AGGREGATE ACREAGE RESPONSE OF CASHEW NUT AND SESAME TO COMMODITY PRICE AND NON PRICE FACTORS IN SOUTHEASTERN TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2013

ABSTRACT

This study aimed at investigating the impact of price and non-price factors on cashew and sesame acreage in Nachingwea and Mtwara rural Districts. Growth rates analyses were also conducted through linearlized exponential growth model to trace the trends for area, yield (productivity) and production of the two crops for the period 1995-2010. The general trend showed positive growth rates in area, yield and production, but with few exceptions. Meanwhile, the logarithmic functional form of the linear Nerlovian adjustment model was employed on time series data from 1995-2010 to estimate acreage response to price and non-price factors. Results revealed that there was a positive and significant relationship of sesame acreage with price, and non-significant relationship with rainfall (non-price factor) in both districts. Similarly, cashew acreage was observed to have positive and significant relationship with price and positive but insignificant relationship with rainfall in Nachingwea District. In Mtwara rural, positive relationship existed between cashew acreage and price, while with rainfall the relationship was negative. The study further established that short and long run price elasticities of sesame acreage were 0.264 and 0.515, respectively in Nachingwea, whereas short and long run price elasticities in Mtwara rural were 0.478 and 1.65, respectively, which implies that farmers are more responsive to price changes in the long run than they are in the short run. Similarly, non-price short and long run elasticities for sesame were 0.035 and 0.06, respectively in Nachingwea; and 0.032 and 0.11, respectively for Mtwara rural District. For cashew acreage, the short and long run price elasticities were 0.326 and 1.364, respectively for Nachingwea while in Mtwara rural short and long run price elasticities were 0.37 and 0.885, respectively. Meanwhile the study found that short and long run non price elasticities for Nachingwea were 0.033 and 0.049, respectively. However, the

elasticities though positive, they generally fell in the inelastic range suggesting that price incentive in itself is essential but not sufficient.

DECLARATION

I, DEVIS FABIAN, do hereby declare to the Senate of Sokoine University of Agriculture, that this dissertation is my own work done within the period of registration and that it has neither been submitted nor being concurrently submitted for degree award to any other institution.

________________________ _____________________

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The above declaration is confirmed

________________________ _____________________

Prof. A. C. Isinika Date

(Supervisor)

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ACKNOWLEDGEMENTS

In the first place, I would like to thank God the Almighty who gave me life and grace to venture into this undertaking. To Him, all praise is due. This work has been accomplished under the inspiring supervision of Prof. A.C. Isinika. She has been a constant source of inspiration from the time of topic selection and proposal development, all the way to the production of this dissertation. I would like to acknowledge her valuable comments and useful recommendations without which this study wouldn't have reached this far.

I would also like to thank my sponsor, the government of Tanzania through the Commission for Science and Technology (COSTECH) for giving me the opportunity to climb another rung of the academic ladder. The provision of funds by the commission is highly appreciated. My acknowledgement also extends to Dr. Elly Kafiriti, Zonal Director for research and development (Southern zone), Dr. G.Mkamilo, Bernadetha Kimata and other staff of Naliendele Agricultural Research Institute who have, in various ways, contributed to the success of this undertaking. Deep appreciation also goes to extension personnel of Nachingwea and Mtwara rural District councils who, all heartedly, agreed to work with me during data collection. Without their willingness, the data for this work could not have been accessed.

My beloved wife Sarah together with our children Dorcas and Hans have also remained a source of motivation for my academic achievements. They, most of the time, had to do without my presence but remained supportive to me. To them I say “thank you”.

DEDICATION

This work is dedicated to my guardians, Mr. Gwalisu Gwaselya and Mrs. Esther Gwaselya who sowed the seed of education in me and made sure it grew to fruition.

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LIST OF ABBREVIATIONS AN ACRONYMS

ADF	Augmented Dickey-Fuller
ASDP	Agricultural Sector Development Programme
CAADP	Comprehensive Africa Agriculture Development Programme
CATA	Cashew nut Authority of Tanzania
CBT	Cashew nut Board of Tanzania
COSTECH	Commission for Science and Technology
DADPs	District Agricultural Development Programmes
DALDO	District Agricultural and Livestock Officer
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IMF	International Monetary Fund
LGAs	Local Government Authorities
MKUKUTA	*Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania*
NARI	Naliendele Agricultural Research Institute
PAFC	Partial Autocorrelation Function
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
TCMB	Tanzania Cashew nut Marketing Board
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The contribution of agriculture sector to the economy in Tanzania remains relatively high, accounting for about 23.7% of the Gross Domestic Product (GDP) (URT, 2012), and employing majority of the rural population which is generally characterized by smallholders (URT, 2009). Hence, its performance in terms of productivity and total output has a significant effect on food security, income and livelihoods. According to URT (2009), the sector accounts for about 50 % of rural household incomes. Despite growth in other sectors such as mining and tourism, their contribution to poverty reduction remains low because they have weak backward and forward linkages to rural sources of livelihoods (*Ibid*). Hence, any plan to reduce poverty and improve the economy will necessarily have to include strategies to improve agriculture.

Due to the importance of agriculture to the economy, in 2005 the government of Tanzania adapted the Agricultural Sector Development Programme (ASDP), which has two main objectives; (i) To enable farmers to have better access to, and foster improvement of agricultural knowledge, technologies, marketing systems and infrastructure – all contributing to higher productivity, profitability and farm income, and (ii) to promote private investments in agriculture based on an improved regulatory and policy environment (URT, 2005).

Effective implementation of the ASDP requires that farmers and extension staff who support them develop farm projects and enterprises that improve productivity such that farmers get positive returns from their investment, and they use such returns to improve their families' livelihoods. For example, at the district level, District Agricultural Development Programmes (DADPs) should be formulated based on technical and economic information regarding the profitability of different enterprises that are recommended to farmers for adoption. Statistics on acreage responsiveness to prevailing policy and other structural changes serve as useful guides when formulating agricultural policies, programmes and projects. If, for instance, production of a particular crop is responsive to price incentives, then policies which lead to increased commodity prices are expected to motivate farmers to allocate more resources for agricultural production. If the markets operate efficiently and farmers are assured of favourable prices, then they willingly adopt improved agronomic practices. Production of food and cash crops will increase and thus meet not only food requirements of the country, but it could also improve foreign exchange earnings through exports. Therefore, any agricultural price policy should aim at achieving fair income levels for farmers and increasing exports.

However, Mumbengegwi (1990) and Muchapondwa (2008) argued that the use of agricultural policy instruments to affect agricultural activities at the farm level and performance, without empirical knowledge of the structural parameters of commodity supply response leaves the possibility that the policy instruments may be inappropriately used and thus affecting the agricultural sector negatively. Also, there is an argument that the area of land demanded by a farmer is a reflection of the expected economic incentives (Bridges and Tenkorang, 2009). For instance, since farmland is shared among different crops, changes in relative anticipated economic incentives leads to changes in the acreage demanded for each crop.

Since land is the primary resource that is used for agricultural production, there was a need to know how farmers respond to policy changes in terms of acreage adjustment when faced with different conditions as dictated by policy, programme and project changes, that are prescribed by different levels of government (viz local, district, national and international levels). This study intended to provide information regarding farmers' acreage response as they face changing commodity prices of cashew and sesame in Southeastern Tanzania. Farmers' response to economic incentives determines agriculture's contribution to the economy especially where the sector is the largest employer (Rahji *et al.,* 2008). Such information is important for policy makers so that they make informed decisions in relation to crop production, marketing and related inputs during policy processes.

1.2 Problem Statement and Justification

As stated earlier, one of the objectives of ASDP was to contribute to agricultural productivity. Traditionally, the national economy has been heavily reliant on agricultural growth and export earnings. In order for the national economy to grow, agricultural activities should be stimulated to increase farmers' purchasing power thereby increasing domestic market for non-agricultural products to rural communities and rising foreign exchange earnings through agricultural exports. The contribution of the agricultural sector in these areas will depend on the responsiveness of agricultural production to various incentives including producer prices.

For that reason, any pricing policy that is formulated in favour of the agricultural sector would require empirical knowledge on the supply response of the agricultural production. However, only a few studies have been conducted to assess the responsiveness of crop production to various factors, and these have been conducted at national level. For instance, McKay *et al*. (2006) addressed aggregate export and food crop supply response to liberalization of agricultural prices and marketing in Tanzania. Another study by Eriksson (1993) addressed peasant response to price incentives in Tanzania. These studies concluded that where liberalization of agricultural markets increases the effective prices paid to farmers can be useful in promoting farm level improvements in production.

There is no study that has focused on acreage response for crops to commodity price and non-price factor changes in Southeast Tanzania. This means, decisions on resource allocation in Lindi and Mtwara Regions have been based purely on experience of the planning officers, some of whom are fairly new to their work environment. Meanwhile, Tanzania has many graduates at the district level who can be used to improve the formulation and planning of DADPs using research based information which provides guidance on what response to expect from farmers, given certain policy or structural changes.

Cashew nut and sesame constitute two major cash crops which play an important role as income sources for majority of farmers in the zone. According to the national sample census of agriculture conducted in 2007/08, Mtwara Region was the leading cashew producer, contributing to 35% of total planted area followed by Lindi (23%) (URT, 2012). Likewise, sesame is known to be the main export oriented oilseed crop in Lindi and Mtwara Regions, accounting for 35% of the total sesame export in Tanzania (Schul and Mburi, 2010). Enhanced cashew and sesame producers' income would, therefore, be expected to encourage investment and adoption of improved techniques for the two crops. This study analyzed whether land (area) allocation decisions of cashew nut and sesame producers in southeast Tanzania have any bearing to changes in prices and non-price factors particularly in the long run. Variations in the annual production of these crops are attributed to the area cultivated and the yield per area of the crops. Production, yield and total area allocated to the crops are therefore of research importance.

As aforementioned, commodity prices play a crucial role in attaining efficient allocation of resources used in production, including land. The question is; how have commodity prices affected cashew and sesame acreage allocation over the years? In addition to price incentives, other non price factors like rainfall and technology are equally important in influencing agricultural production.

The study used the Nerlovian adjustment model to cashew and sesame acreage in two districts of Southeast Tanzania (Nachingwea and Mtwara rural). Extension personnel and other development agents may use findings from this study to improve advisory services to farmers in terms of crop choice and crop mix, hence guide resource allocation. The findings are also expected to provide inputs into the planning of DADPS and in due course feed into improving planning for the ASDP when it is revised.

1.3 Objectives of the Study

1.3.1 General objective

The overall objective of the study was to assess farmers' acreage responsiveness to price changes and to non-price factors for sesame and cashew in Southeastern Tanzania.

1.3.2 Specific objectives:

i. To estimate growth in area, yield and production of sesame and cashew in Nachingwea and Mtwara rural over the period of 1995 to 2010.

ii. To evaluate the impact of price on acreage of sesame and cashew in Nachingwea and Mtwara rural Districts.

iii. To estimate the short and long-run elasticities of sesame and cashew in Nachingwea and Mtwara rural Districts.

1.4 Hypotheses

In relation to the objectives as given above, the study worked on the following hypotheses:

i. The null hypothesis in relation to specific objective number one was;

   There was no growth in area, yield and production of sesame and cashew in the study area during 1995-2010 period.

