. Statistical Package for Social Science (SPSS) 16.0 and Binary Logistic Regression Model were used to analyze data related to descriptive and inferential statistics. The Inferential statistics applied the binary logistic regression model to determine the contribution of cashew nuts towards farmer's livelihood. The findings of the study show that farm size and education level (P=0.000) were the most significant predictors of improvement of farmers' livelihood. The coefficient was positive (1.526 and 1.29) in the sense that farmers who have big farms and education were likely to have good quality houses. Likewise, the findings of the study show that farmers have low knowledge level and negative attitude towards warehouse receipt system.

Sizya (2013) conducted a study on the effectiveness of the Warehouse Receipt System (WRS) in improving smallholder cashew nut income in Tanzania. The research utilized a descriptive survey that employed both qualitative and quantitative methods, including documentary review, semi-structured questionnaires, key informant interviews, and focus group discussions on the wards of Mahuta, Nahnyanga, and Kitama. The findings indicated that, despite the introduction of the Warehouse Receipt System, the price of cashew nuts per kilogram increased from an average of Tshs 800 to 1200 during the cashew nut seasons of 2010/2011 and 2011/2012. However, the income of smallholder farmers remained stagnant, indicating inefficiency and ineffectiveness of the Warehouse Receipt System in Tandahimba District. The study recommended that enhancing the effectiveness of the Warehouse Receipt System could be achieved by implementing rules and regulations aimed at minimizing the operational costs, thereby favorably impacting the income of smallholder farmers.

Fadhili Sifuni (2020). Assessed the factors affecting crop board performance in Tanzania. A case of cashew nuts board of Tanzania. The study had three objectives which were assessing financial availability affecting crop board performance in Tanzania: finding out of the stakeholder's coordination factors affecting cashew nuts crop board performance in Tanzanian policy and regulations factors affecting cashew nuts crop board performance in Tanzania. The study adopted case study design, the study 's population was from CBT employees, cashew nuts farmers and buyers. A sample size of 166 was recruited using convenient sampling techniques. Data was collected using questionnaires and interviews guide and schedule. Both qualitative and quantitative approaches were used in data analysis and presentation. It has been found that the central government remains to be the overall financier of CBT, however lack of fund availability is among the main factors that hinder CBT performance. Also, CBT has the role of setting indicative prices which have the effect on domestic prices as well export prices of the crop. However, the price calculations do not reflect the actual situation in the market. Moreover, CBT is the coordinator of cashew nuts farmers and buyers and all other stakeholders, but the task is not effectively undertaken. The marketing of raw cashew nuts to external markets is largely monopolized by buyers. Regarding the marketing of kernels individual processors are left without support to reach out to buyers, domestic and from abroad, and process, package and advertise final products adequately. The marketing of kernels therefore is still erratic, ad-hoc and unprofessional. The domestic and East African market may constitute a huge potential but there are shortcomings about presentation and advertisement. The environment for doing business in the cashew value chain is not hostile but a complicated one.

2.2.2 The effect of input accessibility under WRS on cashew nuts productivity

Mapunda (2018). assessed the effectiveness of the WRS in creating coffee marketing environment in Mbinga District. The specific objectives were to identify factors influencing farmers' participation in WRS; to determine farmers' perceptions on the WRS achievements in facilitating provision of storage, credit, and market services; and examine effectiveness of the WRS in creation of good marketing environment and improving farm productivity. A cross-sectional research design was used, and data were gathered from 390 households using a questionnaire. Focus group discussions, and key informant interviews were used also. Quantitative data regarding factors influencing farmers' participation in the WRS marketing channel were analyzed using a binary

logistic regression model while qualitative data regarding farmers' perceptions of effectiveness of the WRS were analyzed using thematic content analysis. In addition, the effect of Agro-inputs credit through the WRS on coffee farm productivity was analyzed using the Ordinary Least Squares (OLS) method. The study shows that age of respondents, access to marketing information, sex, and distance from coffee farms to the Agricultural Marketing and Cooperative Societies (AMCOS) or farmers' group (FGs) centers where coffee is collected were significant factors that influenced coffee farmers' decisions to participate in the WRS. The WRS was perceived to be effective by farmers in provision of storage services and facilitation of access to Agro-inputs through AMCOS and FGs. However, coffee marketing was perceived by farmers to be ineffective due to inadequate availability of marketing information regarding coffee prices offered at auctions. Furthermore, the influence of credit in the form of Agro-inputs accessed through WRS marketing channel had a significant impact on the productivity of coffee farms ($p<0.05$). Conclusively, farmers perceived storage and credit services to be effective, henceforth there was a general effectiveness of the WRS. The study recommends that stakeholders in the coffee sector should ensure that farmers access WRS coffee marketing information transparently by facilitating institutionalization of market information.

Mgonja & Shausi (2022), analyzed the challenges faced by small-scale cashew nut processors in Ruangwa District, Tanzania. The study employed a correlational research design using a survey on a sample of 180 small-scale cashew nut processors. Data were collected through questionnaire administration, focus group discussions, key informant interviews and documentary reviews. Quantitative and qualitative data were analyzed by using descriptive statistics and content analysis respectively. The study revealed the following challenges that face small-scale cashew nut processors: use of inefficient local processing tools, less availability of appropriate equipment and machine for processing, lack of money to acquire new technology, and lack of investment and working capital. Other challenges were the availability of raw materials, lack of market information on kernel, lack of reliable training facilities, and lack of government initiative support on cashew nut processing. The study recommends improvement and facilitation of modern processing equipment, training processors on improved processing techniques and improvement of domestic and international cashew nut market.

Mallya (2014). Studied the socio-economic factors affecting cashew nut production with special reference to Ruangwa District Council. Data collection was through structured questionnaire administered to 200 respondents selected through random sampling technique. The overall aim of this study was to investigate the socio- economic factors that affect production of cashew nuts in Ruangwa District. The study objective was realized through the utilization of the multiple linear regression models since model consisted of seven variables, F-test and Z-test were used to test the overall significance of the variables. The main objective in using this technique was to predict the variability of the dependent variable based on its covariance with all the independent variables. The methods of analysis used were descriptive statistics and production function analysis using the Ordinary Least Square (OLS) criterion to estimate the parameters of the production function. Econometric techniques were used to estimate the determinants of cashew production. Linear regression analysis using SPSS (16) and STATA (9) software programs were employed for the modeling of cashew nut production as determined by postulated determinants and to assess the relative importance of various variables. Results showed that majority of the farmers were Female engaged in cashew nut production. Cashew nut farming was the main activity as a minimum farm size was 4.125 acres. Results further revealed that farm size (acreage) physical capital, fertilizer, Price, extension services, primary education were positively related to cashew output while labour and secondary education were inversely related. Based on findings, the study recommend that the government should emphasize on following to increase the production of cashew nut including increase of land size for the purpose of increasing marginal productivity, use of fertilizers, provision of credits to farmers and improvement of infrastructures including roads, communication infrastructures and energy.

Uwagboe, Adeogun & Odebode (2010) examined constraints of farmers in cashew production in Orire Local Government Area of Oyo state Nigeria. There are problems of low yield and utilization of cashew pseudo apple. This study was carried out in 2008 and data were collected from one hundred and ten respondents with the aid of a well-structured questionnaire. Respondents were selected using purposive and systematic sampling techniques. Data were analyzed using descriptive and Pearson Product Moment Correlation (PPMC). Results showed that cashew production in the study area is male dominated with 84.5% of the respondents being males. The majority (70%) of the respondents in the study area ranked inadequate capital (finance) as the most severe constraint while lack of storage facilities was ranked by few (5.50%) of the respondents.

This could be attributed to difficulty in obtaining loans from the banks due to collateral while storage facilities constraint could be attributed to the fact that the cashew farmers in the study area do not store their produce for processing. Also, the constraints experienced by cashew farmers negatively relate to the income generated from cashew fruits.

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Naylor and Falcon (2010) conducted a study for the purpose of analyzing international commodity price movements, assessing food policies in response to price fluctuations and exploring food security implications of price volatility on low-income groups. The study found out that the exchange rates, macro policies and petroleum prices were the important determinants of price variability over 2005-2010 in the agricultural commodities market which affected the world food economy. The study concluded on the long-lasting effects of price spikes on food policies worldwide which often result in the self-sufficiency policies which created even more volatility in the international market. The study suggested that the efforts by the governments to stabilize prices frequently can contribute to even greater food insecurity among poor households and recommended for the need of the refocused policy approaches to prevent and mitigate increase of the prices.

Mitchell (2008) conducted a study in the USA for the purpose of investigating the causes of the increases in the prices of food products in the world. The researcher found out that 23 the major factors which have contributed to the rapid rise in food prices from time to time are the large increase in biofuel production in the USA and EU from food grains, the weak dollar, and the increase in food production costs due to higher energy prices. The study concluded on export bans

and speculative activities which have occurred because they were formulated as the effective response to rising prices of commodities. The study recommended reconsidering the government policies that provide incentives to biofuel production and biofuel policies which have impact on food prices.

Rweyemamu (2002) conducted a study in Tanzania for the purpose of examining the contextual analysis of cashew industry in southern Tanzania after market liberalization. The researcher used secondary sources of information by reviewing various documents and reports as his basis for making assessments. The study findings revealed that liberalization measures have currently led to strong private sector activities in cashew purchase and export as well as the economic development of the country. The study concluded on the weakness of the partially liberalized industry which still suffers from the weakness that impairs the production and marketing system resulting from both market failure and government intervention.

