E RESPONSE OF AGRICULTURAL SECTOR TO ADJUSTMENT
OLICIES IN KENYA 1970-1999

BY

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This research paper is my original work and has not been submitted for examination in any other University.

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This research paper has been submitted for examination with our approval as university supervisors.

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ABSTRACT

The prime objective of our study was to investigate the response of agriculture sector to adjustment policies (SAPs) in Kenya with the aim of suggesting policy options to improve agricultural production and growth. In doing this, our study employed a modified Nerlove model (1958) to estimate the sub-aggregates of the selected tradeable crops (crops traditionally exported) and non-tradeable crops (crops not traditionally exported) and we analysed using the ordinary least square (OLS) regression method as a tool for evaluating the effects of the policies.

The study found that the SAP policies have contributed negatively to agricultural output. This result supports the existing literature that SAPs have had negative impact on output supply. However other factors included in the model such as output price, the amount of rainfall received in a given period of time, public expenditure on agriculture, loan to agriculture sector and area planted were significant factors in influencing agricultural production in the three models estimated.

Policies recommended emerging from the findings of the study include output price be made favourable for the farmers, the government need to devise an effective way of generating credit to the farmers especially small-scale and methods of expanding land be implemented. Intensive rather than extensive methods of production are also recommended as a means of increasing agricultural output supply per hectare.

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INTRODUCTION

1.1.1 BACKGROUND

Agricultural sector plays an important role in the overall development of Kenyan Economy despite its decline since1970s. First and foremost the sector provides food for the entire nation. Secondly, it plays a central role in employment generation. Indeed, a large proportion of Kenya labour force is based in rural areas who depend on agricultural sector for their livelihood. According to the 1989, population census out of 9.3 million people, 7.6million , (about 82%) were based in rural areas where as only 1.7 million were in urban areas . Available data shows that small-scale agriculture absorbs the largest share of new additions of labour force as well. Due to Gross Domestic Product (GDP) decline employment creation in the future is likely to slow down unless policies are put in place to ensure sustainable employment creation (8^{th} National Development Plan, 1997-2001). Thirdly agriculture is the major foreign exchange earner accounting for more than 60% of all total earnings annually. Fourthly it acts as a source of raw materials for the agro-based industries. Thus it is clear that, agricultural sector plays a vital role in the economic development of our country in terms of product, market, foreign exchange and factor contribution.

For several years, agriculture has been the leading sector in the economy although its relative share in GDP has been declining; it has been much higher than that of the manufacturing sector. This is evident from table 1 below which shows that the sector's contribution to GDP has been more than twice that of manufacturing sector.

Table 1. Sectoral Share to Gross Domestic Product

	YEARS				
Sector	1964-74	1974-79	1980-89	1990-95	1996-2000
Agriculture	36.2%	33.2%	29.8%	26.8%	24.68%
Manufacturing	10%	11.8%	12.8%	13.6%	13.3%

Source: National Development Plan, 1997-2001 and Statistical Abstract, 2001.

The factors attributed to GDP decline in agriculture sector are policy related problems especially in marketing and pricing of commondities and investment in agricultural services. In 1970s, It was clear that too much government intervention through parastatals had induced operational inefficiencies: high cost of marketing, poor collection of commodities for marketing, and delayed payments to the producers. The parastatals, which had nation-wide monopolies in marketing, had not achieved the objectives for which they had been set. Price and income stabilisation for farmers, efficient and inexpensive nation-wide distribution, without government subsidies, of commodities to consumers and acting as buyers of last resort for food commodities were some of these objectives. However, in almost all cases, the performance of these monopolies had remained poor due to lack of competition and weak management.

The problems affecting the marketing of commodities particularly crops for export, were compounded by pricing policies. Thus, although prices were generally set with reference to the world market ones, deduction in the form of various cesses, taxes, and levies on producer prices and controlled exchange rate reduced the actual benefits to farmers. This was worsened by the decline of world prices of some commodities such as coffee.

Apart from pricing and marketing problems, trends in government investment indicated that more incentive was being given to the industrial and the commercial sectors than to agricultural sector. This led to a deterioration of terms of trade against the agricultural sector making it less profitable than the other sectors of the economy.

Other factors include: domestic structural factors especially the failure to expand and to diversify exports, the droughts of 1974-75, 1979-80 and 1983-84. This adversely affected agricultural production and led to massive food imports, the break down of East African Community in 1977, which significantly affected the market for Kenya's non – traditional exports; and a military coup attempt in 1982, which adversely affected investment in agriculture sector and caused some capital flight. Another equally significant factor is the tribal clashes, which disrupted farming activities in grain growing areas such as Rift-valley. By the end of the 1970s, economic observers were of the idea that Kenya needed to institute major structural policy changes to stabilize the economy and to restore a reasonable rate of economic growth (Mwega and Njuguna, 1994).