   Mathematically; given the general exponential functional form $Y = ae^{bt}$, then

   Ho: $b = 0$………………………………………………...………………..……... (1)

   Where: b = The coefficient for the growth rate

ii. The second null hypothesis which corresponds to specific objective number two states that change in commodity prices did not influence farmers to adjust the area under sesame and cashew. Mathematically;

   Ho:

   $\gamma d_{is} = \gamma d_{ic} = 0$ ....(2)

   Where: γd_{is} = Adjustment coefficient for sesame in i^{th} district, γd_{ic} = Adjustment coefficient for cashew nut in i^{th} district.

iii. The third null hypothesis specifies that the production of sesame and cashew in the study area was not price elastic, both in the short and long-run. Mathematically;

   Ho: $\varepsilon_{sj} = \varepsilon_{lj} = 0$………………………….……………...…………………………(3)

   Where: ε_{sj} = Short run price elasticity of crop *j*, ε_{lj} = Long run price elasticity for crop *j*.

These hypotheses were addressed using techniques discussed in chapter three. The results of the analyses were then summarized in tables, figures and in narrative form. In the next chapter a review of literature on different aspects of the study is presented.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter presents a review of the literature on the agricultural sector in Tanzania, examining policies governing the agricultural sector, and the production status of sesame and cashew nut sub-sectors in the country. A number of empirical studies on acreage response have been conducted both in developed and developing countries. The chapter also reviews some of these studies with a view to provide an understanding of models that are used in the analysis of acreage response.

2.1 Agriculture Sector in Tanzania

The agricultural sector in developing countries plays a great role in terms of employment of the labour force and providing means of livelihood to a large proportion of the population (Nosheen and Iqbal, 2008; Nosheen *et al.,* 2011; and Gurikar, 2007). In Tanzania, agriculture remains one of the sectors whose contribution to the national economy is relatively large (23.7% of the GDP), and thus, its productivity has a considerable impact on income levels of the farming communities. While the agricultural sector remains central to Tanzania's economy, its contribution to GDP has dropped from about 30% in 1998 to approximately 23.7% in 2008 (URT, 2009; URT, 2012). This could be the result of the demand of non-agricultural goods, as well as the post-farm gate economic activities such as value adding and petty businesses which are not taken into account of the agricultural GDP share (Tey *et al.,* 2010). The decline of agricultural GDP implies that other sectors of the economy are growing. This is supported by Morrissey and Leyaro (2007) who argue that balanced growth is achieved if agriculture is increasingly commercialized while the manufacturing sector grows. In this sense, the manufacturing sector and the economy will become diversified. However, Tanzania has not achieved this, hence, the economy continues to be agricultural-based.

Despite Tanzania's agricultural potential in terms of availability of arable land and water sources for irrigation, agricultural growth has not been encouraging and its contribution to poverty reduction and industrial development has been low (Kidunda, 2010). For instance, in the period 2000-2008 the sector's growth rate averaged 4.4% against MKUKUTA's target of sustained agricultural growth of 10% by 2010 which was not met (URT, 2009). Several constraints are responsible for such poor performance. These include: low net return due to high production costs, weak supporting institutions and poor infrastructure to mention a few. If the growth of the sector is to increase, and poverty and food insecurity are to be reduced especially in rural areas, then there should be deliberate efforts to increase agricultural productivity, coupled with efficient market mechanism.

Realizing its importance, Tanzania has elected to foster agricultural growth through programmes like ASDP and *Kilimo Kwanza,* which strive to revive agriculture by attracting more investment to the sector as well as providing incentives to both small holder farmers and large investors.

2.2 Agricultural Policy in Tanzania

In Tanzania agriculture is guided by the agricultural policy of 1997 which is in the process of being revised. The general objective of the policy is to improve the well being of the agrarian community whose livelihood is largely dependent on agriculture (URT, 1997). Since the majority of these people are smallholder farmers, their mode of production is not purely commercial though they also sell a small surplus. In light of this, the agricultural policy of 1997 focused on commercializing agriculture to make it a profitable occupation, thereby increasing the income levels of smallholders. The policy addresses nine general objectives some of which are; (i) to improve the standard of living in rural areas through increased income generation from agricultural production, processing and marketing, and (ii) to increase foreign exchange earnings for the nation by encouraging the production and export of cash crops, food crops, as well as by-products and residues (URT, 1997).

General economic reforms took place between 1986 and 1995 where the macroeconomic environment of Tanzania changed from a state controlled economy to a free market economy, which entailed changes of the guiding policies. While the macro-economic policy had a large positive effect on domestic commodity prices, the producer's share of the export price declined over this period for some key export crops, indicating that the agricultural sector policy did little to improve export price incentives during the late 1980s and early 1990s (URT, 2005). From the mid 1990s, significant changes took place for marketing institutions of major export crops (cashews, coffee, cotton, tea and tobacco). The changes included allowing private companies to enter into crop marketing. Primary societies now had a choice to sell to private traders or to cooperative unions.

These changes resulted into producers receiving a higher share of the export price, which increased from an average of 54% during 1988-94 to 63% during 1994-99, varying by crop (URT, 2005). However, during the late 1990s, these benefits to farmers were reduced following significant appreciation of the exchange rate (IMF, 2005) as presented in Fig. 1.

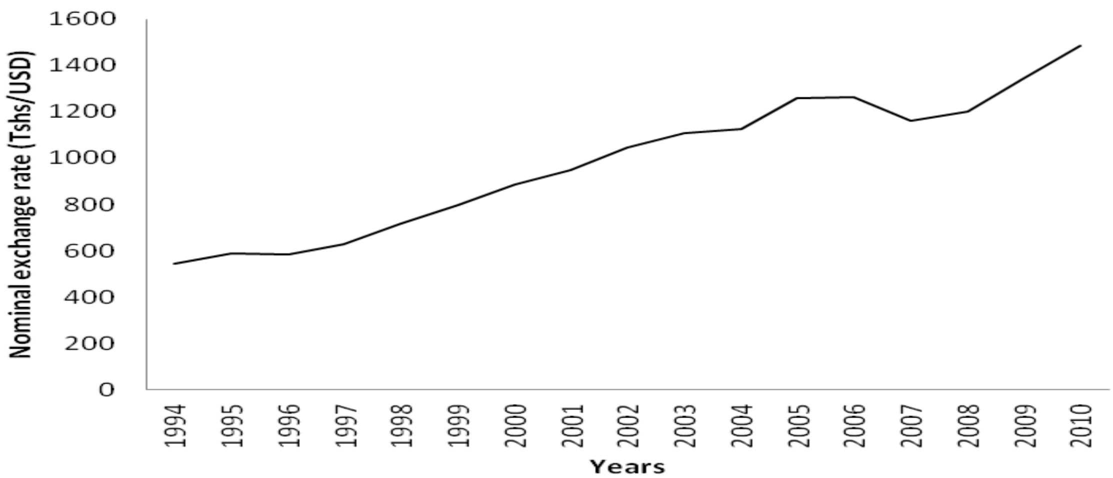

Figure 1: Trend of exchange rates of the Tanzanian shillings against the USD

Source: Economic bulletins of Bank of Tanzania

Sesame and cashew nut have been contributing to foreign exchange earnings for the country as well as to the livelihood of individual producers. Unshelled cashew nuts ranked fourth while sesame occupied the ninth position in list of major export crops of Tanzania in 2008 (Table 1).

Table 1: Major export crops of Tanzania in 2008

Rank	Commodity	Quantity (Tonnes)	Value (1000 $)	Unit value ($/tonne)
1	Tobacco, unmanufactured	45910	177752	3872
2	Coffee, green	45356	100001	2205
3	Cotton lint	54116	80893	1495
4	Cashew nuts, with shell	52743	42871	813
5	Tea	28103	42545	1514
6	Wheat flour	58493	36672	627
7	Dry peas	72290	36024	498
8	Cotton carded, combed	33792	34866	1032
9	Sesame seed	31776	31268	984
10	Palm oil	19612	27875	1421
11	Cashew nut shelled	7725	26503	3431
12	Cocoa beans	9721	25555	2629

Source: FAOSTAT, 2011

The two crops are particularly important as cash crops for farmers in southeastern Tanzania (Lindi and Mtwara Regions). In light of this, there is a need to regularly review the policy instruments which affect agriculture in general and sesame and cashew in particular, so as to improve the performance of the sector and enhance the livelihoods of farmers in the major growing areas.

2.3 Sesame Production

Tanzania is one of the world's major sesame producers (FAO, 2005), ranking twelfth in the world and sixth in Africa after Sudan, Uganda, Nigeria, Ethiopia, and Central African Republic (Table 2). In Tanzania, Sesame *(Sesamum indicum)* is one of the common oilseed crops. It is the second most important cash crop in South Eastern

Table 2: World's major sesame producers

S/N	Country	Area Harvested (in "000" acres)	Production (in "000" tonnes)	Productivity (Tonnes/acre)
1	China	1633	800	0.49
2	India	4571	750	0.16
3	Myanmar	3385	606	0.18
4	Sudan	4201	331	0.08
5	Uganda	521	121	0.23
6	Nigeria	408	83	0.20
7	Pakistan	334	75	0.22
8	Ethiopia	230	72	0.31
9	Bangladesh	198	55	0.28
10	Central African Republic	104	47	0.45
11	Thailand	158	46	0.29
12	Tanzania	259	45	0.17
13	Egypt	74	41	0.55
14	Guatemala	138	39	0.28
15	Chad	235	39	0.17
16	Paraguay	168	37	0.22

Source: FAO, 2005

Tanzania after cashew (Mkamilo, 2004). Despite the release of several improved sesame varieties by Naliendele Agricultural Research Institute (NARI), sesame production in the zone is much lower than the potential (NARI, 2008). In order to realize this untapped potential, sesame production could be enhanced through use of improved technology as well as increased area under cultivation. The discussion on cashew sub sector is presented in section 2.4.

2.4 Cashew nut Sub-sector in Tanzania

Cashew nut is grown in several regions of Tanzania including Mtwara, Lindi, Ruvuma, Coast, Dar es Salaam, and Tanga. Cashew nut is an important export crop for Tanzania (World Bank, 2004) and the biggest contributor to the economies of Mtwara, Lindi and the Coast Regions (Fynn, 2004), constituting a vital source of cash earning and a major means for improving livelihood of people in the respective areas.

Despite its importance, the cashew nut sector nearly collapsed in the 1980s following replacement of primary societies, which acted on farmers' behalf, by village agents acting for the Cashew nut Authority of Tanzania (CATA). This weakened farmers' influence and brought the marketing of cashew under the control of the government (Baregu and Hoogeveen, 2009). The start of villagization in the mid 1970s also contributed to the decline in cashew production as farmers abandoned their cashew fields. However, the crop has since then made a remarkable recovery (Fig. 2) following economic reforms which begun in 1986 and sector reforms which took off in the mid-1990s (World Bank, 2004). Economic reforms included trade liberalization and exchange rate adjustment, while sector reforms included eliminating the monopoly of the Tanzania Cashew nut Marketing Board (TCMB).