In summary, the literature on the Warehouse Receipt System (WRS) in enhancing smallholder farmers' participation and income generation, particularly in cashew nut production in Tanzania, reveals several significant gaps. While margin theory suggests that participation is influenced by the balance of demand and available resources, there is insufficient exploration of how factors like age, market information, and education impact farmer decisions. Studies indicate minimal income improvement despite better pricing availability, underscoring a lack of understanding regarding the effectiveness and operational challenges of the WRS. The relationship between market dynamics, farmer behavior, and socio-economic attributes remains poorly analyzed, and barriers to adoption, such as inadequate farmer knowledge and negative attitudes toward the system, need further investigation. Additionally, the interplay between agricultural policies and farmer welfare is not comprehensively addressed, indicating the necessity for more research to develop effective strategies for enhancing the impact of WRS on smallholder farmers.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The main objective of this research was to analyze the effect of Warehouse Receipt System on cashew nuts production in Tanzania. This chapter describes the research methodology. It includes a discussion of the model adopted, data sources as well as data analysis, measurement and the diagnostic tests carried out.

3.1 The Theoretical Model

As a beacon for this study, the Solow model was used. The Solow model relates production to two sources; inputs and factor productivity, where output level is a result of both physical and human capital, as well as labour productivity. According to the model therefore, there are two distinct effects of inputs on the output growth. It assumes that adding capital and labour raises output. That means the level of output per input depends on how a farmer is transforming a given physical input into physical output. Likewise, this study relates inputs like fertilizer, pesticides, herbicides, head of household, education, radio, cellphone, bicycle and motorcycle to cashew nuts productivity and warehouse cashew nut prices, pesticides, cultivated area and labor force to cashew nut production.

The theoretical model of Solow (1957) or neoclassical model as reviewed by Wilson & Briscoe (2004) holds that the production function can be written in the form where some measure of output is related to the relevant inputs (as in equation (1). Using the Cobb-Douglas form

$$Y_t = Ae^{gt} K_t^{a} L_t^{b} M_t^{c} \quad \text{……………………………………………………………………………1}$$

Where Y is production, K is the physical capital stock, L denotes labour and M is the materials and intermediate input variable. This presents a technical relationship between inputs and outputs. There is an extra term, which attempts to pick up the effects of technological change (i.e. an exponential time trend in times series estimation). The parameters a, b and c are interpreted as

factor shares. This basic model can be augmented, in approximation to second generation growth accounting models, by the inclusion of different types (or vintages) of capital,

$$K_{1t}^{a1} \ldots K_{nt}^{anb} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 2$$

similarly, different types of labour (i.e. different lengths of schooling, qualifications, occupations, etc.). Assuming that the homogeneous nature of the variables, as in equation (1) is maintained, but representing their changing quality by some measure or vector of measures, H, a model is derived as;

$$Y_t = AK_t^a L_t^b M_t^c H_t^d \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 3$$

where H is an indicator of the changing quality of inputs. However, output cannot be accounted for only by the variables in the equation. We add variables Z to cater for other important control variables that affect output. The equation thus becomes:

$$Y_t = AK_t^a L_t^b M_t^c H_t^d Z_t^e \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4$$

In this study Z stands for current and past values of variables that are important for output and these include prices, pesticides, fertilizers and other inputs.

3.2 Model specification to analyze effect of warehouse-regulated prices on cashew nuts production.

To analyze the effect of warehouse-regulated prices on cashew nuts production, the study utilized the Autoregressive Distributed Lag (ARDL) approach developed by Pesaran and Shin (1998) and re-assessed by Pesaran et al. (2001) to analyze the short and long run linkages between selected the independent variables and cashew nut production. The ARDL approach provides several advantages over traditional methods for evaluation of co-integration and short-run and long-run linkages.

First, opposite to traditional co-integration methods such as Johansen's tests (Johansen, 1991), Granger and Engle causality test (Engle and Granger, (1987)), the ARDL can be utilized to test for

a level relationship for variables that are either *I* (0) or *I* (1) as well as for mix *I* (0) and *I* (1) variables (Duasa 2007, Adom et al. 2012). But ARDL approach does not apply with non-stationary variables integrated of order two *I* (2). The possibility to combine *I* (0) or *I* (1) variables is a great advantage as economic time series often are either *I* (0) or *I* (1). The ARDL approach solves the problem of endogeneity. Pesaran and Shin (1998), argued that modeling the ARDL with the appropriate lags will adjust for both serial correlation and endogeneity problems. Jalil, Ma, and Naveed, (2011) contend that endogeneity is less of a problem if the estimated ARDL model is free of serial correlation. The impact on a given variable is due to its past values as well as the values of other variables and their lagged values.

The ARDL general form, can be represented thus;

$$A(L)y_t = a + \beta(L)X \quad \text{.....5}$$

An ARDL regression (p,q) model consists of lag p on dependent variable and lag q on independent variables. According to Pesaran et al. (1998)), the model can be written as;

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_p y_{t-p} + a_0 X_t + a_1 X_{t-1} + a_2 X_{t-2} \ldots + a_q X_{t-q} + \varepsilon_i \quad \text{.....6}$$

where ε_t is a random "disturbance" term.

Empirically the following ARDL equations were estimated.

$$\Delta InCashewp_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta InCashewp_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta InWprice_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta InPest_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta InCarea_{t-i}$$
$$+ \sum_{i=1}^{n} \beta_5 \Delta InLforce_{t-i} + \rho_1 InCashewp_{t-i} + \rho_2 InWprice_{t-i} + \rho_3 InPest_{t-i} + \rho_4 InCarea_{t-1} + \rho_5 InLforce_{t-1} + \varepsilon_{1t} \ldots\ldots 7$$

Whereby:

Δ denotes the first difference operator, *P* is the lag order selected by the Schwarz Bayesian Criterion (SBC), $\beta 0$ is the drift parameter while vt is the error term which is (0,2). The parameters γ, and ϕij are short-run parameters and λ, βij are the long-run multipliers. $Cashewp$ is Cashew

nuts production $Wprice$ is warehouse cashew nut prices $Pest$ is Pesticides $Carea$ is Cultivated area and $Lforce$ is Labor force.

The study was estimated with the bounds test by employing the OLS method, which is normally the first procedure in the ARDL model. The F-test was used to test for the presence of long-run relationships among the variables in equations. The null hypotheses of no long-run relationship among the variables in equations was tested against the alternative hypotheses of a long- run relationship. The hypothesis was as follows:

$$H_0 : \rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5 = 0 \ldots\ldots\ldots\ldots a_0 X_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_p y_{t-p} + a_0 X_t + a_1 X_{t-1} + a_2 X_{t-2} \ldots + a_q X_{t-q} + \varepsilon_i$$

$$H_1 : \rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq \rho_5 \neq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

To accept or reject the above hypotheses, the calculated F-statistic and tabulated critical value were compared. And the explanatory variables are assumed to be integrated of order zero that is I(0) for values of the lower bound. While the upper limit values expected to be integrated of order one that is I(1). Therefore, the decision rule is that if computed F-statistic falls below the lower bound value that is I(0), then the null hypothesis (no co-integration) cannot be rejected. On the other hand, if the computed F-statistic exceeds the upper bound value I(1); then it can be concluded that the selected macroeconomic variables in this study are co-integrated. In a situation whereby the F-statistics fall within the bounds, then the result is said to be inconclusive. The long-run and short-run parameters of the model were estimated once the co-integration relationship was established. The ECM was used to identify causality in long-run, short-run and short-and-long run jointly. The equations to be estimated for the ECM was thus;

$$\Delta InCashewp_t = \varphi_0 + \sum_{i=1}^{n} \varphi_{11} \Delta InCashewp_{t-i} + \sum_{i=1}^{n} \varphi_{22} \Delta InWprice_{t-i} + \sum_{i=1}^{n} \varphi_{33} \Delta InPest_{t-i}$$

$$+ \sum_{i=1}^{n} \varphi_{44} \Delta InCarea_{t-i} + \sum_{i=1}^{n} \varphi_{55} \Delta InLforce_{t-i} + \gamma_1 ECT_{t-1} + \mu_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

From the equations above, Δ represent change, μ_{it} are residual terms, which are assumed to be independent and normally distributed. The statistical importance of ECT_{t-1} (that is the lagged of error correction term) is that it further validates the established long run relationship between the

variables. It indicates the speed of adjustment at which the long run was achieved from the short run in the model. It is also used to identify causality in long-run; short run; and short-and-long run jointly. For example, the statistical significance of ECT_{t-1} coefficient with negative sign indicates the existence of long run causal relation using the t-statistic. For the short run, the causality is indicated by the joint $\chi 2$ statistical significance of the coefficients of the first difference-lagged independent variables. While the joint significance of estimates of the lagged terms of independent variables and error correction terms is derived from the Wald test, which further confirms the existence of short-and-long run causality relations.

Table 3.1: Variable description, Definition and expected signs.

Variable	**Variable definition and Description**	**Expected sign**
InCashewp	Natural log of Cashew nuts production	
InWprice	Natural log of Warehouse cashew nut prices	Positive
InPest	Natural log of Pesticides	Positive
InCarea	Natural log of Cultivated area	Positive
InLforce	Natural log of Labor force	Positive

Cashew nuts production quantities expressed in hundreds of thousands of tones was the independent variable of the study. It is comprised of annual data spanning from 1990 to 2020. Tanzania has one of the largest-sized nuts with a very high natural yield per hectare, providing a good export value. According to the Cashew nut Board of Tanzania, Tanzania has a substantial potential to extend production and increase the amount and add value to domestically processed cashew nuts beyond the current 10% while also making use of by-products. The lagged values of cashew nuts production were predicted to be positively related with current cashew nut production.

The variable price likewise measures the average price of cashew nuts at warehouse level. The effect of variable and its lagged values were predicted to have a positive effect on the dependent variable. As cashew nut price raises, farmers would in response increase production with the lag years of between 3 to 5 years it takes for the crop to mature for harvest.

Pesticides: The term pesticide covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. In Tanzania cashew nut growers increasingly use chemical control (pesticides) to control parasites and fight against weeds. The variable pesticides are expressed in liters of pesticides used annually between 1990 to 2020.