In light of the above, a number of policies have been designed and implemented as a means of ensuring that agriculture continue to play it's role in economic development. The structural adjustment programme (SAPs) is the latest in this direction. Indeed SAPs were designed to improve macroecnomic environment, the incentive structure and the regulatory framework within which economic activity takes place. The overriding aim of these reforms has been to stabilise economy, reverse economic decline and build a firm foundation for sustainable development.

1.1.2 POLICY REFORMS IN AGRICULTURE SECTOR

Although the policy reforms were advocated in 1980, it was not until 1986 when the government officially spelt out the wide range of policy reforms for the whole economy in Sessional paper No. 1 on Economic Management for Renewed Growth (GOK, 1986). The reforms focused on the reduction of government controls and hence a shift towards increasing the role of the private sector in most activities in the economy. Consequently, the main role of the government was to control and regulate private participation in the market, which was to be guided by forces of supply and demand rather than by direct interventions by the government. The specific reforms involved; Deregulation of markets to provide a market- based incentive system to channel resources into the most productive uses, liberalisation of trade and marketing policies and removal of price controls to make the economy more competitive and removal of government support (subsidies) on most essential services (extension, research, veterinary services, etc.) with the move towards cost sharing whereby the beneficiaries would contribute increasingly to the cost of the services.

The implementation of policy reforms since inception to late 1991 was not characterised by public controversy and the implementation was not impressive but it was characterised by considerable official ambiquity and covert and overt resistance (Ikiara et al.1993). While the government gave the impression that it was not opposed to agricultural and other economic reforms, only half -hearted efforts were made to implement them. For instance, in grain marketing, the reforms emphasised restructuring of National Ceareals and Produce Board (NCPB) to confine it's role to being a buyer and seller of the last resort, but government insisted on some central regulation for food security reasons. As a result, there was an on-and off removal of controls until

1993 when the sub-sector was fully liberalized though NCPB is still involved in marketing along side the private sector.

There was an average growth in agricultural production of about 3.5% per annum during the first period of implementation of the reforms (1983 to 1990). This was followed by a steady decline in the second phase ranging from minus 0.4% in 1990/1991 to lowest level of minus 4.1% in 1992/93. The reasons for this decline were bad weather and poor implementation of agricultural policy reforms, deteriorating terms of trade between agricultural exports and imports, rapid population growth, shortage of land in the high and medium potential areas for agricultural production and decline in real terms of public investment in agriculture by about one third of the levels in the 1960s and 1970s (Nyangito and Kimenye, 1996) were major contributing factors. In addition, the withholding of external aid on the advice of the World Bank and International Monetary Fund (IMF) in 1991 and 1992 denied the country foreign exchange resources for financing food imports, agriculture inputs and other agricultural investment.

In 1992, reforms in macroeconomic policies i.e. monetary and fiscal policies which affect macro prices (interest rates, exchange rates) were also introduced. Removal of restrictions on the exchange retention and remittances and liberalization of the interest rates are some of monetary reforms implemented and expected to have a positive impact on the prices of export crops. As for fiscal reforms, reduced government spending through cuts of the number of employees in the public service and reduced government borrowing, will help to reduce inflationary pressures and to increase real earnings received by farmers.

Following progressive implementation of the reforms in 1993, as well as good weather, there has been an upsurge in agricultural growth; the first positive growth rate in 1990's was registered at 2.8% in 1993-94 and 4.8% in 1994-95, though this growth cannot be attributed to all

agricultural crops. However, for the successive years the sector continued to register a steady decline in growth rate. For instance, there was a decline from 4.8% in 1994-95 to 2.8% in 1996-97. The reasons attributed to this drastic decline, was due to drought in late 1996 and part of 1997 coupled with abnormally heavy rains all over the country during the last quarter of 1997 caused by el nino weather phenomenon which adversely affected agricultural output. As a result nearly all crops registered decline in production. This tightened food supply situation prompting the government to declare a national disaster besides providing relief food, maize seeds and tools for planting. The El Nino rains also resulted in very destructive floods that led to massive crop and livestock losses in most parts of the country. For the period 1998-1999 and the year 2000, the sector registered a growth rate of 1.35% and -2.4% respectively. The factors responsible for this were due to bad weather, poor world market price and poor infrastruture facilities among others.