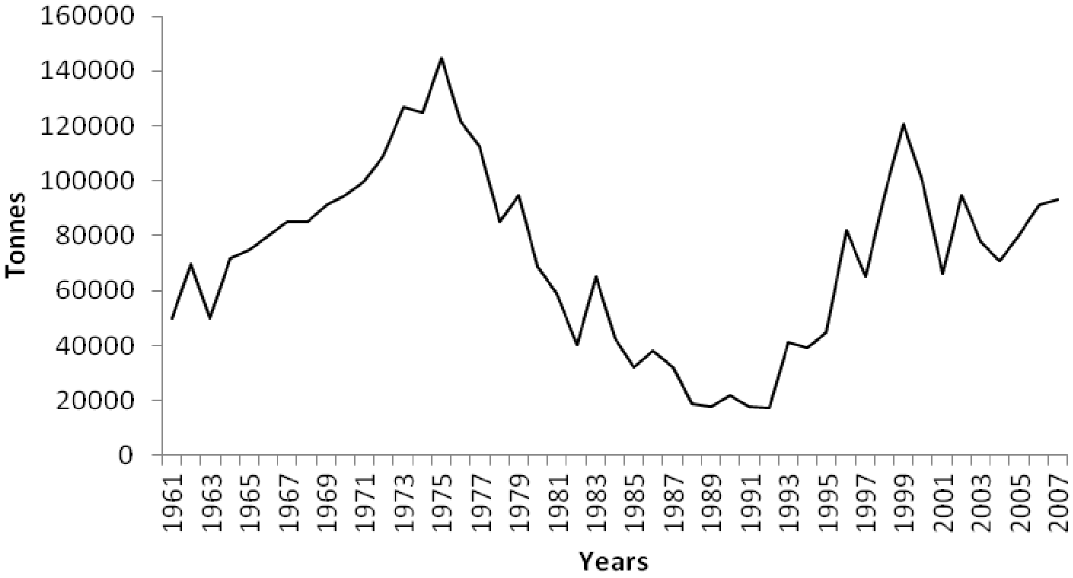

Figure 2: **Production of cashew nut in Tanzania: 1961 -2007**

Source: FAO stat (cited 18/07/2012).

The regulatory functions of the TCMB were taken over by the Cashew nut Board of Tanzania (CBT) (Mkude, 2003). Exchange rate adjustment resulted into tripling the real producer prices for raw cashew nut from the mid-1980s to the mid-1990s (World Bank, 2004). These reforms were designed to improve producer prices. It was necessary however to empirically assess how farmers responded to price through area allocation and subsequent productivity and production growth. The next section presents the discussion on growth rates and the concept of acreage response in agriculture.

2.5 Growth Rate Analysis and Acreage Response

2.5.1 Compound growth rates in agriculture

The concept of "computation of compound growth rates" has been used quite widely, particularly in the discipline of agricultural economics (Gurikar, 2007; Ramachandra, 2006; and Guledgudda, 2005). The current general procedure being followed for computation of growth rate is presented in this section as adapted from Prajneshu and Chandran (2005).

If Y_t denotes an observation (eg. Agricultural production, yield, or area) at time t and r is the compound growth rate, estimating the growth rate is based on the model presented below:

$Y_t = Y_0 (1 + r)^t e^{\varepsilon}$ ……………………………………………………………………….(4)

The model is usually linearlized by logarithmic transformation, resulting into

equation (8).

$\mathrm{Ln}\ (Y_t) = \mathrm{Ln}\ (Y_0) + \mathrm{Ln}\ (1 + r)t + \varepsilon$……………………………………………………………..(5)

The data are then used to fit equation (8) using ordinary least square (OLS). The model's goodness of fit is assessed by the coefficient of determination (R^2), as well as the sign and levels of significance of respective coefficients. The compound growth rate is given by the antilog of log (B-1)100 where B = Ln (1 + r).

Many studies have estimated the trends for area, yield and production of different crops using different forms of growth models. The exponential model is the most commonly used. Ramachandra (2006) evaluated the trend in area, production and productivity of sapota fruit in Karnaka state, India using a growth model of the form;

$Y_t = ab^t \varepsilon_t$……………………………………………………………………………….(6)

Where;

Y_t = area or production or productivity in the year ‘t’

a = intercept indicating Y in the base period (t = 0)

b = Regression coefficient

t = Time period in years

ε_t = Disturbance term for the year‘t’.

The linearlized form of equation 6 was used for empirical estimation (Equation 7).

$$\ln Y_t = \ln a + t\ln b + \ln\varepsilon_t \quad \text{...}(7)$$

Where Y_t, a, b, t and U_t are as previously defined.

The findings by Ramachandra showed a positive growth rate of 4.54% per annum while production and productivity showed negative growth rates of -1.98% and -6.24% per year, respectively. Gurikar (2007) similarly used a growth model in the linearlized form of equation (8) as presented by equation (9) to study rates of change in the area, production and productivity of onions in major growing states of India.

$$Y = ab^t e^{\varepsilon} \quad \text{..}(8)$$

Where;

Y= dependent variable (Area or production or productivity)

a = intercept term

b = (1+r) and r is the compound growth rate.

t = time trend (t = 1,2,3,……..n)

e = Natural log

ε = error term.

$\log Y = \log a + t \log b + \varepsilon$ ……………………………………………………….………....(9)

Where; all variables are as previously defined.

Results showed that Karnataka state registered a significant positive growth rate in the production of onion, resulting from increased area in the major onion growing districts. Likewise, Khan *et al*. (2002) used an exponential growth model in equation (10) in their analysis of growth and trend of production and yield of two varieties of rice in Bangladesh.

$Y = ae^{bt}$……………………………………………………………………………..(10)

Where;

Y = dependent variable (production or yield)

t = independent variable (time)

a = intercept

b = growth rate.

The final fitted model took the logarithm form of:

$\ln Y = \ln a + bt$………………………………………….…………………………..(11)

with "b" representing the growth rate in decimals which was multiplied by 100 to express the annual percentage compound growth rate. The findings by Khan *et al.* (2002) indicated that the two rice varieties registered positive growth rates both in production and yield. Studying the acreage response to price and non-price factors is equally important, and it is discussed in the next section.

2.5.2 Acreage response and estimation techniques

Acreage response to commodity price is among the core issues of agricultural economics (McDonald and Sumner, 2002). Assessing acreage response is important in analyzing farm programs. Many studies have been done to assess the relationship between crop production (acreage, productivity and production) and crop prices. According to Houston *et al.* (1999), acreage has been measured in different forms including; the planted acreage, harvested acreage, volume or weight produced of an individual crop, and revenue per planted unit. The planted acreage of any crop may increase or decrease in response to changes in the price per unit the crop is expected to bring (Barnes, 2010). This relationship is the primary principle behind acreage or supply response.

Many studies have been conducted on supply and/or acreage response to commodity price and other non-price factors. The literature shows that Nerlovian adjustment also known as the expectation model is the most widely used estimation technique by researchers. For example, Tey *et al*. (2010) used a logarithmic functional form of the linear Nerlovian expectation model to study the acreage response of paddy in Malaysia. The area planted with paddy was used as the dependent variable while lagged price, lagged area, lagged yield and government support were independent variables in the model. The negative short run elasticities of area under paddy with respect to paddy price was -0.30 and that for yield was -0.24 indicating that there was an inverse relationship between area under paddy and paddy price. Similarly, the long run price elasticity of -0.6355 indicated a negative relationship between the planted area for paddy and price. The study also found that the expectation coefficient of paddy price was one, meaning that the expected price for the current year was same as the actual price in the previous year. Likewise, the area adjustment coefficient was 0.4777 which meant, farmers adjusted moderately toward the desired area planted with paddy.

Another study by Nosheen and Iqbal (2008) in Pakistan also applied a Nerlovian model to estimate the response of cotton, wheat and sugarcane area to changes in their respective prices and other relevant factors. The coefficients of the area response were estimated using Ordinary Least Squares (OLS). The short run price elasticity of area for cotton was estimated to be 0.263 while the long run price elasticity was 1.09. These results suggest that the price of cotton played an important role in farmers' decisions to expand or contract the area for cotton during the reference period. The adjustment coefficient was found to be 0.241 indicating farmers' slow pace of adjustment in response to price movement in the long run.

Meanwhile, the short run price elasticities of wheat and sugarcane area were 0.045 and 0.229, respectively while the long run elasticities were calculated at 0.105 and 0.653, respectively implying that sugarcane was relatively more elastic than wheat. One of the reasons for relatively low elasticity coefficients for wheat may be the very large area already devoted to wheat cultivation in Pakistan and its dominance in the cropping pattern and thus not leaving much scope for further extension of wheat area (Nosheen and Iqbal, 2008).

These results point out the influence of producer prices on the area planted to wheat and sugarcane. The findings also revealed that the area adjustment coefficients for wheat and sugarcane were 0.44 and 0.35, respectively, meaning that farmers could adjust more easily to wheat area than they could for sugarcane. The possible explanation for this relatively slow adjustment in sugarcane crop may be its longer duration to maturity and ratooning practices. These findings could have similar implication for sesame and cashew under study. One would expect that the area adjustment to commodity price changes would be faster for sesame relative to cashew, thus a higher adjustment coefficient.

Other studies have added innovation in the analytical models. Duffy *et al*. (1994) for example used an expected utility model that included output price and yield uncertainty to estimate cotton, maize and soybean acreage response for South-Eastern USA. Time series data were used and the model fitted the soybean and maize data well. Own-price elasticity estimates were 0.317 and 0.727 for maize and soybeans, respectively, which were higher than the national average, implying the availability of production substitutes in the southeastern part of USA. This implies producers were responsive to changes in profitability, following product price changes.

Mythili (2008), while studying acreage and yield response for major crops in the pre- and post-reform periods in India, included the lagged relative price index and rainfall as quantitative variables in the final functional form which was based on the Nerlovian model. A crop dummy variable was added to capture the effect of the main and substitute crops, and a period dummy to reflect the period before and after the reforms. McKay *et al*. (2006) studied aggregate export and food crop supply response in Tanzania using Nerlove's model by incorporating price expectations and adjustment costs. Their estimates suggested that agricultural supply response was quite high indicating that the potential for agricultural sector response to liberalization of agricultural prices and marketing was quite significant. Generally speaking, variants of the Nerlovian model have been used in different forms by researchers to address supply or acreage response of various crops given changes in both price and non-price factors (Rahji *et al*., 2008;

Niamatullah and Zaman, 2009; Molua, 2010; and Nosheen *et al*., 2011). These and other researchers have used different variables in their models and they are discussed in the next section.

2.5.3 Variables used in acreage response studies

2.5.3.1 Dependent variables

Farmers tend to plan certain levels of output to be produced in response to price and non-price factors. The planned output represents farmer's response to price expectations. It is, however, difficult to find time series data on planned output, hence the need to use an appropriate proxy. There is an ongoing debate among researchers about which dependent variable to use. One group of researchers including Mythili (2008) contends that the area under a crop could be an appropriate proxy for planned output on the basis that data on area under different crops can be readily obtained from various sources.

Other researchers claim that production response (total output) is the most appropriate variable to measure farmers' response to price and other policy induced changes rather than the area of a particular crop. They stress that in modern agriculture with land saving technologies, land is regarded as a secondary factor in production (Gurikar, 2007). Significantly higher values of production can be obtained from a small area if intensive technologies such as green houses and liquid or foliar fertilizers are used. Yet, there is another group of researchers who suggested using both area and yield in addressing farmers' response to price and non-price factors (*Ibid).*

In the present study, area under the crop was used as a dependent variable to assess the farmers' response to price and non-price factors since land is the primary factor in production of cashew nut and sesame in the study area. Land saving technologies which include green house and foliar fertilizers are not being used for the production of sesame and cashew in the study area. In addition, crop area has been preferred over production as farm production is also influenced by weather conditions, which are often beyond the control of farmers. Yield was not used because it is also subject to more random variation than acreage due to factors outside the farmers' control such as the weather (Nosheen and Iqbal, 2008). Based on the literature and discussion with farmers the main factors (independent variables) which impact farmer's allocation of crop area are presented in the next section.