Cultivated area: Cashews can adapt to different soil conditions without loss of productivity. While Cashews can be grown on poor soils, they will do much better on good soils. To increase output, cultivated areas may be increased. Over the years the area cultivated for cashew nuts production in Tanzania has expanded. The data was expressed in acres of land captured annually between 1990 to 2020.

The labour force comprises people aged 15 and older who supply labor to produce goods and services during a specified period. Labor force size tends to vary during the year as seasonal workers enter and leave derived using data from International Labour Organization. "The labor force is the supply of labor available for producing goods and services in an economy. For this study, labour force refers to those engaged in cashew nuts production in Tanzania.

3.3 Model estimation for the effect of input accessibility under WRS on cashew nuts production

For objective two, to estimate the effect of input accessibility under WRS on cashew nuts productivity a log-log specification regression analysis for the model was used since it is suitable for estimating situations where rates of change or percentage changes are of importance. In this case, the study looked at the extent wishes input accessibility under WRS affects cashew nuts production. The factors in the model included cashew nuts total production, fertilizer, pesticides,

herbicides, head of household, education, radio, cellphone, bicycle, and motorcycle. Objective two was analyzed using OLS regression analysis.

$$Cashewp = f(\text{fertilizer, pesticides, herbicides, education of head of household, education, radio, cellphone, bicycle, motor cycle}) \quad \ldots 7$$

$$Cashewp_i = \beta_0, \text{fertilizer}_i^{\beta_1} \text{pesticides}_i^{\beta_2}, \text{herbicides}_i^{\beta_3} \text{education}_i \text{ of head of household}_i^{\beta_4}, \text{radio}_i^{\beta_5}, \text{cellphone}_i^{\beta_6}, \text{bicycle}_i^{\beta_7}, \text{motor cycle}_i^{\beta_8}, \varepsilon \quad \ldots 8$$

Converting it into the logarithmic form:

$$\log Cashewp_i = \beta_0 \log(\text{fertilizer}_i^{\beta_1}, \text{pesticides}_i^{\beta_2}, \text{herbicides}_i^{\beta_3}, \text{education of head of household}_i^{\beta_4}, \text{radio}_i^{\beta_5}, \text{cellphone}_i^{\beta_6}, \text{bicycle}_i^{\beta_7}, \text{motor cycle}_i^{\beta_8}), \varepsilon \quad \ldots 9$$

In order to obtain rates of change, the equation is transformed by use of the natural logs as below;

$$InCashewp_i = \beta_0 + \beta_1 In\text{ferti}_i + \beta_2 In\text{pesti}_i + \beta_3 In\text{herbi}_i + \beta_4 In\text{educa}_i + \beta_5 In\text{radi}_i + \beta_6 In\text{cell}_i + \beta_7 In\text{bicy}_i + \beta_8 In\text{cycle}_i + \varepsilon \quad \ldots 10$$

Whereby:

β_0 = constant, β_1 = coefficient of fertilizer, β_2 is the coefficient of pesticides, β_3 = coefficient of herbicides, β_4 = coefficient of education of head of household, β_5 =coefficient of radio, β_6 = cellphone, β_7 = coefficient of bicycle β_8 = coefficient of motor cycle

In = natural log that measures the rate of growth and *i* denotes the cross section, ε = is the error term.

Table 3.2: Variable description, Definition and expected signs.

Variable	Variable definition and Description	Expected sign
$InCashewp_i$	Natural log of cross section value of cashew nuts total production	
$In\text{ferti}_i$	Natural log of cross section value of fertilizer	Positive
$In\text{pesti}_i$	Natural log of cross section value of pesticides	Positive
$In\text{herbi}_i$	Natural log of cross section value of herbicides	Positive
$In\text{educa}_i$	Natural log of cross section value of education of head of household	Positive
$In\text{radi}_i$	Natural log of cross section value of radio ownership	Positive
$In\text{cell}_i$	Natural log of cross section value of cellphone ownership	Positive
$In\text{bicy}_i$	Natural log of cross section value of bicycle ownership	Positive
$In\text{cycle}_i$	Natural log of cross section value of motorcycle ownership	Positive

Cashew nuts productivity is the dependent variable in this study. Productivity is measured by the number of tons or kg produced per hectare. From the Tanzanian agricultural census, productivity increased by 400 percent in 2007/2008 from 0.31 tons per Ha to 1.7 tons per Ha.

Fertilizer use: Cashew plants respond well to the application of fertilizers. This variable is represented as a dummy i.e 1 if the farmer uses fertilizers and 0 otherwise These compounds are applied at various stages of the plant. Fertilizer is applied to the plant at the base with a radius of

22.5 m and depth of 15 cm. Cashew plants need nutrients for good growth, root development and fruit formation. It is therefore important to supply compound fertilizers such as compound D and single super phosphate. Urea or ammonium nitrate will also supply nitrogen that promotes vegetative growth. The effect is assumed to be positive on the cashew nuts production. Cross-section data on the number of fertilizers expressed in kilograms was used.

This variable is represented as a dummy i.e 1 if the farmer uses pesticides and 0 otherwise the term pesticide covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. Cashew nut growers increasingly use chemical control methods to stem parasites. Their effect is supposed to be positive in cashew nuts production. Cross-section data on the number of pesticide liters used by farmers was used.

Using herbicides is one way of managing weeds in cashews. This variable is represented as a dummy i.e 1 if the farmer uses herbicides and 0 otherwise Effective chemical weed control methods are available for cashew plantations. Herbicides such as gram Oxone or roundup are used to a limited extent. The use of herbicides is assumed to have an appositive effect in cashew nuts production. Cross-section data on the number kilograms of herbicides used by farmers was used.

The education of the head of household as a way of establishing the human capital the household was used. Several years of education was used. The more the number of years were assumed better. Education was assumed to have a positive effect on the production of cashew nuts.

Radio ownership was one of the variables used. This variable is represented as a dummy i.e 1 if the farmer owns a radio and 0 otherwise. This was because ownership of radios, especially in rural areas facilitates access to acquiring information from the different radio programs about cashew nuts management, price, and market. Radio ownership can hence have a positive effect on cashew nuts production. The number of farmers with radios was determined.

Similarly, cellphone ownership facilitates information access by farmers. This variable is represented as a dummy i.e 1 if the farmer owns a cellphone and 0 otherwise. Farmers can also

easily keep in contact with other farmers and are easily informed of the prevailing conditions such as weather or the market. Cellphone ownership is assumed to have a positive effect on cashew nut production. The number of farmers with cellphones was determined.

Bicycle ownership by farmers of cashew nuts is assumed also to have an appositive effect on production. This variable is represented as a dummy i.e 1 if the farmer owns a bicycle and 0 otherwise. Bicycles enable the farmers to easily transport inputs to the farm such as fertilizers and herbicides. They make movement easier and hence help save time at the farm. The effect from owning and using a bicycle is assumed to be positive on the production of cashew nuts. The number of farmers with bicycles was determined.

Likewise, motorcycle ownership just like bicycle ownership facilitates quick movement. This variable is represented as a dummy i.e 1 if the farmer owns a motorcycle and 0 otherwise Moreover, during harvest, transport of the crop is facilitated and hence lowers the cost of transport of items on the farm if transport were to be hired. The effect from owning and using a motorcycle is assumed positive on the production of cashew nuts. The number of farmers with motorcycles was determined.

3.4 Data source

The data needed for regression tests on objectives the independent variables for objective one (warehouse cashew nut prices, pesticides, cultivated area, labor force) as well as for the dependent variable (Cashew nuts production) were obtained from the UNdata of the United Nations. Whereas for objective two independent variables were (fertilizer, pesticides, herbicides, education of head of household, radio, cellphone, bicycle, and motorcycle. Objective two was analyzed using OLS regression analysis) and dependent variable (cashew nuts total production).

For objective one, variables with annual data between 1990 and 2020 were obtained from the UNdata of the United Nations. Cashew nuts production measures the annual production of cashew nuts in Tanzania between 1990 and 2020 expressed in hundreds of thousands if metric tons.

For objective two, this study used cross sectional survey data of 2007/2008 agricultural survey conducted in Tanzania at village level.

3.5 Estimation procedure

The analysis of the effect of Warehouse Receipt System on cashew nuts production in Tanzania was performed in two stages that consisted of preliminary and econometric analysis. Preliminary analysis consisted of generating descriptive statistics and diagnostic tests. These were important because they gave a general overview of the data used in the study. Descriptive statistics explain the mean, median and standard deviations of the variables. Diagnostic tests were performed to avoid spurious regression. The econometric analysis was carried out using Eviews 10 data analysis program. The study used an autoregressive distributed lag model (ARDL) regression for objective one and Ordinary Least Square (OLS) technique to analyze objective two. The values and signs of the coefficients from the estimated models helped in answering the study question.

3.6. Diagnostic tests

These are various tests that were carried out to ensure that the data used was suitable for analysis. The following tests were therefore executed accordingly.

3.6.1. Normality test

The normality test was performed to find out whether the data is normally distributed before being used for estimation. It is a requirement that time series data is checked to be normally distributed before using it for estimation. This study used the Jarque-Bera statistic to test for normality with the following hypotheses:

Ho: The series is normally distributed

H1: The series is not normally distributed.

Data is normally distributed in case insignificant Jarque-Bera values are obtained and vice versa.

3.6.2. Test for Stationarity

Stationarity means that the time series data of the variables is time invariant meaning that over time, the key moments i.e. the mean, variance and auto-covariance of the series don't change i.e. it is stationary over time. The Augmented Dickey-Fuller (ADF) for unit root testing was used to test and determine stationarity or non-stationarity of the variable. The ADF test takes the unit root as the null hypothesis Ho: $\rho = 1$. The null hypothesis is tested against the

Alternative H_1: $\rho < 1$.

3.6.3. Non-stationarity Correction

To avoid spurious regression results which is a situation where the adjusted R^2 > Durbin Watson which leads to poor forecasts, differencing the non-stationary variable makes it stationery and use of differenced variables to perform a regression improves the forecasts.