However, controversies among various stakeholders have arisen in the course of implementing the reforms. In coffee and tea sub-sectors, there is general dissatisfaction that the implementation of the reforms is not taking into account the interest of all the stakeholders, particularly farmers organizations. It is further argued that the government is still holding on some controls of these sub-sectors. Controversies have also arisen as a result of the liberalization of the dairy and maize sub-sectors as well as the provision of some agricultural services to farmers at full-cost. (Nyangito, 1998).

1.2 STATEMENT OF THE PROBLEM.

A signifigant part of the literature on supply response of agricultural to SAPs has focused on the short run and long- run supply response of individual crops to changes in output and input prices. A number of supply response functions have been estimated for individual crops in Kenya. Most of these studies focus on price elasticities. The studies are important to agricultural response analysis because prices are the avenue through which structural adjustment policies were to affect agricultural variables (output, supply, and income). For instance, the emphasis on market forces, the elimination of marketing boards and withdrawal of government from direct production all aim for an environment in which agricultural output is responsive to market forces. An analysis of agricultural supply response to changes in prices is, therefore, a crucial element in assessing the effects of structural adjustment policies in agriculture sector. This will go along way in shedding light on controversies that have arisen as a result of substantial implementation of agricultural policy reforms. In addition to this it will permit empirically based judgement to be made regarding the extent Kenyan agricultural sector has benefted or lost.

Non-price incentives are also vital complements to SAPs in Kenya. For instance improvement of infrastracture facilities in high and medium potential areas all aim to complement the price incentives during SAP period. Therefore, a study of the response of agriculture to adjustment policies would estimate price and non-price elasticities.

1.3 OBJECTIVES OF THE STUDY.

The objectives of this study are:

(i) To investigate the main determinants of supply response in agriculture sector.

(ii) To determine the impact of each of the determinants on supply of selected tradeable and non-tradeable crops.

(iii) To ascertain whether SAPs have had a significant impact on agriculture supply response.

(iv) To suggest policy options to direct and guide institutional reforms, for agricultural development.

1.4 SIGNIFICANCE OF THE STUDY.

Structural adjustment policies (SAPs) have been in operation for a period of more than 20 years in Kenya. In this regard therefore, agriculture has witnessed reforms in pricing policies and marketing institutions, which were aimed at promoting competition and efficiency in the sector. Indeed, the price liberalisation and divestment policies may lead to modification of the structure financial allocation especially by the government to the sector. Furthermore, little is known about the extent of these policy reforms on agriculture and their effects on agricultural output in quantitative terms. There is need to assess the impact of these policy reforms on agriculture sector so as to permit emperically based judgement to be made regarding the extent Kenya agriculture has benefited or otherwise lost.

Our study therefore, attempts empirically to analyse the impact of these policies on agriculture sector and to generate crucial information to supplement the studies that have already been done on agriculture response to adjustment policies in Kenya. This will guide policy makers in making comprehensive policies, which would go along way in increasing agricultural productivity and growth hence strengthening the role of agriculture in economic development.

CHAPTER TWO

2.0 LITERATURE REVIEW

Substantial studies have been done on supply response of agricultural production. both in developing and developed countries. The theoretical and empirical literatures on response of agriculture to adjustment policies are diverse. The theoretical literature specifies theoretical propositions about responsiveness of economic agents. particularly farmers. to price and non-price variables. the empirical literature test the propositions.

2.1 Theoretical literature

The theoretical literature can generally be classified into three arguments. firstly; the economic agents are responsive entirely to price variables. secondly; because of structural rigidities that are dominant characteristics (features) of developing economies. price mechanisms are less capable of inducing significant response among economic agents. thirdly; the economic agents respond simultaneously to price and non-price variables.

The World Bank (1981). Kuester et al. (1990). Mundlak et al. (1989) and Krueger et al (1990) belong to the first group. whose proposition are classified as neo-classical counter-revolutionary paradigm. They are called neo-classical and it is counter-revolutionary because it represents a negation of revolution Keynes. The three major proposition of the paradigm are: The market is perfectly competitive. implying that economic agents are rational and fully informed while economic resource are perfectly mobile. Prices are the most efficient system of information and incentive and adjustment is made fairly smoothly through price signals, the mobilisation of factors between alternative uses. and the ability of the entrepreneurs to exert foresight and anticipate future needs in the search for maximum rates of return on capital (Killick. 1990). Though

Market failure and externalities justify government intervention. especially in less developed countries. the World Bank justification of SAP on the basis that state intervenion has distortionary effects in the three major areas; namely resource use. domestic absorption and use of scarce foreign exchange.