2.5.3.2 Independent variables

Independent variables which are commonly used in acreage response studies include price and non-price factors. Of these explanatory variables, commodity prices have frequently been used for reasons discussed below. According to Minde (1991); and Rweyemamu and Kimaro (2006), producer prices are among the most important and effective tool for influencing agricultural output. These prices are crucial in determining profit or loss in the farm enterprise. When producer prices are calculated in relation to the costs incurred by farmers in the production process, they lead to profit and provide incentive to producers to grow more (Gurikar, 2007). This has led to increased attention on the effect of short-run changes in prices on production behaviour. Gurikar further asserts that in order to bring about sustained and balanced economic growth, it is very important to understand the long-run effect of prices on production.

Different forms of price factors have been used to study farmers' supply responses. For instance, Nosheen *et al.* (2011) used prices of a commodity received in the recent past to study farmers' response to price and other factors for rice production in Pakistan. The results showed positive price elasticity of acreage. In Cameroon, Molua (2010) used relative prices in his study on price and non-price determinants of acreage response on rice. He concluded that the area under rice would increase by 1.35% for a ten percent increase in world price relative to rice producer price. Meanwhile, Niamatula and Zaman (2009) used lagged market price to estimate the Nerlovian adjustment model in studying the acreage response of wheat and cotton to respective price changes. Their results revealed that short and long run price elasticities of wheat production were 0.0139 and 0.0274, respectively. Lagged prices of a commodity are often used in the model because prices received by the farmers in the recent past shapes economic incentive for the commodity. This is supported by Nosheen and Iqbal (2008) and Nosheen *et al*. (2011) who argue that farmers' resources allocation decisions are mainly based on the crop prices they received in the recent past.

However, price differences explain only part of the variation in the response variable. Acreage response has also been considered a consequence of changes in several non-price factors, which influence production. For this reason a favourable price policy alone may not influence farmers to increase agricultural output through increased acreage. For instance, it is known that yield is an important determinant for the profitability of crops in a given year. Yet the yield of any crop at its planting time is not known. Farmers therefore base their expectation of profitability of a given crop on the yield realized in the recent past. Hence lagged yield enters the model as an independent variable. Lagged area is also used as an independent variable to capture the effects of farmers' know-how and experience with the given crop (Molua, 2010; Nosheen and Iqbal, 2008; and Nosheen *et al*., 2011).

Other non-price factors are known to influence agricultural production. According to Gurikar (2007), changes of climatic factors as well as incidence of pests and diseases adversely affect agricultural production in the short-run while technological advancements cause long-run supply changes. Rainfall has been used as an independent variable quite frequently in empirical studies to represent non-price factors (Gurikar, 2007; Mythil, 2008; Niamatula and Zaman, 2009; Molua, 2010). Meanwhile, technology has been represented by trend variable (Gurikar, 2007) to reflect its tendency to change over time. Different analytical innovations have been developed to accommodate the other non-price factors. Based on the experience of other researchers as discussed in this chapter the methodology and analytical model for this study is presented in chapter three.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

This conceptual framework focuses on the analysis of cashew nut and sesame supply response relations. Basically, supply response concerns output response to a change in price of the product (Akanni and Okeowo, 2011). This may be due to the application of more or less productive resources resulting from a price increase or decrease. The response may also be represented by a change in farm size. Variables like credit, price, weather, and market information which influence agricultural production are expected to bring about supply response.

Under peasant economy, farmers tend to practice intercropping or cultivate a number of plots in different locations to diversify income and reduce risks of crop failure (Mkamilo, 2004). The underlying objective for pursuing these objectives is utility maximization. It is known that farmers respond to price incentives partly through intensive application of variable inputs to a given piece of land (Bridges and Tenkorang, 2009). It is also well established that agricultural policies and institutional factors influencing commodity prices and input prices have an impact on farmers' decisions on resource allocation. This also includes assigning acres of land to different crops. Since the product price is the most important variable in the response function, policy makers should take into account farmers' response to price during policy making.

3.2 Research Design

In Tanzania, most of the agricultural policies are formulated at the national level, and implemented through various programmes such as the ASDP, *Kilimo Kwanza*, which conform to regional and global programmes such as the Comprehensive Africa Agriculture Development Programme (CAADP). Within each of these programmes, there is room for LGAs to adapt the macro policies and strategies to suit their specific requirements. Adaptations can be made by LGAs to provide room for developing policies and strategies within the framework of the District Development Programme and DADPS. These adaptations include; (i) efforts to improve farmers' access to and use of agricultural knowledge, technologies, marketing systems and infrastructure; (ii) promoting stronger links between smallholders and agribusiness; and (iii) raising the amount and quality of cash and food crops produced to improve the livelihood of the farming communities. This study used district level time series data for acreage, production and prices of cashew nut and sesame to assess the farmers' response to changes in policies governing commodity prices as well as other non-price factors.

3.3 Choice of Crop and the Study Area

Nachingwea and Mtwara rural Districts are found in the southeast of Tanzania. Nachingwea District is in Lindi Region while Mtwara rural is in Mtwara Region. These districts were selected for this study due to their climatic and topographical characteristics which suits the production of cashew nuts and sesame. It is not surprising to find farmers in these districts cultivating both crops because the soils and climate are suitable. Cashew nut and sesame were selected because they constitute the most important cash crops and they play a substantial role in generating income for the majority of the community members in the zone (Fynn, 2004).

3.4 Description of the Study Area

3.4.1 Area and location

The Directorate of Research and Development of the Ministry of Agriculture, Food and Cooperatives has divided Tanzania in seven research zones including Southeastern zone. The zone which is in the south east of Tanzania comprises of Mtwara and Lindi Regions; and Tunduru District which is in Ruvuma Region. It covers 103 500 sq km of which 17 750 sq km is in Mtwara Region and 67 000 sq km is in Lindi Region; while Tunduru District covers the remaining 18 750 sq km. The zone borders with the Indian Ocean in the east, Morogoro and Ruvuma Regions in the west, the Coastal Region in the North and with the Ruvuma River in the south, which forms a boundary with Mozambique (Fig. 3).

Mtwara rural District covers 3597 square kilometres. The Indian Ocean borders it to the East, while the Ruvuma River separates it from Mozambique to the South. The district borders with Lindi Region to the North and Tandahimba District to the West. Meanwhile, Nachingwea District which is one of six districts of Lindi Region is bordered to the North by Liwale District, and to the east by Ruangwa District. To the Southeast, it borders with Mtwara Region, while Ruvuma Region shares the border with it to the Southwest.

3.4.2 Demography

Based on 2012 Tanzania National Census, the size of the Mtwara District population is 228 003 of which 107 922 are males and 120 081 are females (URT, 2013). The Census results also reported the total population of 178 464 people in Nachingwea District with 86 382 males and 92 082 females. Mtwara Region recorded a higher average annual intercensal population growth rate, 2002 – 2012 censuses (1.2%) compared to Lindi Region (0.9%) in which Nachingwea District belongs.

3.4.3 Climate and topography

Generally, south-eastern Tanzania is characterized by mixed farming systems whose elements change with variations in climate and environment. There are two main seasons: a humid and hot wet season (November to May) and a cooler, less humid dry season (June to October).

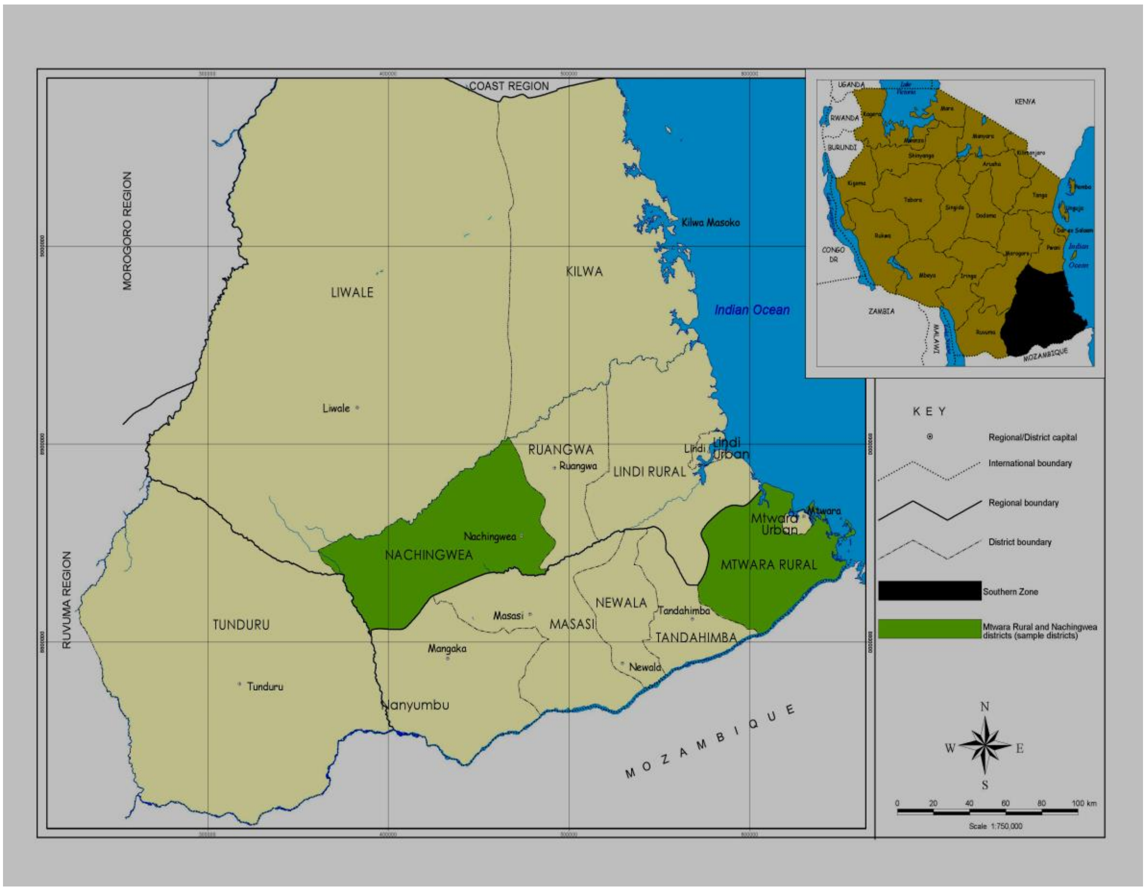

Figure 3: A map of Southeastern Tanzania showing sample districts (Nachingwea and Mtwara rural)

The mean annual rainfall ranges from 800 mm within inland and central areas to 1200 mm in the hills and plateau near the Coast. Soils are variable, ranging from deep, well drained, but not very fertile sandy soils of the sedimentary zones to deep, well drained, and somewhat more fertile red clay soils of Nachingwea and Masasi Districts

(FSR, 1992). This kind of climate and topography favour the production of cashew nut and sesame which are the main crops contributing to the economy of southeast Tanzania.