For this study, non-stationarity was corrected through differing the variables. Variables will be different until they become stationary.

3.6.4. Serial correlation test

Serial correlation is normally a result of model misspecification or genuine autocorrelation of the model error term. In the presence of serial correlation, ordinary least squares estimators are no longer Best Linear Unbiased Estimators (BLUE). The R^2 may be overestimated, standard errors underestimated, and t-statistics overestimated. If there are lagged dependent variables on the right-hand side, OLS estimators are biased and inconsistent. Serial correlation will therefore be tested.

The Durbin-Watson (DW) statistic was used to test for first order serial correlation. This statistic measures the linear association between adjacent residuals from a regression model. The DW test is based on the hypotheses:

Ho: r = 0, no serial correlation

H1: r = 1, presence of serial correlation

A rule of thumb for this test is that:

DW » 2, there is no serial correlation.

DW < 2, there is a positive serial correlation.

DW > 2, there is negative serial correlation.

CHAPTER FOUR:

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.0 Introduction

This chapter presents and discusses analyzed results for the examined two objectives. Objective one analyzes the effect of warehouse-regulated prices on cashew nuts production in Tanzania. Objective one uses time series data to analyze the effect of warehouse-regulated prices on cashew nuts production in Tanzania. There are five variables, and they include cashew nuts production, warehouse cashew nut prices, pesticides, cultivated area and labor force which this study undertook to examine. The analysis process consisted of generating descriptive statistics, followed by performing diagnostic tests and then carrying out the ARDL regression analysis and the bounds test. Objective two analyzes the effect of input accessibility under WRS on cashew nuts production in Tanzania. The ten variables include cashew nuts total production, fertilizer, pesticides, herbicides, head of household, education, radio, cellphone, bicycle and motorcycle. Objective two was analyzed using OLS regression analysis.

4.1 The Effect of Warehouse Regulated Prices on Cashew Nuts Production in Tanzania

4.1.1 Descriptive Statistics

The following subsection shows the descriptive statistical results of the five variables expressed in logarithms. They include cashew nuts production, warehouse cashew nut prices, pesticides, cultivated area and labor force. In this study, log of cashew nuts production is the dependent variable while the rest of the above variables are the independent variables.

Table 4.1: Descriptive statistics

Variable	Mean	Median	Std. Dev.	Observations
Cashew nuts production	11.4	11.4	0.6	30
Warehouse cashew nut prices	7.7	7.4	7.0	30
Pesticides	14.2	14.0	13.6	30
Cultivated area	14.3	14.1	13.2	30
Labor force	8.6	8.4	8.1	30

Computed by author.

Table 4.1 shows some important descriptive statistics of this study. It presents for each variable, the mean, median and standard deviation presented in logarithmic form. Standard deviation is difficult to interpret in absolute terms. However, it can be interpreted in relative terms by comparing the standard deviation for two different distributions, i.e., the distribution with smaller standard deviation exhibits less dispersion and larger standard deviation shows higher dispersion. The analysis reveals insightful details about Tanzania's cashew nut production dynamics from 1990 to 2020:

The descriptive results indicate that on average, Tanzania's annual Cashew nuts production between 1990 and 2020 has been 2.718 exponential 11.4 tons with median production of 2.718 exponential 11.4 tons and standard deviation of 2.718 power 0.6 tons. The mean and median values being close (11.4) suggest a relatively stable production trend over time. This stability is reassuring for stakeholders in the cashew nut industry, indicating consistent production levels without significant outliers affecting the average. Whereas the small standard deviation suggests that, the production values are tightly clustered around the mean, indicating consistent production levels over the observed period.

The average warehouse cashew nut prices are 2.718 exponential 7.7 Tanzanian shillings a kilogram with the median price as 2.718 exponential 7.4 shillings a kilogram and standard deviation from the mean of 2.718 exponential 7.0 shillings a kilogram. The mean logarithm (7.7) and median (7.4) being slightly apart suggests a distribution skewed towards higher prices, potentially influenced by occasional spikes in market conditions. This could affect profitability and price forecasting for producers and traders. The large standard deviation (7.0) indicates substantial price volatility, which may pose challenges in financial planning and risk management.

Meanwhile the quantity of pesticides used by cashew nut farmers were on average 2.718 exponential 14.2 liters with the median estimated at 2.718 exponential 14.0 and a standard deviation from the mean of 2.718 exponential 13.6 liters respectively. The mean (14.2) and median (14.0) being close indicates a consistent level of pesticide usage across observations. This uniformity suggests a common practice among farmers, likely influenced by agronomic practices and pest pressures. The high standard deviation (13.6) reflects significant variability in pesticide

application rates. This variability could stem from differences in pest severity, farmer practices, or regulatory factors.

The average area under cashew nut cultivation is on average 2.718 exponential 14.3 acres with a medium of 2.718 exponential 14.1 acres and standard deviation of 2.718 exponential acres 13.2. The mean (14.3) and median (14.1) being similar suggests a balanced distribution of cultivated areas. This consistency indicates widespread land use patterns among cashew nut farmers. The notable standard deviation (13.2) indicates varying farm sizes. Understanding these differences is crucial for land use planning, resource allocation, and assessing the sector's spatial dynamics.

Similarly, the number of those engaged in the cashew nuts cultivation between 1990 and 2020 was on average 2.718 exponential 8.6 people with a median of 2.718 exponential 8.4 people and standard deviation of 2.718 exponential 8.1 people. The mean (8.6) and median (8.4) indicate a relatively stable workforce size involved in cashew nut production. This consistency suggests steady employment opportunities within the sector. The moderate standard deviation (8.1) suggests variability in labor force sizes, potentially influenced by seasonal fluctuations or regional differences in agricultural practices. This variability could stem from seasonal labor fluctuations or varying farm sizes.

4.2 Diagnostic tests

The study carried out various tests that included the normality test, stationarity test, serial correlation tests, etc. The results of these tests are presented in the following tables.

4.2.1 Normality test

One of the key tests carried out is the normality test which was performed to find out whether the data was normally distributed. It is a requirement that time series data is checked to be normally distributed before using the least squares estimation technique in order to avoid inaccuracies. Data is normally distributed in case insignificant Jarque-Bera values are obtained and vice versa. The normality test was performed to find out whether the data of the variables follows a normal distribution. For this test, the Jarque-Bera statistics were used. The results from the normality test in table below show the five variables that include cashew nuts production, warehouse cashew nut prices, pesticides, cultivated area and labor force that this study undertook to examine. The Jarque-

Bera shows that cashew nuts production, pesticides, and cultivated area under this study are non-normally distributed at 5% level of significance. The rest are normally distributed. The study could not discard the non-normal variables because of their importance from theoretical background. Logarithms were therefore taken to correct the data from outliers.

Table: 4.2 Normality test results

Variable	**Jarque-Bera**	**Probability**
Cashew nuts production	7.159414	0.027884
Warehouse cashew nut prices	2.816884	0.244524
Pesticides	9.799447	0.007449
Cultivated area	35.73204	0.000000
Labor force	1.875747	0.391459

4.3.2 Testing for stationarity

The study also carried out a stationarity test. The Augmented Dickey-Fuller (ADF) for unit root testing was used to test and determine stationarity or non-stationarity of the variable. The ADF test takes the unit root as the null hypothesis Ho: $\rho=1$. The null hypothesis is tested against the Alternative H1: $\rho<1$. To avoid spurious regression results which is a situation where the adjusted R2 > Durbin Watson which leads to poor forecasts, differencing the non-stationary variable makes it stationery and use of differenced variables to perform a regression improves the forecasts. Therefore, non-stationarity was corrected through differing variables. To check whether the data series of the variables were time invariant, the stationarity test was performed. The first part tested for stationarity at level (Table 4.3) and hence went ahead to difference the series as a way of correcting for the stationarity (Table 4.4 and Table 4.5).

Table: 4.3 Augmented Dick Fuller (ADF) test results at level (before differencing)

	ADF test statistic	**1% critical value**	**5% critical value**	**10% critical value**
Variable	-1.399741	-3.67017	-2.963972	-2.621007
Cashew nuts production	-1.224602	-3.67017	-2.963972	-2.621007
Warehouse cashew nut prices	-2.586435	-3.679322	-2.967767	-2.622989
Pesticides	0.873277	-3.689194	-2.971853	-2.625121
Cultivated area	-2.007887	-3.679322	-2.967767	-2.622989
Labor	-1.579559	-1.579559	-1.579559	-1.579559

After carrying out a stationarity test of the variables in this study, using the ADF unit root test, as from the table above, it is clearly shown that all the other variables (cashew nuts production, warehouse cashew nut prices , pesticides, cultivated area, labor) were non-stationary at level i.e. 1%, 5% and 10% levels.