3.4.4 Economic activities

Agriculture is the main activity for majority of the population, both for food security and cash income. The most important crops are: tree crops particularly cashew, coconut, orange and banana; oilseeds especially sesame and groundnut; starchy staples notably cassava, sorghum, maize, rice and millet; vegetables such as onion, tomato and sweet potato; and leguminous crops mainly pigeon pea, cowpea, lablab bean, green gram and bambaranut. Cashew nut is the most important cash crop in the zone followed by sesame. Cassava, maize, coconuts and groundnuts also provide means of living for farmers in the zone. Some livestock are also kept, mainly cattle, goats, sheep and poultry (Kidunda, 2010).

Farming technology is mainly characterized by rudimentary hand tools, and traditional recycled seeds for various crops. Despite the development and dissemination of agricultural improved technologies by NARI in the past 20 years, the pace of technology uptake in the zone has not been fully realized. For example, the study by Kidunda *et al*. (2013) revealed that more than 91% of farmers in the study area were fully aware of improved cashew technologies but only a proportion (57%) had adopted the same. This state of affairs also translates to other commodities such as sesame.

The southeastern zone has a lot of potential for development but its economic infrastructure, road network in particular, is still underdeveloped. For instance, by 2003 Mtwara rural District had a total road network of 1134 Km, of which only 25 Km were tarmac, 220 gravel and the remaining was earth road (Baraldes, 2003). The situation was not that different in Nachingwea District in terms of the condition of road networks.

3.5 Data Type and Sources

This study employed data on acreage, production and price for Nachingwea and Mtwara rural Districts for years 1995 to 2010. It also utilizes rainfall data for 1994/95 to 2009/10 cropping seasons in the two districts. Other source of data included the Cashew nut Board of Tanzania (CBT) where data on cashew nut production and prices were obtained. Rainfall data for Mtwara rural were obtained from Naliendele weather station whereas those for Nachingwea were obtained from Mkumba weather station.

3.6 Data Analysis

3.6.1 Growth rate analysis

Objective (i), which aimed at assessing changes in area, yield and production of cashew nut and sesame over the period of 1995 to 2010, was addressed using growth rate analysis. The compound growth rates were computed using a power function which was estimated by ordinary least squares fitting the logarithmic function given below as equation (16). In this case, time (t) was taken to be an independent variable to capture changes of area or yield or production over time.

$$Y = ae^{bt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

By log linear transformation the function is expressed as,

$$\ln Y = \ln a + bt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Where; Y = dependent variable (area or production or yield);

a = intercept;

b = is the growth rate. When multiplied by 100 it expresses the percentage growth (compound annual growth rate)

t = time trend (t = 1, 2, 3…n);

The coefficient of determination (R^2) was computed to test for the goodness of fit. Objectives (ii) and (iii) called for the application of Nerlovian model as discussed in the next sub section. While growth models (Equation 15 and 16) provide information on trends of variables of interest, a Nerlovian model estimates the pace of adjustments as well as responsiveness.

3.6.2 Nerlovian model specification and estimation method

Acreage response to price and non-price factors could be analyzed by a supply function derived from a profit-maximizing framework and the Nerlovian adjustment model (Tey *et al.*, 2010). This first approach of supply function required detailed information on all the input prices which were difficult to obtain from the study area. The second approach of Nerlove (1958) as cited by Tey *et al.* (2010) is more plausible to provide both the speed and level of adjustment of the actual acreage toward the desired level via adjustment coefficient, short run and long run elasticities. According to the Nerlove-Koyck adjustment model, the desired acreage (A_t*) is a function of expected nominal price, while the actual acreage (A_t), adjusts to the desired acreage with some lag. Estimation of elasticities was expressed in the linear Nerlovian expectation model as:

$$A_t^* = \beta_0 + \beta P_t^* + \beta_1 Z_t + V_t \quad \text{.......... (14)}$$

Where:

A_t^* = desired planted area for crop i; i= 1, 2 for cashew nut or sesame, respectively.

P_t^* = expected nominal price

Z_t^* = other exogenous factors

V_t = a disturbance term

$\beta_{0,}$ β and β_1 = Coefficients.

Since, the desired planted area is unobservable; it is therefore assumed to be a function of the observed lagged area and can be expressed as:

$$A_t - A_{t-1} = \gamma(A^*_t - A_{t-1}) \qquad (15)$$

This adjustment mechanism can alternatively be written as;

$$A_t = \gamma A^*_t + (1 - \gamma) A_{t-1} \quad 0 < \gamma \leq 1 \qquad (16)$$

Where A_{t-1} is lagged area and γ is the coefficient of area adjustment which indicates the pace of adjustment between the desired and the actual planted area in the previous year. If γ approaches 0 the adjustment is slow while if it approaches 1, the speed of adjustment is high.

Substituting equation (16) into (18);

$$A_t = \gamma(\beta_0 + \beta P_t^* + \beta_1 Z_t + V_t) + (1 - \gamma) A_{t-1}$$

$$A_t = \gamma\beta_0 + \gamma\beta P_t^* + \gamma\beta_1 Z_t + \gamma V_t + (1 - \gamma) A_{t-1} \qquad (17)$$

However, the expected price is unobservable. It is assumed that the farmer uses the available price information to decide on the size of his farm to devote to any particular crop under production (Nmadu, 2010). It is also assumed to be a function of the lagged price and can be expressed as:

$$P_t^* = P_{t-1} + \delta (P_{t-1} - P_{t-1}^*) \; 0 < \delta \leq 1 \quad \ldots\ldots (18)$$

Where P_t^* is the unobservable expected price, P_{t-1} is the lagged price, and δ is the coefficient of expectation. If δ approaches 0, there is no difference between this year's expected price and last year actual price; and if $\delta = 1$, expected price is identical to last year actual price (Gujarati, 2004; and Nosheen and Iqbal, 2008).

From equation (17);

$$P_t^* = \delta P_{t-1} + (1- \delta) P_{t-1}^* \quad \ldots\ldots (19)$$

Substituting (19) into (17) gives;

$$A_t = \gamma\beta_0 + \gamma\beta[\delta P_{t-1} + (1- \delta) P_{t-1}^*] + \gamma\beta_1 Z_t + \gamma V_t + (1 - \gamma) A_{t-1}$$

$$A_t = \gamma\beta_0 + \gamma\beta\delta P_{t-1} + (1- \delta)\gamma\beta P_{t-1}^* + \gamma\beta_1 Z_t + \gamma V_t + (1 - \gamma) A_{t-1} \quad \ldots\ldots (20)$$

Lagging equation (20) by one time period we get;

$$A_{t-1} = \gamma\beta_0 + \gamma\beta P^*_{t-1} + \gamma\beta_1 Z_{t-1} + \gamma V_{t-1} + (1 - \gamma) A_{t-2} \quad \ldots\ldots (21)$$

Multiplying equation (21) by (1-δ);

$$(1-\delta) A_{t-1} = (1-\delta)\gamma\beta_0 + (1-\delta) \gamma\beta P^*_{t-1} + (1-\delta) \gamma\beta_1 Z_{t-1} + (1-\delta)\gamma V_{t-1} + (1-\delta)(1 - \gamma) A_{t-2} \quad \ldots\ldots (22)$$

Subtracting (22) from (20) and rearranging terms gives equation (23);

$$A_t = \beta_0\gamma\delta + \beta_1\gamma\delta P_{t-1} + [(1-\gamma) + (1-\delta)]A_{t-1} - (1-\delta)(1-\gamma)A_{t-2} + \gamma\beta_1 Z_t - [\gamma\beta_1(1-\delta) Z_{t-1}] + [\delta V_t - \delta(1-\gamma) V_{t-1}] \quad (23)$$

The reduced form linear equation with lagged dependent variables appearing as independent variables is:

$$A_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 A_{t-1} + \alpha_3 A_{t-2} + \alpha_4 Z_t + \alpha_5 Z_{t-1} + v_t \quad (24)$$

Where;

$$\alpha_0 = \beta_0\gamma\delta \quad (25)$$

$$\alpha_1 = \beta_1\gamma\delta \quad (26)$$

$$\alpha_2 = (1-\gamma) + (1-\delta) \quad (27)$$

$$\alpha_3 = -(1-\delta)(1-\gamma) \quad (28)$$

$$\alpha_4 = \gamma\beta_1 \quad (29)$$

$$\alpha_5 = -\gamma\beta_1(1-\delta) \quad (30)$$

$$v_t = \delta V_t - \delta(1-\gamma) V_{t-1} \quad (31)$$

By taking into account weather variable (rainfall), and yield in the previous year, equation (24) is therefore specified as:

$$A_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 A_{t-1} + \alpha_3 A_{t-2} + \alpha_4 Y_{t-1} + \alpha_5 W_t + v_t \quad (32)$$

Where:

Y_{t-1} = Lagged yield of crop i; i = 1, 2 for cashew nut or sesame, respectively.

W_t = Weather variable (proxied by rainfall)

Other independent variables are as described earlier.

Based on equation (32), the data for the period 1995 – 2010 for identified variables were collected from District Agricultural and Livestock Development Offices (DALDOs) as well as the Cashewnut Board of Tanzania. Rainfall data was collected from respective weather stations. Since time series data is normally associated with autocorrelation, there was a need to test for stationarity of the model. The Augmented Dickey-Fuller (ADF) test was conducted and it was established that the data had unit root problem. This was corrected using the first difference technique. The Partial Autocorrelation Function (PACF) was used to determine the length of the lag which was established to be one (1). The final estimated functional form of the equation was thus as represented in equation 33:

$$A_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 A_{t-1} + \alpha_3 Y_{t-1} + W_t + v_t \quad (33)$$

All the variables were in logarithmic form for convenience of mathematical manipulations and for direct estimation of elasticities (Nosheen an Iqbal, 2008). Given the data constraints and availability, the specifications of the Nerlovian adjustment model ignored the biological characteristics of each crop. In essence, these characteristics would be considered in determining the length of the lag, which in turn would result in estimating sesame response differently from cashew. This approach was also used by Onyango and Bhuyan (2000) in their study on supply response analysis of the fruits and vegetable sector in New Jersey during 1980-1997.

The adjustment coefficients, γ were obtained by subtracting the coefficient of the lagged planted area from one. The area adjustment coefficient indicates the pace of adjustment between the desired and actual planted area in the previous year. It is assumed that if the adjustment coefficient is close to 1, then farmers' adjustment of actual acreage to desired acreage is fast while if the adjustment coefficient is close to zero, then adjustment takes place slowly (Greene, 2002; Mythili, 2008). The adjustment coefficient can also be used to compute price expectation coefficient, δ, from equation (30), where;

$$\delta = 2 - \alpha_2 - \gamma \qquad (34)$$

The short run elasticities were given directly by the coefficient of each independent variable while the long run price elasticity was produced by dividing the short run price elasticity over the adjustment coefficient (Tey *et al.,* 2010, and Niamatullah and Zaman, 2009). The next chapter presents results of analyses and their respective discussions.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter is divided into four main sections. The first section presents results of growth rate analysis pertaining to area, production and yield of sesame and cashew nut in Nachingwea and Mtwara rural Districts. The second section discusses results of the stationarity test while the third and fourth sections present results and discussion of acreage response for sesame and cashew nut, respectively. The last section gives a summary of the main findings from the study.

4.1 Growth Rates of Area, Yield and Production

The growth rates of area, yield (productivity) and production of sesame and cashew for the period 1995 – 2010 were calculated on the basis of the growth model as presented by equation (13) in chapter three. The results of the estimated model are presented in Table 3. The analysis shows that all the districts registered positive and significant growth rates in the area of sesame. The growth rates were 2.9% and 4.1% for Nachingwea and Mtwara rural Districts, respectively. However, during the same period, Nachingwea experienced negative yield growth rate at -5.6%, while for Mtwara rural it was positive (1.6%) and significantly different from zero. This increase in yield per acre of sesame in Mtwara rural District might be attributed to the adoption of improved technology which includes the use of high yielding varieties and improved agronomic practices.

Table 3: Growth rates of area, production and yield of sesame and cashew

District	Crop	Variable	Coefficient (b)	Annual growth (%)	R^2
Nachingwea	Sesame	Area	0.029**	2.9	0.37
		Yield	-0.056***	-5.6	0.25
		Production	-0.027	-2.7	0.09
	Cashew	Area	0.064***	6.4	0.86
		Yield	0.008	0.8	0.05
		Production	0.072***	7.2	0.86
Mtwara rural	Sesame	Area	0.041**	4.1	0.38
		Yield	0.016***	1.6	0.39
		Production	0.057***	5.7	0.60
	Cashew	Area	0.066***	6.6	0.84
		Yield	0.005	0.5	0.02
		Production	0.071***	7.1	0.89

Where: *** = Significant at 1%; ** = Significant at 5%

The combined effect of a 2.9% growth in area and 5.6% decline in yield resulted in a decline in total sesame production in Nachingwea by 2.7%. This fall in production is also reflected in Fig. 4 which shows a decline in the trends for sesame production in Nachingwea District between 1995 and 2010.

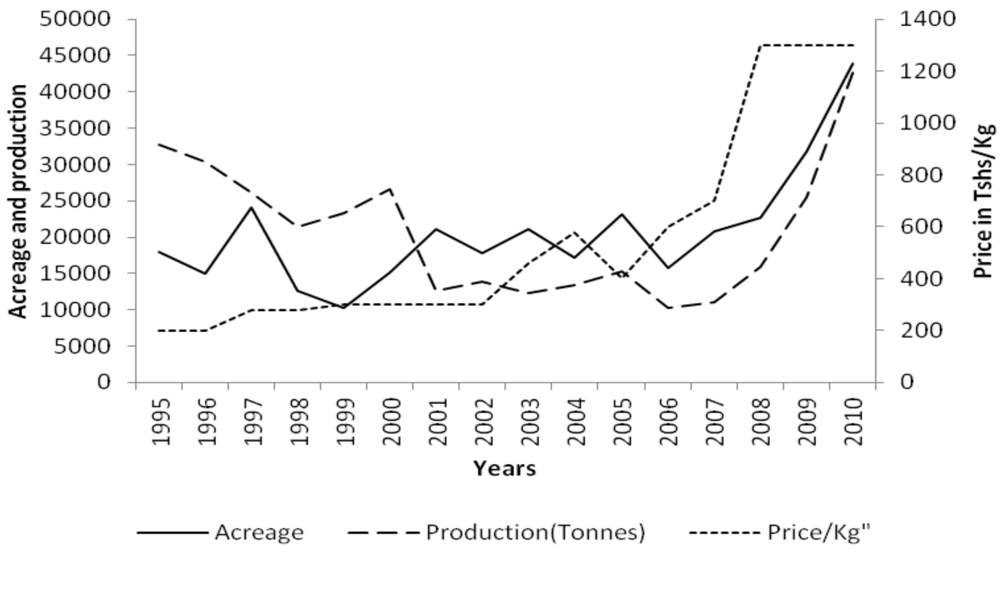

Figure 4: Sesame acreage, production and price in Nachingwea

On the other hand, Mtwara rural District registered positive and significant growth rate (5.7%) in the production of sesame. The increasing trend of production of sesame in Mtwara rural District (Fig. 5) was because both area and productivity of the crop increased during that period.

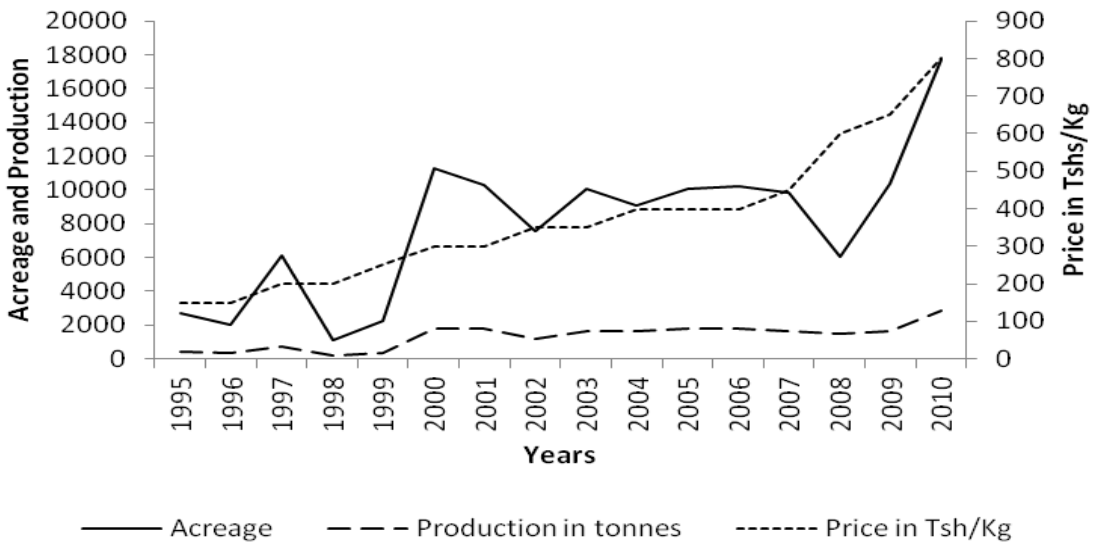

Figure 5: Sesame acreage, production and price in Mtwara rural

The growth rates of cashew nut in Nachingwea District were also high and significantly different from zero, estimated at 6.4% and 7.2% for area and production, respectively. These results conform to the trends presented in Fig. 6 which clearly shows that the two parameters were increasing.

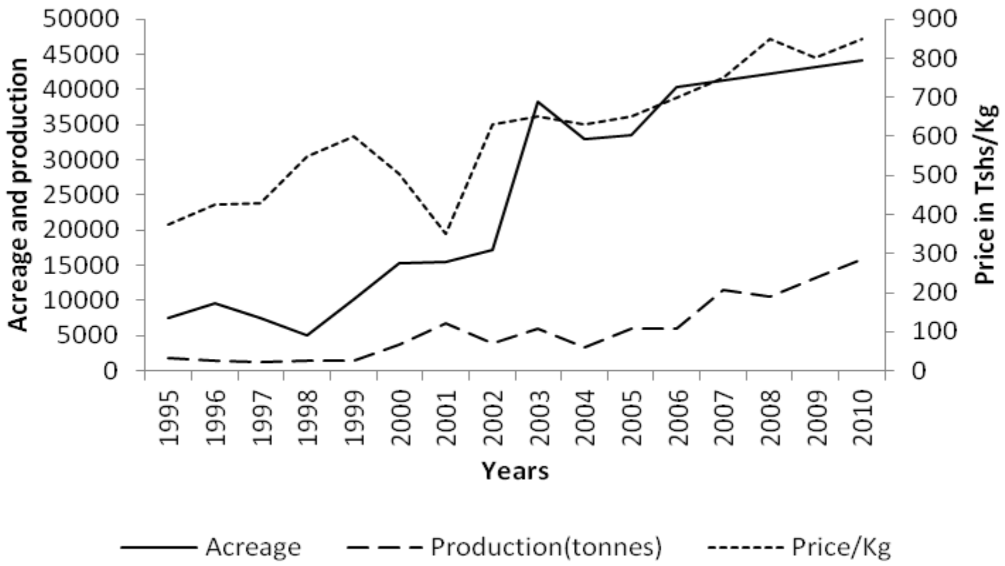

Figure 6: Cashew acreage, production and price in Nachingwea

Mtwara rural District also showed positive and significant growth rates for area and production of cashew nut at 6.6% and 7.1%, respectively as presented in Table 3, which is also supported by trends as shown in Fig. 7. However, the two districts registered positive non-significant growth rates in the yield of cashew nut being 0.8% for Nachingwea and 0.5% for Mtwara rural Districts, respectively.

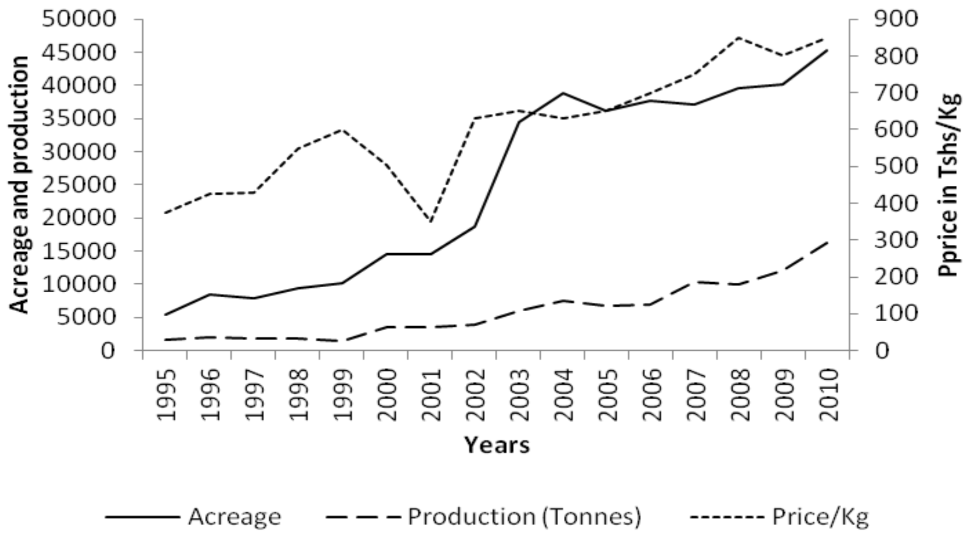

Figure 7: Cashew acreage, production and price in Mtwara rural

The positive increase in the yield of cashew nut is attributed due to improvement in technology and proper management of the fields. The increasing trend of production of cashew in Nachingwea District (Fig. 6) could be explained by both the area and productivity of the crop over the years. While growth models generally show the trends, the Nerlovian adjustment model presents the acreage response to price and non-price factors. Before estimating these models, the data were tested for stationarity as presented below.

4.2 Test for Stationarity

There is a basic statistics principle which requires that any time series data that is used in econometric application must be stationary. That is, the mean and variance should not change systematically over time (Gujarati, 2004; Wooldridge, 2005). Otherwise, the series are said to be non-stationary (have a unit root problem). Hence, before proceeding with further acreage response analysis, a unit root test of each of the time series was undertaken using the augmented Dickey-Fuller (ADF) test using econometric package STATA 11. The critical values are the Mackinnon appropriate value for rejection of the null hypothesis of a unit root based on the null hypothesis of non stationarity. From the results (Appendices A.1 and A.2), it can clearly be seen that most of the computed ADF test-statistics are greater than the critical values implying that the set of data has the unit root problem. The unit root problem was corrected at the first difference, which entails running the regression, not on the original variables, but on the differences of successive values of the variables (Gujarati, 2004). All the test statistics of the differenced variables were well below the ADF critical values at the 1% significance level (Appendices 1 and 2). This method transforms non-stationary series into stationary series (Asari *et al.*, 2011).