Table: 4.4 Augmented Dick Fuller (ADF) test results after differencing (first difference)

Variable	**ADF test statistic**	**1% critical value**	**5% critical value**	**10% critical value**
DCashew nuts production	-6.259586	-3.689194	-2.971853	-2.625121
DWarehouse cashew nut prices	-5.755204	-3.689194	-2.971853	-2.625121
DPesticides	-6.062057	-3.699871	-2.976263	-2.62742
DCultivated area	-6.199944	-3.689194	-2.971853	-2.625121
DLabor	-4.06667	-3.679322	-2.967767	-2.622989

Whereby:

DCashew nuts production is cashew nuts production after differencing (first difference)

DWarehouse cashew nut prices is warehouse cashew nut prices after differencing (first difference)

DPesticides domestic savings is pesticides after differencing (first difference)

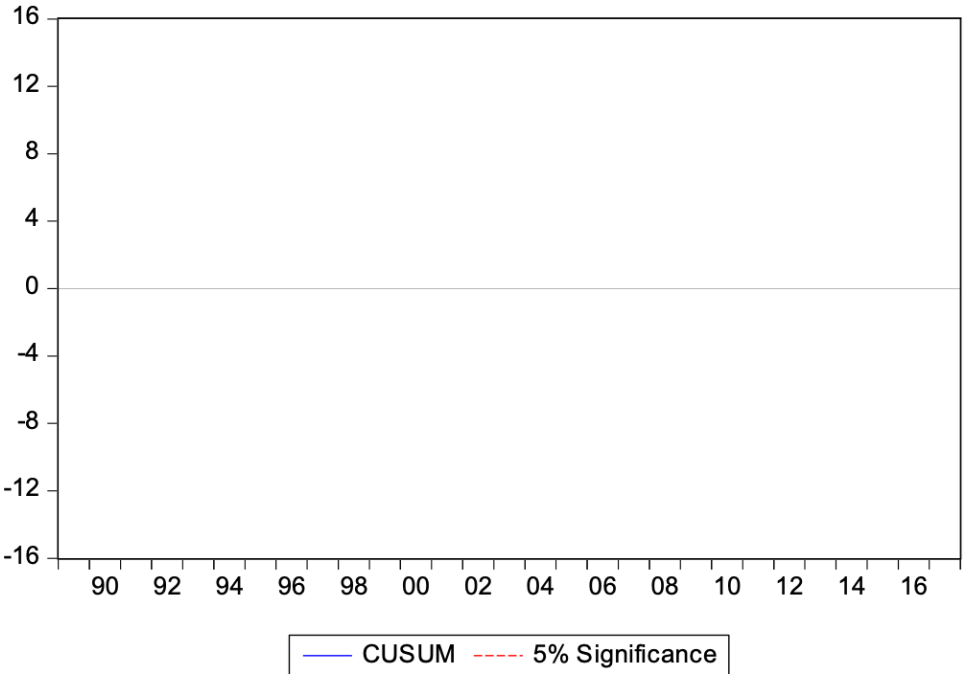
DLabor force is labor force after differencing (first difference)

DCultivated area is cultivated area (first difference)

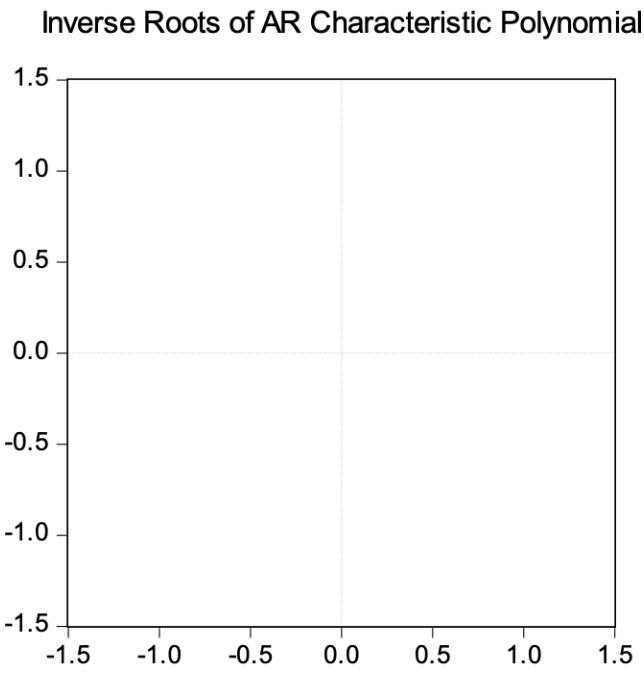
DLabor is labor after differencing (first difference)

The above table presents the results of the ADF test for stationarity of the variables after taking their first difference and the results show that all the variables in Table 4.4 were found to be stationary at 5% level.

The following CUSUM indicates that our model was stable since it lies within the boundaries.

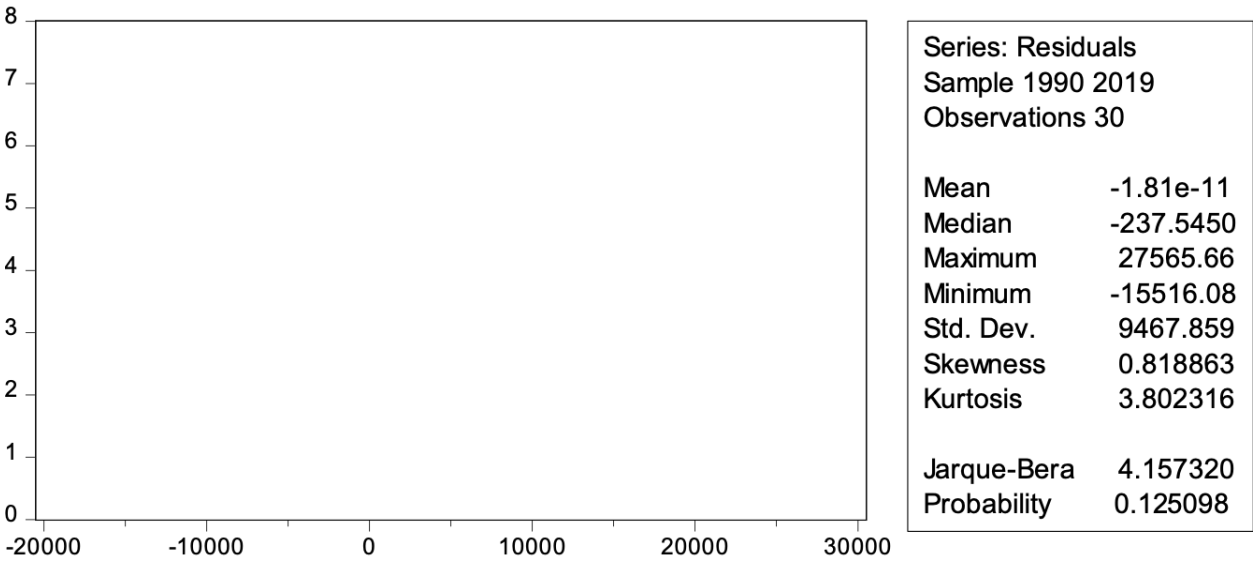


The stability of the model was further confirmed by the roots graph. If the CUSUM value exceeds far from the zero line, it shows that the model is unstable. The 5% significance level of the test is obtained by rejecting stability when CUSUM crosses the lines ±0.948. Our model is hence stable and not explosive.



The stability of the model was further confirmed by the roots graph. The results show that all the observations lie within the unit circle. Our model is hence stable and not explosive.

Figure 4.7 Normality of the residuals



The Jarque-Bera residual normality test shows that the residuals are normally distributed at the 5% level of significance.

Date: 07/02/23 Time: 04:35

Sample: 1990 2020

Included observations: 30

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |**. |	. |**. |	1	0.263	0.263	2.2957	0.130
. | . |	. *| . |	2	-0.006	-0.081	2.2971	0.317
. | . |	. |* . |	3	0.050	0.079	2.3846	0.497
.**| . |	.**| . |	4	-0.255	-0.317	4.7855	0.310
. *| . |	. | . |	5	-0.165	0.008	5.8297	0.323
. |* . |	. |* . |	6	0.089	0.114	6.1497	0.407
. | . |	. | . |	7	0.028	0.008	6.1816	0.519
. *| . |	.**| . |	8	-0.169	-0.270	7.4245	0.492
. | . |	. | . |	9	-0.061	-0.014	7.5950	0.575
. *| . |	. *| . |	10	-0.181	-0.162	9.1749	0.516
. | . |	. |**. |	11	-0.010	0.227	9.1801	0.605
. |* . |	. | . |	12	0.203	0.025	11.372	0.497
. | . |	. *| . |	13	0.040	-0.088	11.464	0.572
. | . |	. *| . |	14	-0.043	-0.168	11.577	0.640
. | . |	. |* . |	15	0.012	0.115	11.587	0.710
. *| . |	. *| . |	16	-0.162	-0.129	13.394	0.644

The test of the residuals for autocorrelation shows that there is no autocorrelation since the probabilities for the Q statistic are all large and insignificant for autocorrelation.

4.3.3. Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.879932	Prob. F (2,27)	0.1720
Obs*R-squared	4.522614	Prob. Chi-Square (2)	0.1042

The study also reviewed the diagnostic tests of interest, which were: Breusch-Godfrey Serial Correlation LM Test. The test shows insignificant values for the f-statistic autocorrelation at 5% level of significance.

4.3.4. Heteroscedasticity Test

To test whether the variance in the errors is heteroscedastic or homoscedastic the White Heteroscedasticity Test was carried out. The heteroscedasticity test revealed that variances were homoscedastic since all the probability values for heteroscedasticity were large and insignificant.