Meanwhile the computed Durbin-Watson statistics that lie between the lower and upper limits suggest that there is no evidence of auto-correlation problem in the data. After transforming the non stationary series into stationary series, the acreage response model was estimated and the results are discussed in the next section.

4.3 Acreage Response of Sesame

The independent variables included in the sesame acreage response (Nerlovian adjustment/expectation) model of the present study included; lagged sesame acreage, lagged sesame price, lagged sesame yield and average rainfall, all in logarithmic form. The estimated coefficients of equation (33) are presented in Table 4 for Nachingwea and Mtwara rural Districts.

Table 4: Acreage response of sesame to price and non-price factors

District	Variable	Coefficient	t-Statistic	Sig.
Nachingwea	Constant	1.452**	3.128	0.010
	$Ln(P_{t\_1})$	0.264**	3.129	0.016
	$Ln(A_{t\_1})$	0.485***	5.641	0.000
	$Ln(Y_{t\_1})$	0.072	0.910	0.382
	Ln(Wt)	0.035	0.155	0.880
Mtwara rural	Constant	-2.582	-0.385	0.708
	$Ln(P_{t\_1})$	0.478	0.652	0.528
	$Ln(A_{t\_1})$	0.710**	2.771	0.018
	$Ln(Y_{t\_1})$	0.243	0.327	0.750
	Ln(Wt)	0.032	0.114	0.911

Where:*** = Significant at 1%; ** = Significant at 5%

	Nachingwea	Mtwara rural
F - value	5.854	5.397
Adjusted R^2	0.564	0.54
Durbin Watson (DW) Statistics	1.549	1.832

Critical values for DW (d-lower =0.74; d-upper= 1.93)

In the case of Nachingwea District, only lagged price and lagged area coefficients were statistically significantly different from zero at $\alpha = 0.01$ and $\alpha = 0.1$, respectively. The coefficients of the rest of the variables in Nachingwea District were not significantly different from zero. In Mtwara rural the influence of lagged price on sesame acreage was positive but insignificant, while the coefficient of lagged area was statistically significantly different from zero at $\alpha = 0.05$ indicating that in both districts, last year's acreage affected the current year acreage.

The estimated coefficients were used to compute short term and long term elasticities as well as adjustment coefficients as explained in chapter three. Table 5 presents estimates of adjustment coefficients, as well as short and long run elasticities of the acreage response of sesame in the study area.

Table 5: Adjustment coefficient, short run and long run elasticities for sesame

District	Variable	Adjustment coefficient	Short run elasticity	Long run elasticity
Nachingwea	Price	1.000	0.264	0.513
	Planted area	0.515	0.485	
	Yield		0.072	0.140
	Rainfall		0.035	0.060
Mtwara rural	Price	1.000	0.478	1.650
	Planted area	0.290	0.710	
	Yield		0.243	0.837
	Rainfall		0.032	0.110

4.3.1 Adjustment and expectation coefficients for sesame

The area adjustment coefficients (γ) were 0.515 for Nachingwea District and 0.29 for Mtwara rural District. The positive but low coefficient for area adjustment in Mtwara rural (0.29) implied that farmers adjust slowly to price incentives toward desired sesame planted area. Since the adjustment coefficient is relatively small (γ falls in the range of $0 < \gamma < 1$ as explained in chapter three), it means the area could be allocated for other competing crops such as pigeon peas which have gained popularity among farmers in the recent past.

Meanwhile, the price expectation coefficient of sesame was one (1) which means the expected price in Nachingwea and Mtwara rural Districts was the same as the actual price in the previous year. According to Tey *et al.* (2010), the adjustment pace by farmers is not necessarily a positive response to the fundamental changes, to a certain extent, it depends on the sign of the estimated short and long run elasticities as they are discussed in next sections.

4.3.2 Short run and long run elasticities for sesame

It is noted from Table 5 that the short run elasticities of sesame planted area with respect to price were 0.264 and 0.478 for Nachingwea and Mtwara rural, respectively. This means, *ceteris paribus*, an increase of 1% in the market price of sesame is expected to lead to 0.264% and 0.478% increase in sesame planted area for Nachingwea and Mtwara rural Districts in the short run. Since these elasticities were positive, it implied that farmers in these districts responded by adjusting the level of acreage of sesame given changes to product prices.

The short run non-price elasticities (represented by rainfall) can be observed from Table 5, being 0.06 for Nachingwea and 0.032 for Mtwara rural District. Both elasticities were not significantly different from zero which indicates that the variable did not bring significant change in the acreage level of sesame crop in the study area over the reference period. On the other hand, the short run elasticities of planted area with respect to lagged yield of sesame were 0.072 (Nachingwea) and 0.243 (Mtwara rural). This implied the presence of varying degrees of rigidity in the process of adjusting to the desired level of area given sesame yield. Price and non-price factors can have long run impact on the decisions of farmers in allocation of productive resources including land as discussed below.

Nachingwea District registered a long run price elasticity of 0.513 (Table 5) indicating that in the long run, a 1% increase in sesame price is expected to result in 0.513% expansion of the sesame planted area in the district. Similarly, the long run price elasticity for Mtwara rural District was 1.65 implying that a 1% increase in sesame price increased area under sesame by 1.65%. The magnitudes of lagged sesame yield in the long run were 0.14 (Nachingwea) and 0.837 (Mtwara rural). This suggests that farmers' experience about obtaining yield of sesame helps in determining its profitability, and hence attracts them to expand the cultivation of the crop. Nosheen and Iqbal (2008) pointed out that as farmers at planting time are not aware of the yield to be obtained, it is their past experience in this context which becomes important. Thus, these results imply that if increasing trend in sesame yield continues it will help farmers' expansion of its cultivation in future.

4.4 Acreage Response of Cashew Nut

Lagged cashew nut acreage, lagged cashew nut price, lagged cashew nut yield and rainfall were used as explanatory variables. Regression analysis estimates for Nachingwea and Mtwara rural Districts cashew nut acreage response model are provided by Table 6.

Table 6: Acreage response of cashew nut to price and non-price factors

District	Variable	Coefficient	t-Statistic	Sig.
Nachingwea	Constant	-2.242	-1.939	0.079
	Ln(Pt_1)	0.912	2.891	0.015
	Ln(At_1)	0.761	6.316	0.000
	Ln(Yt_1)	0.332	1.718	0.114
	Ln(Wt)	0.033	0.138	0.893
Mtwara rural	Constant	1.997	0.369	0.719
	Ln(Pt_1)	0.370	0.563	0.584
	Ln(At_1)	0.582	2.267	0.045
	Ln(Yt_1)	0.268	0.406	0.693
	Ln(Wt)	-0.644	-1.663	0.124

Where:*** = Significant at 1%; **Significant at 5%; * Significant at 10%

	Nachingwea	Mtwara rural
F -value	29.740	7.330
Adjusted R2	88.5%	61.3%
Durbin Watson (DW) Statistic	1.575	1.914
Critical values for DW (d-lower = 0.74; d-upper = 1.93)		

While the coefficients for lagged price and lagged area were positive and statistically significant at $\alpha = 0.05$, the coefficients for lagged yield and rainfall were not significant indicating that their increase did not have much influence on farmers' expansion of the area under cashew in Nachingwea. In the case of Mtwara rural the estimates depict positive and significant coefficients ($\alpha = 0.05$) for lagged area, but insignificant coefficient for lagged price and lagged yield. The coefficient for rainfall was negative and insignificant. The area adjustment and price expectation coefficients are discussed in the next section.

4.4.1 Adjustment and expectation coefficients for cashew

Table 7 presents estimates for adjustment coefficients, short run and long run elasticities for cashew nut in the study area. The area adjustment coefficient figures turned out to be 0.239 for Nachingwea and 0.418 for Mtwara rural. In both districts the area adjustment coefficient was relatively small (below 0.5) implying that farmers in the districts adjust slowly toward desired planted cashew area in response to product price.

Table 7: Adjustment coefficients, short and long run elasticities for cashew nut

	Variable	Adjustment coefficient	Short run elasticity	Long run elasticity
Nachingwea	Price	1.000	0.326	1.364
	Planted area	0.239	0.761	
	Yield		0.332	1.389
	Rainfall		0.033	0.138
Mtwara rural	Price	1.000	0.370	0.885
	Planted area	0.418	0.582	
	Yield		0.268	0.641
	Rainfall		-0.644	-1.541

A possible explanation for this relatively slow adjustment in cashew crop may be its nature as a perennial crop which does not allow quick adjustment.

Meanwhile, unitary (1) price expectation coefficients were computed for Nachingwea and Mtwara rural implying that there was no difference between the expected price and the actual price in the previous year. This reflects inefficient price transmission due to price control by traders who tend to set price ceiling and effectively operate as an oligopoly. This problem can be reduced if farmers form groups to increase their bargaining power in product and factor markets (Levins, 2002). In the next section we examine the response rates measured by the short run and long run price and non-price elasticities.

4.4.2 Short run and long run elasticities for cashew

Table 7 also presents the short run and long run price elasticities of cashew nut acreage. Nachingwea and Mtwara rural Districts recorded short run price elasticities of 0.326 and

0.37, respectively. This means, if all other factors remain the same, 1% increase in cashew nut price would result in 0.326% and 0.37% increase in the planted area for cashew nut in the short run in Nachingwea and Mtwara rural Districts, respectively.

Similarly, the short run elasticities for rainfall in relation to cashew acreage were 0.033 and -0.644 in Nachingwea and Mtwara rural District, respectively. The inelastic response to rainfall in Nachingwea implies that a change in annual rainfall resulted in very small changes in a newly planted area during the current year. In Mtwara rural a 1% increase in rainfall would actually reduce acreage by 0.644%. Following good rainfall, farmers could probably opt to use the land which was meant for establishing new cashew trees to grow annual crops which mature within a single season. Meanwhile, the area elasticities with respect to cashew yield in the short run were 0.332 and 0.268 for Nachingwea and Mtwara rural, respectively whereas long run elasticities were 1.389 (Nachingwea) and 0.641 (Mtwara rural). These figures imply that in the long run, an increase of one percent in cashew yield is likely to cause an expansion of cashew area by 1.389% and 0.641% in Nachingwea and Mtwara rural, respectively. Higher cashew nut yield could be attributed due to application of recommended agrochemicals such as karate and sulphur to control pest and diseases which have been known to reduce cashew nut yield in the districts. Also the adoption of improved cashew clones has contributed to the improvement in yield of the crop (Kasuga, 2003).

The long run price elasticity of 1.364 and 0.885 were computed for cashew nut in Nachingwea and Mtwara rural, respectively. These results suggest high response of cashew area to changes in its prices in the long run especially in Nachingwea District. A 1% increase in cashew nut price is expected to result in 1.364% and 0.885% expansion of cashew nut planted area in Nachingwea and Mtwara rural, respectively.

Thus maintaining a positive and forward looking price policy for cashew nut can play an important role in stimulating and sustaining cashew area expansion in order to meet the increasing requirements of cashew nut for domestic consumption and exports.

4.5 Summary of Main Findings

4.5.1 Growth rates

In order to increase the volume of export of sesame and cashew nut in the country, a high growth rate in the production of such crops is important. The present study, among other things, estimated the growth in area, production and yield of sesame and cashew nut in Nachingwea and Mtwara rural Districts.