Table 4.5 Heteroscedasticity Test

Number of obs	130
F(9,130)	5.43
Prob > F	0.001
R-squared	0.49
Adj R-squared	0.42

Table 4.6 : The effect of warehouse regulated prices on cashew nuts production in Tanzania. (ARDL results)

Variables	Model 1		Model 2	
	Coefficients	**Standard errors**	**Coefficients**	**Standard errors**
Log Production (-1)	1.74***	(0.137)	1.88***	(0.1069)
Log Production (-2)	-0.73***	(0.133)	-0.86***	(0.1074)
Log Prices	0.0012**	(0.0006)	0.99***	(0.0008)
Log Prices (-1)	0.0009**	(0.0004)	-1.88***	(0.1067)
Log Prices (-2)	0.001*	(0.0005)	0.85***	(0.1076)
Log Prices (-3)	0.0014**	(0.0009)	-0.001	(0.00069)
Log Pesticides	0.019***	(0.0077)	-	-
Log Pesticides (-1)	0.004***	(0.0009)	-	-
Log Pesticides (-2)	0.731*	(0.1323)	-	-
Log Pesticides (-3)	-0.0016	(0.001)	-	-
Log cultivated area	-0.0003***	(0.001)	-0.0015*	(0.0011)
Log cultivated area (-1)	-0.001***	(0.0009)	-0.0022**	(0.00104)
Log cultivated area (-2)	-0.002*	(0.00087)	-0.0027**	(0.00105)
Log cultivated area (-3)	-0.001	(0.00096)	-0.0023	(0.00089)
Log labour	-0.002*	(0.0011)	-0.00089	(0.00098)
Log labour (-1)	-0.0012	(0.0010)	-0.00091	(0.00068)
Log labour (-2)	-0.0002	(0.0011)	0.0002	(0.00099)
Log labour (-3)	-0.0003	(0.0009)	-0.0006	(0.00103)
C	-0.034*	(0.0397)	-0.093***	(0.02008)
Adjusted R-squared	0.95		0.94	
Prob(F-statistic)	0.000		0.000	
Durbin-Watson stat	2.154336		1.502815	

*Significance of coefficients: ***Significant at 1%, ** Significant at 5%, *Significant at 10% Standard Errors in Brackets*

The results in Table 5 show the effect of warehouse regulated prices on cashew nuts production in Tanzania using ARDL regression analysis. Several other independent variables such as value of pesticides, cultivated area and expenditure on labour force were included for control purposes. Determination of the significance level as usual is done by comparing the absolute values of the computed student t-value to the critical t-value obtained from the tables. For this objective, two models were estimated in which variable pesticides were excluded in model two. The intention was to look at how the model changes given the excluded variable. The outcome is confirmed by use of probability values (generated automatically by Eviews 9) where the decision rule for significance is the p-value of less than 0.005 inclusive. This study determines significance at 5%, which is 95% confidence level. Taking the degrees of freedom into account the critical t-value is 2.060.

The first observation made for objective one of the studies is that on average a 10% change in the previous log of cashew nuts production lagged by one (-1) period, holding other factors constant would significantly increase current production by 17.4% for model 1 and by 18.8% for model 2. These results imply that a larger previous production level affects positively the current production level of cashew nuts and vice versa. The positive and significant effect of previous log of production lagged by one (-1) period is explained by the fact that a larger previous cashew nut production makes available resources that are then invested in more cashew nuts production. The higher level of the resources from the previous production raises current production levels. Having this in mind, efforts to ensure increasing production should be taken to ensure that current production is well cared for since today's production will affect the next year's production. On the other hand, the effect of the log of cashew nuts production lagged by two (-2) years on its current production is negative. Meaning that on average a 10% change in the previous log of cashew nuts production lagged by two periods (-2), holding other factors constant would significantly reduce current production by 7.3% for model 1 and by 8.6% for model 2. Meaning that production of years ago does not positively affect output. The previous production might have been due to loans

which need to be paid back in the current year. According to Lukurugu et al 2022 there is need to ensure, various means are used to improve on production of the cashew nuts since it is a high value crop. Thus, in the same spirit, the Tanzanian government is intervening to ensure increased production through the provision of free im0puts to farmers of the crop.

The results secondly show a positive and significant effect of the current warehouse prices for cashew nuts on the current production rate. On average a 10% increase in the current log of cashew nuts prices positively leads to production to increase by 0.012% for model 1 and 9.9% for model 2 respectively. For both models, the effect of the current log of cashew nuts price rate is significant. In this case, the current cashew nuts prices rate increases current production. This means that higher warehouse prices for cashew nuts lead to increased production for the crop. This implies that the prices offered for cashew nuts in warehouses at a given time directly influence the current production levels of cashews. When warehouse prices for cashew nuts are high, farmers are more motivated to invest in cashew nut production. They may allocate more resources, such as labor, fertilizers, and irrigation, to ensure a successful harvest.

Thus, the higher prices in warehouses can encourage farmers to expand their cashew nut cultivation areas. They may convert or allocate more land to cashew nut production, leading to an increase in overall production. Likewise, with the expectation of higher returns, farmers may also pay more attention to the care and management of their cashew orchards. This can include activities like timely pruning, pest and disease control, and proper irrigation, all of which contribute to higher yields. When prices are favorable, farmers may invest in technologies and practices that improve the quality of cashew nuts produced. This can include better post-harvest handling, processing, and storage practices, which are essential for maintaining the value and marketability of the crop.

Although this positive effect has been realized, since cashew nuts production may not quickly react to an increase in price, it follows that a time lag is necessary in terms of years to increase output as na response to a price increase. Analysis on the effect of the log of cashew nut warehouse prices lagged by one period (-1) on the crops current production shows that on average a 10% change in the prices leads current production to increase by 0.009% for model one and to reduce by18.8%

for model 2 respectively. The conflicting signs for the two models indicate that for the previous year's warehouse prices the effect on current production is not clear. On the other hand, for the third year's warehouse prices, the effect on current cashew nuts production is that a 10% change on average leads to 0.01% for model 1 and 8.6% for model 2. The positive sign infers to a positive relationship between the cashew nuts prices of two years ago and the current cashew nut production. There is also a positive effect of the cashew nut warehouse prices lagged for three years on current production where on average a 10% change in the warehouse prices of three years influences current production of 0.014% for model 1 holding other factors constant.

The relationship between the warehouse price and production for cashew nuts has received greater attention from a variety of researchers in the world. Several empirical studies indicate that warehouse price for cashew nuts rate is good for the crops production. Kashangaki (2015) in 2015 found that cashew nut production in Tanzania fluctuated following the changes in price. The study established that price of the cashew nuts influence production of cashew nuts in Tanzania. The study also shows that the government has been regularly adjusting taxation structure as regards agricultural equipment and products to help both farmers and traders from the burden of price fluctuations. Hence this realization goes straight to other factors that impact the price such as petroleum availability as well as other inputs. Sifuni (2020) the Warehouse Receipt system cashew increased the price of cashew per kilogram, but the income of smallholder farmers remained dormant.

Given that farmers access most goods from the market, the issue of price is of paramount importance. Moreover, Tanzanian farmers have been facing a situation where fluctuation in the price of their cashew nut products tend to change from time to time thus gaining less from the market after selling their cashew nut products. With low prices, farmers may be unable to accumulate enough funds to procure the necessary capital goods and other inputs necessary to add value on cashew nuts. Consequently, they end up selling the unprocessed crop at lower prices. This in addition may affect efficiency and productivity thus leading decreased production levels. With such a situation, Tanzania may fail to realise the planned production level of 1,000,000 tonnes of cashew nuts by 2025,

Since a positive relationship between price and production of cashew nuts. All efforts should focus on ways to increase the price for the farmers. Encouraging private actors to set up processing factories will help value addition. This in turn will increase prices because of the improved value, allowing it to flow down to the farmers to enable them to receive between 2000 to 3000 Tanzanian shilling per kilogram. Higher prices act as motivators to farmers and act a signal for them to produce more cashew nuts.

However, lower prices normally tend to lower farmers motivation and eventually may be tempted to switch from producing cashew nuts to produce other food products such as maize and beans. Farmers cannot keep on changing crops whenever the price changes. For instance, an increase in the price for cashew nuts may be followed by an expansion of farmland to produce the crop away from other crops. But given the fluctuations, these changes may impact negatively in the farmers which may grow tired and just decide to remain only with their food crops. According to shifting to Yeboah et al (2023), cashew nut cultivation might help to increase income and reduce poverty, but on the other, the transition to cashew might harm sustainable livelihoods because of fear of food insecurity and insufficient land for future generations due to the escalating agrarian change. However, it's important to note that while there is likely a positive correlation between high warehouse prices and increased production, other factors can also influence production levels. These may include weather conditions, availability of inputs (like seeds, fertilizers, and labour), and access to credit and technical support.

On average a 10-percentage change in the current log of cashew nuts pesticides, holding other factors constant leads current cashew nuts production to increase significantly by 0.19% for model one. The result implies that use of pesticides at the current time has a positive effect on the production levels of cashew nuts. Lagged values of cashew nuts pesticides show that on average a 10% change in the lagged pesticides by one year leads production to change positively by 0.04%. While for pesticides lagged for two years, the effect is positively 7.3% and when lagged for three years, it is a decrease by 0.016% on current cashew nuts production. These results highlight the positive effect of applying pesticides on cashew nuts during production. The agricultural use of pesticides has enabled cashew farmers to increase their crop yields significantly in cashew producing regions. Cashew trees are susceptible to various pests and diseases, including cashew

leaf and nut pests, fungal infections, and bacterial diseases. Pesticides can effectively control or mitigate these threats, ensuring healthy tree growth and nut development. Pesticides help protect cashew trees from various pests and diseases. By reducing the damage caused by these factors, the overall yield of cashew nuts can be significantly increased. This is crucial for meeting the demands of a growing global population.

Pesticides provide a useful means to control insects (insecticides), weeds (herbicides), plant diseases (fungicides), as well as other agricultural pests. The use of pesticides has been adopted and promoted by the government of Tanzania and on the positive note; farmers have not resisted using them. As a result, increased yields have been realised leading to increased earnings within the participating households affecting their welfare. According to Nyirenda (2021), a warehouse receipt system (WRS) has been in place. The system ensures all cashew production is sold via cooperatives through an auction centrally managed by the Cashew Board of Tanzania (CBT). In this system, farmers send their cashew to the nearby Agricultural Marketing Cooperative Societies (AMCOS) and are paid 70% of the value of their cashew nuts minus any loans obtained from banks by the primary cooperatives and advances made to farmers in form of inputs. Using pesticides in cashew nut production can have several positive effects, but it's important to note that their use should be balanced with responsible and sustainable agricultural practices. Here are some potential positive effects of using pesticides in cashew nut production:

Regarding the effect of the log of the current cultivated area for growing cashew nuts on the current cashew nuts production, the results show a negative relationship where on average a 10% change in the current cultivated area leading current production to reduce by 0.003% for model 1 and 0.015% for model 2 holding other factors constant. Similarly, on average a 10% change in the log of cultivated area for cashew nuts by one-year leads to current cashew nuts production to reduce by 0.01% for model 1 and by 0.022% for model 2 holding other factors constant. Similar results for were found for the variable lagged for two years. Where on average 10% change in the log of cultivated area for cashew nuts leads current cashew nuts production to reduce by 0.02% for model 1 and by 0.027% for model 2 respectively. The negative sign was unexpected. However, this result could be due to the poor soil productivity where even an increase in the cultivated area per se may not largely affect production. Finding sufficiently large pieces of land ideal for cultivation of

cashew nuts is difficult and hence only marginal unfertile lands remain. Therefore, increase of cashew nuts production acreage may not improve production quantities.

The study found that the labour force rate, when holding other factors constant, has a negative impact on the rate of cashew nuts production. Additionally, lagged values were observed to have no effect on current production. This suggests that the existing labour force is adequate, and further increases in labour force may not be necessary to boost production. The implication is that the current level of available labour is sufficient, and additional workforce may not contribute significantly to increasing cashew nuts production.

4.4 Long run analysis Co-integration tests

Since the precondition for applying the ARDL model is the existence of a long run relationship between the dependent variable and the vectors of the independent variables, it is only possible to proceed to the ARDL model when co-integration test reveals the existence of such a long run relationship. This study hence applied the bounds test based on the F-test statistic to detect the long run relationship.

To find out whether there is any long run relationship the Wald test of the coefficients was conducted. The Null of all the estimated coefficients is that coefficient one C (1)) is equal to coefficient two (C (2)) is equal to coefficient three (C(3)) and so on until all the estimated coefficients are included as in; All the coefficients equal to zero was significantly rejected as shown by the F statistic.

Table 4.7 Co-integrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Log Prices)	0.01	0.06	0.17	0.87
D(Log Prices (-1))	-0.05	0.06	-0.97	0.35
D(Log Prices (-2))	0.03	0.03	0.89	0.39
D(Log Pesticides)	0.07	0.03	2.12	0.05
D(Log Pesticides (-1))	-0.05	0.04	-1.20	0.25
D(Log Pesticides (-2))	0.04	0.04	1.04	0.32
D(Log cultivated area)	0.00	0.01	0.31	0.76
D(Log cultivated area (-1))	-0.02	0.01	-1.92	0.07
D(Log cultivated area (-2))	-0.03	0.01	-3.58	0.00
D(Log labour)	-0.003	0.001	-0.27	0.79
D(Log labour (-1))	0.003	0.001	2.4	0.04
D(Log labour (-2))	0.001	0.001	1.0	0.32
CointEq(-1)	**-0.76**	**0.11**	**-6.84**	**0.00**

There is a quick adjustment in cashew nuts production when warehouse cashew nut prices, pesticides, cultivated area and labour force change. Importantly, the long-run coefficients from the co-integrating equation are reported with their standard errors, t-statistics, and p-values. The error-correction coefficient is negative (-0.76) as required and is very significant. This is interpreted as the previous year's errors will be corrected at the current year with an adjustment speed of 0.76%. This implies that warehouse cashew nut prices, pesticides, cultivated area and labour-force together have a long run influence on Tanzania's cashew nut production.

Table 4.8 Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Log Prices	0.23	0.09	2.65	0.02
Log Pesticides	0.30	0.10	3.05	0.01
Log cultivated area	0.09	0.03	2.91	0.01
Log labour	0.11	0.02	7.17	0.00
Constant	13.70	1.67	8.22	0.00

From the co-integration estimation, there is a long-run equilibrium relationship between the log of warehouse cashew nut prices and Tanzania's log of cashew nut production. In the long run warehouse cashew nut prices positively affect cashew nut production and this relationship is significant. A change in warehouse cashew nut prices by 10% causes the crops production to increase by 2.3% holding other factors constant. This may not be surprising as Tanzania's economy heavily relies on agriculture including the production of cashew nuts. Similarly, in the long run an increase in Tanzania's pesticides by 10% will affect cashew nuts production to increase by 3% holding other factors constant. If Tanzania's cultivated area changes by 10%, cashew nuts production will respond by a change of 0.9% in the long run. A 10% change in Tanzania's labor force will result in a long-run change of 1.1 percent in Tanzania's cashew nuts production.

ARDL Bounds Test

One of the main purposes of estimating an ARDL model is to use it as the basis for applying the "Bounds Test". The null hypothesis is that there is no long-run relationship between the variables.

Table 4.9

Test Statistic	Value	k		
F-statistic	**10.46001**	4		
Critical Value Bounds				
Significance	I0 Bound	I1 Bound		
10%	2.45	3.52		
5%	2.86	4.01		
2.5%	3.25	4.49		
1%	3.74	5.06		

We see that the F-statistic for the Bounds Test is 10.46001, and this clearly exceeds even the 1% critical value for the upper bound. Accordingly, we strongly reject the hypothesis of "No Long-Run Relationship". This confirms that there is a long run relationship between Tanzania's cashew nut production and cashew nut warehouse prices, pesticides, cultivated area and labor force.

4.5 The Effect of Input Accessibility under Warehouse receipt system on Cashew Nuts Productivity in Tanzania.

4.5.1 Descriptive Statistics

The following subsection shows the descriptive statistical results of selected variables. They include cashew nuts productivity, warehouse cashew nut prices, pesticides, cultivated area and labor force. In this study, log of cashew nuts production is the dependent variable while the rest of the above variables are the independent variables.

Table 4.10: Descriptive statistics of the selected variables

Variable		**Mean**	**Min**	**Max**
Productivity		1.76	0.00	9.29
Education of household head		6.4	0	16
Fertilizer	Uses	0.22	0	1
	Does not use	0.78	0	1
Pesticide	Uses	0.01	0	1
	Does not use	0.99	0	1
Herbicides	Uses	0.01	0	1
	Does not use	0.99	0	1
Radio	Owns	0.69	0	1
	Does not own	0.31	0	1
Cell-phone	Owns	0.37	0	1
	Does not own	0.63	0	1
Bicycle	Owns	0.55	0	1
	Does not own	0.45	0	1
Motorcycle	Owns	0.03	0	1
	Does not own	0.97	0	1

Descriptive statistics of the selected variables above indicate that productivity average data is 1.76 tons per ha with a minimum of zero and maximum of 9.29 tons per ha Productivity is measured by the number of tons or kg produced per hectare. From the Tanzanian agricultural census, productivity increased by 400 percent in 2007/2008 from 0.31 tons per Ha to 1.7 tons per Ha. Furthermore, from the 2007/2008 census, there was a huge difference within regions producing cashew nuts, Mtwara being the highest producing region and proprietor for the warehouse receipt system recorded 5 tons per Ha. While Arusha was the lowest, recording 0.06 tons per Ha.

The average years of education of household head is 5.4 years with a minimum of zero years and maximum of 16 years. The average figure implies that most of the cashew nut farmers never attended secondary education, which normally begins after primacy school. Education is an important factor with implications for productivity.

Descriptive statistics show that 22.0 percent of the farmers used fertilizer whereas the majority (78.0%) did not use fertilizers. This may have affected the productivity of cashew nuts. Only 1.0 percent indicated that they apply pesticides whereas 99,0 percent don't use them. It is a similar scenario where only 1.0percent used herbicides and 99.0 percent did not use them.

Regarding radio ownership, the majority (69.0%) of the farmers own a radio whereas 31.0 percent do not own a radio. Whereas, 37.0 percent own a cell phone, 63 percent do not own one. Regarding transport means, 55.0 percent of the farmers own a bicycle and 45.0 do not own a bicycle. Only 3percent own a motorcycle and 97 percent do not own any motorcycle.

Table 6: The effect of input accessibility under WRS on cashew nuts production in Tanzania. (OLS results)

Table 4.11

Variable	**Coef.**	**Std errors**	**t-values**	**P>t**
Productivity	-	-	-	-
Head of HH Education	0.158***	(0.0428)	3.69	0.01
Uses Fertilizer	0.222***	(0.0527)	4.21	0.001

Uses Pesticides	0.253***	(0.0688)	3.68	0.01
Uses Herbicides	0.125***	(0.0269)	4.64	0.01
Owns Radio	0.284*	(0.1193)	2.38	0.061
Owns Cellphone	0.51	(0.2698)	1.89	0.21
Owns Bicycle	0.204***	(0.0347)	5.87	0.00
Owns Motorcycle	0.201	(0.1661)	1.21	0.36
Constant	0.393	(0.0653)	6.02	0.14

*Significance of coefficients: ***Significant at 1%, ** Significant at 5%, *Significant at 10%*
Standard Errors in Parenthesis

The results in Table 5 for objective two show the effect of input accessibility under WRS on cashew nuts production in Tanzania using OLS regression analysis. A number of other variables such as fertilizer, pesticides, herbicides, head of household, education, ownership of radio, cellphone, bicycle and motorcycle were included for control purposes. Determination of the significance level is done by comparing the absolute values of the computed student t-value to the critical t-value obtained from the tables. The outcome is confirmed by use of probability values (generated automatically by Stata 16) where the decision rule for significance is the p-value of less than 0.005 inclusive. This study determines significance at 5%, which is 95% confidence level. Taking the degrees of freedom into account the critical t-value is 2.060.

Head of Household Education

This study found that on average a 10% change in the household head level of education, holding other factors constant, significantly and positively, increases cashew nuts production by 1.6%. This finding links education attainment to the yield of the cashew nut crop. Therefore, the more educated the household head in a household that farms cashew nuts, implies better production. This finding means that better educated household heads influence the production of the cashew nuts since they are able to acquire further knowledge about cashew nuts farming from the available resources such as from internet sources, mobile phone messages, newspapers, extension services and others.