In Mtwara rural District, sesame farmers increased production by allocating more land for cultivation. Consequently, the district registered a positive and significant growth rates of sesame in terms of; area (4.1%), yield (1.6%) and production (5.7%) as shown in Table 3. The increasing trend of production has been attributed to the increase in both area and yield over the years. For Nachingwea District, only the growth rate for area was positive and significant (2.9%), while yield (-5.6%) and production (-2.7%) showed negative growth rates. The negative growth rate in total production is the result of fall in the total yield which outweighed the increase in area under sesame.

In the case of cashew nut, both districts recorded positive and significant area growth rates of 6.4% and 6.6% for Nachingwea and Mtwara rural, respectively. While the growth in yield was positive (0.8% and 0.5% for Nachingwea and Mtwara rural, respectively), these values were not significantly different from zero. Nonetheless both districts registered positive and significant growth rate in production of cashew nut (7.2% and 7.1% for Nachingwea and Mtwara rural, respectively), which reflects the relative strength of area growth since the growth in production of cashew nut in the two districts was a result of increase in area under cashew nut cultivation. The study also estimated acreage response of both crops with respect to price and non-price factors as summarized in the next section.

4.5.2 Acreage response to price and non price factors

This study investigated the impacts of price and non-price factors on sesame and cashew acreage. Regression analysis results for acreage response of sesame to price and non-price factors (Table 4) showed that lagged price and lagged area coefficients for Nachingwea were significantly different from zero at α = 0.01 and α = 0.1, respectively. In Mtwara rural the coefficients for lagged area was significantly different from zero at α = 0.05. In the case of cashew, the coefficients of lagged area were significantly different from zero at α = 0.01 and α = 0.05 in Nachingwea and Mtwara rural, respectively, while the coefficient for lagged price was significantly different zero (at $\alpha = 0.05$) only in Nachingwea.

Estimates of short and long run elasticities of sesame acreage with respect to price were 0.264 and 0.513, respectively, and those for rainfall were 0.035 and 0.06, respectively for Nachingwea District (Table 5). In Mtwara rural District, the short and long run price elasticities for sesame were 0.478 and 1.65, respectively, while those for rainfall were 0.032 and 0.11, respectively. Similarly, short and long run price elasticities on cashew nut acreage for Nachingwea were estimated at 0.326 and 1.364, while for rainfall were 0.033 and 0.138, respectively (Table 7). In Mtwara rural District, the short and long run price elasticities were 0.37 and 0.885, respectively, whereas non price elasticities were -0.644 in the short run and -1.541 in the long run. These findings suggest that sesame and cashew acreage were generally more responsive to price than they were to rainfall in Nachingwea District. In Mtwara rural cashew acreage showed a negative relationship with rainfall both in the short and long run.

Meanwhile, the sesame area adjustment coefficients were 0.515 for Nachingwea District and 0.29 for Mtwara rural District (Table 5). The coefficient for cashew area adjustment was 0.239 for Nachingwea and 0.418 for Mtwara rural District (Table 7). These results suggest that farmers adjust at a different pace toward desired or long run level of area depending on location and type of crop.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In Tanzania agriculture is an important sector in terms of employment creation, contribution to GDP and food production. Various government policies influence production decisions at the farm level, of which price policy stands out to be the most important. Apart from price incentives, there are non-price factors including rainfall, technology and government support which also have important effects on the farmers' production decisions, as well as allocation of land for different crops. Hence, when the government provides different incentives, it must do so based on adequate information regarding farmers' response to price and non-price factors.

Based on the results, this study concludes that during the reference period there was growth in area, yield and production of sesame and cashew nut in the study area with few exceptions. Growth in yield was particularly attributed due to the use of improved technologies which include improved varieties and proper management practices. It was furthermore noted that farmers in the two districts exhibited different adjustment paces towards desired planted area for the crops in question. This indicates the presence of varying levels of technological and institutional constraints that prevent farmers from realizing the desired acreage level.

The study also found that price signals influenced land allocation for the two crops. This implies that producer prices of sesame and cashew nut played an important role in farmers' decision to expand or contract sesame and cashew planted area during the reference period. However, the elasticities though positive fell in the inelastic range suggesting that while it is a reliable factor, price alone cannot influence farmers' acreage allocation decisions. This means apart from price, other external factors might also be responsible for influencing farmers' resource allocation decisions.

5.2 Recommendations

Given the empirical findings, the study makes the following recommendations:

1. Since sesame and cashew area allocation is responsive to commodity prices in both the short and long run, future expansion of sesame and cashew output should be guided by policies to improve market price of the two crops. This implies that agricultural policy should create conducive atmosphere so that markets allocate resources in the most economically desirable way in order to increase the production of for local consumption and export of sesame and cashew nut in the country. LGAs through DADPs should also plan for complementary programmes to improve market efficiency. These interventions can be expected to make producers more responsive and hence expanding total output.

2. Improved production technologies have been proven to increase yields. The extension service delivery system should be improved to advocate for the dissemination and use of high yielding varieties together with appropriate crop management techniques. The research-extension linkage should be strengthened so that sesame and cashew technologies developed by Agricultural Research Institutes reach farmers timely. Given that there is a room for increasing the production of sesame and cashew nut in Nachingwea and Mtwara rural through increasing the use of improved technologies (improved varieties, improved pest and disease control methods, and other improved management practices); the study recommends that farmers adopt the technologies.

3. Most of the price elasticities fell in an inelastic range especially in the short run. This implies that there could be factors other than prices that may as well affect land allocation decision for sesame and cashew farmers in the districts. It is therefore recommended that future research may wish to include other factors such as price of competing crops, climate change and government support or intervention that might affect the planted area for the crops.

4. The limitation of this study was the approach used in modeling which was dictated by the availability of data. For example, due to lack of data, our model ignored the difference in biological characteristics of sesame and cashew. The researcher believes that the availability and adequacy of relevant data will greatly improve the modeling of this kind of studies in the future. The study therefore recommends that personnel responsible for data collection at district levels should routinely compile and store such data and make it available to researchers.

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APPENDICES

Appendix 1: Augmented Dickey-Fuller test statistics of unit roots for Nachingwea

Crop	Variable	Definition	ADF	Critical value
Sesame	**Level**			
	At	Sesame planted area	-0.218	-2.63
	Pt	Sesame price	0.113	-2.63
	Yt	Sesame yield	-1.659	-2.63
	First difference			
	At	Sesame planted area	-4.192***	-3.75
	Pt	Sesame price	-3.923***	-3.75
	Yt	Sesame yield	-4.246***	-3.75
Cashew	**Level**			
	At	Cashew nut planted area	-0.655	-2.63
	Pt	Cashew nut price	-2.375	-2.63
	Yt	Cashew nut yield	-1.659	-2.63
	First difference			
	At	Cashew nut planted area	-4.775***	-3.75
	Pt	Cashew nut price	-3.836***	-3.75
	Yt	Cashew nut yield	-4.246***	-3.75

***Critical value at 1% level; **Critical value at 5% level

Appendix 2: Augmented Dickey-Fuller test statistics of unit roots for Mtwara rural

Crop	Variable	Definition	ADF	Critical value
Sesame	**Level**			
	At	Sesame planted area	-2.468	-2.63
	Pt	Sesame price	2.237	-2.63
	Yt	Sesame yield	-1.473	-2.63
	First difference			
	At	Sesame planted area	-5.243***	-3.75
	Pt	Sesame price	-2.713**	-3.00
	Yt	Sesame yield	-8.174***	-3.75
Cashew	**Level**			
	At	Cashew nut planted area	-0.772	-2.63
	Pt	Cashew nut price	0.098	-2.63
	Yt	Cashew nut yield	-2.274	-2.63
	First difference			
	At	Cashew nut planted area	-4.701***	-3.75
	Pt	Cashew nut price	-3.438**	-3.00
	Yt	Cashew nut yield	-4.547***	-3.75

***Critical value at 1% level; **Critical value at 5% level

Appendix 3: Area under sesame production by districts

Year	Nachingwea Hactares	Mtwara rural Hactares
1995	7183.9	1077
1996	6009.19	800
1997	9663.08	2442
1998	5039.2	450
1999	4105	900
2000	6074	4500
2001	8456.4	4115
2002	7100.7	3020
2003	8412.2	4040
2004	6879.7	3619
2005	9264.1	4033
2006	6330.8	4073
2007	8325	3948
2008	9085.6	2419
2009	12740.4	4158
2010	18370.4	7080.9

Source: Nachingwea and Mtwara rural District councils (2012)

Appendix 4: Volume of sesame production by districts

Year	Nachingwea Tonnes	Mtwara rural Tonnes
1995	3607.9	431
1996	3356.6	320
1997	2884.1	733
1998	2356.6	180
1999	2576.3	360
2000	2941.5	1800
2001	1386.7	1815
2002	1537.9	1208
2003	1362.5	1616
2004	1480.3	1629
2005	1679.3	1815
2006	1124.3	1813
2007	1213.0	1679.2
2008	1763.7	1469.4
2009	2808.8	1663
2010	4698.1	2832

Source: Nachingwea and Mtwara rural District councils (2012)

Appendix 5: Sesame market prices by districts

Year	Nachingwea Tshs/Kg	Mtwara rural Tshs/Kg
1995	200	150
1996	200	150
1997	280	200
1998	280	200
1999	300	250
2000	300	300
2001	200	300
2002	300	350
2003	460	350
2004	580	400
2005	400	400
2006	600	400
2007	700	450
2008	1300	600
2009	1300	650
2010	1300	800

Source: Nachingwea and Mtwara rural District councils (2012)

Appendix 6: Area under cashew nut production by districts

Year	Nachingwea Hactares	Mtwara rural Hactares
1995	3019.2	2183.2
1996	3816.0	3380.0
1997	2989.0	3148.8
1998	2016.4	3764.0
1999	4066.0	4084.8
2000	6099.0	5824.0
2001	6220.0	5850.0
2002	6906.9	7461.2
2003	15275.6	13800.4
2004	13164.1	15544.0
2005	13429.4	14434.4
2006	16148.0	15112.8
2007	16519.0	14852.4
2008	16899.0	15821.6
2009	17288.0	16050.0
2010	17685.0	18142.4

Source: Nachingwea and Mtwara rural District councils (2012)

Appendix 7: Volume of cashew nut production by districts

Year	Nachingwea Tonnes	Mtwara rural Tonnes
1995	1852.3	1574.7
1996	1428.6	2073.9
1997	1284.0	1890.8
1998	1444.0	1853.2
1999	1512.3	1529.3
2000	3768.8	3599.9
2001	6848.5	3550.9
2002	3862.6	3977.8
2003	6020.4	6089.5
2004	3402.8	7495.6
2005	6060.3	6813.9
2006	6055.8	6969.0
2007	11458.1	10402.1
2008	10494.0	9925.0
2009	13121.0	12081.4
2010	15863.0	16196.9

Source: Nachingwea and Mtwara rural District councils (2012), and CBT (2012).

Appendix 8: Cashew nut market prices by districts

Year	Nachingwea Tshs/Kg	Mtwara rural Tshs/Kg
1995	375	375
1996	425	425
1997	430	430
1998	650	650
1999	750	750
2000	505	505
2001	350	350
2002	630	630
2003	630	650
2004	630	630
2005	630	650
2006	630	700
2007	630	725
2008	725	750
2009	725	800
2010	725	850

Source**:** Nachingwea and Mtwara rural District councils (2012), and CBT (2012).