The more educated persons are usually less resistant to use of better methods of farming. They easily adopt to new scientific methods from research. All these opportunities enable a household with better education to have a positive effect on cashew nuts production. Hence, education of the head of the household is taken as an input. Schooling for farmers has substantial benefits to farmers' productivity particularly in terms of efficiency gain. Head of household education increases the economic resources (income) of the family through higher wages and increased productivity in self-employment, which can lead to an increased purchasing power for cashew nuts input. Education can also increase skills and knowledge as well as the ability to adapt to new ideas, behaviours and acts which may have a positive impact on productivity for an individual/society/nation.

Uses Fertilizer

The dummy variable for the use of fertilizer by farmers is positive and statistically significant at 1% in the model and positive in the regression. This means that on average productivity increases by 22 percent for the farmers who use fertilizers than for those who do not apply them, holding other factors constant. The relationship is positive and significant at 1 percent level of significance. The positive and significant effect of fertilizer use on cashew nut production is explained by the fact that use of adequate fertilizer amounts is responsible for the increased volume of cashew nuts. Thus, the higher the number of farmers that apply fertilizer to their cashew nut gardens, the more likely therefore, that more output is realized because of increased productivity. Fertilizers do help maintain a balanced nutrient profile in the soil. This is important for ensuring that cashew nut plants have access to the right mix of nutrients they need for optimal growth and development.

As the yield improves, so is the ability of the farmers to increase their earnings from the increased quantities produced. And this implies ability to access more and more required inputs. Cashew is often grown as a casual crop by smallholder farmers and as a result its fertilizer requirements are overlooked. Also, the trees are long standing and are frequently grown in soils that are of poor quality. As each season passes, the soils cashew becomes more depleted, and productivity gradually declines. Yields of trees grown in this way are very much lower than the potential that could be gained if fertilizer was applied. Experiments have demonstrated that regular application

of the major plant nutrients (nitrogen, potassium, and phosphorus) is beneficial for healthy trees and increased cashew yields. In addition, application of magnesium to cashew is beneficial (Fernandopulle, 2000). Two separate mixtures of fertilizer, based on the combination of nitrogen (N), phosphorus (P) and potassium (K), have been recommended according to the growth stage of the plant. Given that soil fertility has been declining extensively, farmers who use fertilizer tend to increase their productivity as compared to their counterpart group. This finding agrees with Mallya (2014), who found that farm size (acreage) physical capital, fertilizer, Price, extension services, primary education were positively related to cashew output while labour and secondary education were inversely related.

Uses pesticides.

A related observation is that there is a positive and significant effect of pesticides use on cashew nuts productivity. The dummy variable for the use of pesticide use by farmers is positive and statistically significant at 1% level of significance. On average for those farmers that apply pesticides, productivity increases by 25.0 percent than for those farmers who do not apply pesticides, holding other factors constant. For the model, the effect of pesticide use rate is significant. In this case, use of pesticides increases cashew nut productivity. The positive relationship between pesticide uses and cashew nut productivity has received greater attention from different researchers in the world. The lack of herbicide use is hence likely cashew nut productivity in numerous ways.

Several empirical studies indicate that the use of pesticides is good for cashew nuts growing, survival and yield (Adeigbe, 2015; Vanitha & Saroj, (2015). In Tanzania, the predominant pesticides used for cashew nut production include Sulphur and others. Hence increasing pesticide use in the right amounts is beneficial in cashew nuts productivity.

Use of herbicides

Likewise, the dummy variable for the use of herbicides by farmers is positive and statistically significant at 1% in the model. This means that on average productivity increases by 12.5 percent for the farmers who use herbicides than for those who do not use them, holding other factors constant. The relationship is positive and significant at 1 percent level of significance. Herbicides use is another important factor that relates to cashew nuts productivity hence enhances positively

on yield. Herbicides, which is key in ensuring healthy cashew nut plants, are crucial, during the production process. Ameyaw et al (2015) corroborate this whereby increased herbicide use was attributed to better cashew nut yields. The positive effect of herbicides use should however be applied with care to avoid overuse which may reduce the positive effect on the plants.

Owns radio.

Likewise, the dummy variable for those farmers who own a radio is positive but statistically insignificant at 1% in the model. The results show that on average productivity increases by 28.4 percent for the farmers who own radios than for those who do not own them, holding other factors constant. The relationship is positive at 1 percent level of significance. The positive effect of radio possession indicates that the more the number of households in possession of radios, the more cashew nuts productivity realized in the area. Possession of radios enables the households to access latest information constantly useful in the production of cashew nuts. Similar to this finding Arun (1999) used a regression model, which displayed radio possession as a positive factor for cashew nut productivity.

Radio ownership is meaningful in measuring how the community can access information concerning various agricultural techniques as to enhance production. Information is an ideal factor to productivity.

Owns cell phone.

Results show that on average for those that own cellphones holding other factors constant the cellphone ownership dummy is positive but insignificantly affects cashew nuts productivity by 51.0% than for those that own cellphones. For both cases, this relationship is positive.

Owns bicycle, motorcycle.

The dummy variable for bicycle ownership by farmers is positive and statistically significant at 1% in the model and positive in the regression. This means that on average productivity increases by 20.4 percent for the farmers who own bicycles than for those who do not own them, holding other factors constant. The results show a positive and significant effect of bicycle ownership on cashew nuts productivity. Similarly, the dummy variable for motorcycle ownership by farmers is

positive although statistically insignificant at 1%. This means that on average productivity increases by 20.1 percent for the farmers who own motorcycles than for those who do own them, holding other factors constant. These are means of transport used by various people in a particular area in helping them move from one point to another. These enhance productivity since they are very useful in the transportation of labour, inputs, and produce from one point to another.

The results of this study agreed with the theory by Solow model (1957) by confirming the link between the inputs such as fertilizer, pesticides, herbicides, human capital, and tools such as ownership of bicycle, cellphone, motorcycle to the output.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

This study was conducted on Tanzania's cashew nuts production. The study had two objectives. Objective one was analyzed using the ARDL model, focused on the impact of warehouse-regulated prices on cashew nuts production in Tanzania. Key findings included positive and significant effect of the previous year's cashew nut production on the current production, suggesting a carryover effect. Negative effect of cashew nut production lagged by two years on current production, possibly due to previous production being linked to loans. Current warehouse prices positively influence current cashew nut production, indicating a responsive relationship. Positive correlation between warehouse prices and production supported by previous research. Time lag observed in the response of cashew nut production to price increases. A long-run relationship between variables was established.

Objective two, employing the OLS model, investigated the effect of input accessibility under WRS on cashew nuts production. Results showed that farmers using fertilizers, pesticides, and herbicides experienced higher productivity. Ownership of radios was associated with a substantial increase in productivity. Positive effects of radio, cell phone, and bicycle ownership suggested that more households possessing these assets led to increased cashew nut productivity in the area.

5.2 Conclusions

Findings from the study, showed that variables such as warehouse cashew nut prices and pesticides in the first model, and fertilizer, pesticides, herbicides, head of household, education, ownership of radio, cellphone, bicycle and motorcycle in the second model are significantly and positively related to cashew nuts production for objective one There should therefore be emphasis on supporting all those factors that lead to increased cashew nuts production in Tanzania. Such efforts should begin with empowerment of the population with easy access to inputs, enabling easy access to capital and affordable loans and ability to have savings, which leads to increased investment in the cashew nuts sub-sector.

5.3 Recommendations

This study therefore recommends that the government should intervene in the cashew nuts sub-sector and provide subsidized inputs for the small farmers to reduce the cost of producing cashew nuts. This will in effect motivate and encourage the farmers to continue producing the crop.

The government through cooperative societies should encourage and invest in educational programs for farmers to enhance their knowledge and skills in cashew nut production. This could be achieved through workshops, seminars, radio talk shows and extension services. The sensitization of farmers frequently to equip them with knowledge on how to carry out the cultivation of the crop. Farmers should ensure quality handling of the crop to avoid the issue of getting spoilt in the process of harvesting.

Further to WRS policy, the study revealed that education plays a vital role for cashew nuts productivity. Basing on this finding, the government should continue providing universal education especially in rural areas where agriculture is practiced at large. Another priority is greater funding for vocational colleges in terms of training and good pay to improve their efficiency. Greater emphasis on government contracting of extension services - organizations like Naliendele research center can also lead to improved productivity in the agriculture sector for small scale and especially those living in rural areas.

The authorities should encourage the appropriate and safe use of pesticides to control pests and diseases in cashew nut production. This should be done through providing training and support on proper application techniques and safety precautions. Advocate for the responsible use of herbicides to control weeds in cashew nut farms. Provide training and resources to help farmers make informed decisions about herbicide application. Cashew nut farmers should be supported with information. This may be through promotion of access to information through radio ownership. Support initiatives that provide timely and relevant agricultural information to farmers through radio programs or other communication channels.

The government should subsidize technology-based gadgets to encourage the adoption of modern agricultural technologies, such as cell phones, to facilitate communication and information sharing among farmers. Provide training on the use of mobile technology for agricultural purposes.

In addition to the above, the government should support the cashew nut production sector through. Supporting initiatives that improve transportation and mobility for farmers, such as providing bicycles or motorcycles. This can enhance farmers' ability to move inputs, labor, and produce efficiently.

Encouraging farmers to strike a balance in the use of inputs like fertilizers, pesticides, and herbicides. Provide guidance on optimal application rates to avoid overuse or misuse.

Investing in research and development in the cashew nut industry to identify and promote best practices, new technologies, and innovative approaches that can improve productivity and sustainability.

Implementing policies that support sustainable cashew nut production, including providing incentives for responsible input use and creating an enabling environment for agricultural education and training.

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Areas for future research

The research was conducted to assess the effect of warehouse receipt system and cashew nuts production in Tanzania. The researcher faced and data constraints, so that not all essential issues could be analyzed. Had it not been for those constraints, the researcher could have included more factors affecting cashew nuts production. So, study therefore recommends further research on other factors affecting cashew nuts production such as environmental factors, government policy and others should be taken.

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