Killick (1990) and Yagci et al (1995). suggest the need for caution in attributing the crisis of developing economies solely on domestic policies. Two factors can be identified. The first. external factors that are linked to the asymmetrical relationship that exists between less developed and developed capitalist countries. These factors entail dependence on a few primary exports and on capital goods imports, low income elasticities for primary products. competing synthetic. terms of trade deterioration, weak infrastructure of international trade etc. The second set consist of internal factors. which include policies. climatic vagaries. population growth. political instability. wars among others.

The analytical base of SAP raises two problems namely;

Is getting policies right sufficient to counteract all external and internal constraint?

Is getting policies right synonymous with getting price right?

It is crystal clear that from SAP the solution to both questions is yes. It is crucial to point out that if these proposition were invalid. the effects of SAPs on domestic economy would be significantly adverse. The empirical exercise that we perform in this study is therefore a partial test of the validity of the underlying premises of SAP.

Policy evaluation occupies a broader frame than supply response analysis. This is because supply by definition indicates a one-to-one correspondence between prices and quantities. When it is the intention to investigate the impact of policy, it would be necessary to consider output response to price and non-price variables. Ademola (1990). points out that structural adjustment

policies aimed at inducing increased production of agricultural tradeables and exports in Sub-Saharan Africa have two major parts. Some policies concentrate on boosting price incentives, and in that respect a careful analysis of tradeable output responses to changing prices is a crucial element in an attempt to determine the effects of structural adjustment policies. Other aspects of these policies focus on enhancing incentives for increased production of tradeables through non-price factors. Consequently, one must be concerned not only with supply response to price incentives, but also with supply response to changes in non-price incentives. By providing better price and non-price incentives to producers of tradeables, structural adjustment policies are expected to improve the balance of payments by inducing an increased supply of exportables. In the context of Sub-Saharan Africa countries the agricultural sector is expected to be the primary source of an increased supply of exportables. Thus, in order to make realistic assessment of the effects of structural adjustment policies on growth performance of the sector, it is important to determine the elasticity of aggregate agricultural supply to price and non-price incentives. The objectives of a policy are multiple. Beyond changing the structure of domestic and the composition of output (Increment along the production possibility frontier -PPF), policy also expects improvement in efficiency and innovation i.e. movement towards the PPF. These changes would have consequences for employment, income distribution, social balance and external balance.

The evaluation of supply or output responsiveness of agriculture to adjustment policies faces a key methodological problem. Binswanger (1989) argues that the responses of a broad agricultural aggregate to the policy changes are more appropriate than individual crop response. Apart from methodological problem, a distinction is made in empirical literature about elasticities in the short run and in the long run. Short-run impact multipliers are expected to be lower than those for long run. Binswanger linked the difference to differential variability of size between short

and long runs. For example, input size is more variable in the long run than in the short run. As a result intersectoral resource flows occur mainly in the long run. It is for this reason that Binswanger insists that even though tradeables may expand in the short-run, non-tradeables (food) would be less responsive in the short run. As a result, the adjustment would be at the cost of food security. Besides this, cost may rise since the fiscal activity that SAP requires would reduce the state's infrastructural support for agriculture as a whole. As a result, the intra sectoral resource shift would be in favour of tradeables to the detriment of non-tradeable.

2.2 Empirical Studies.

The World Bank (1986) conducted a study where they took a sample of numerous estimates made by researchers of supply response for individual crop and their study revealed that even in the short- run, agricultural output supply responses are quite significant in developing countries. The output response of wheat in Africa was 3.1% in the short run and 6.5% in the long-run, while in other developing countries it was it was 1.0% and 10.0% respectively. The bank concluded that the pricing, marketing and macroeconomic policies were unfavourable for the agriculture sector. The Bank however, failed to tell us how these results were obtained in terms of the methodology used whether the response was due to price alone or even to other factors.

Kere, (1986) carried out study to analyse the supply response of large-scale wheat production in Nakuru, Nyandarua, Uasingishu, Trans-Nzoia and Narok Districts for the period 1969 to 1983. The prime objective of his study was to compare the producer's response to prices in different regions. In his study, he used Nerlovian model with the planted acreage as a function of the previous producer price, previous acreage planted, and a rainfall variable. In addition, he incorporated the effect of competing crops whereby maize, barley, milk and pyrethrum were taken

as substitute for wheat. The results showed that the rainfall variable was negative but significant. The short run price elasticity was positive except in Narok and values ranged from -1.78 to 0.91. The long- run elasticity was only calculated for Narok (9.36) and Nyandarua (1.67) as the coeffient of lagged acreage was statistically insignificant in other districts. The coefficient of determination was found to fall in the range of 0.56 to 0.85. Estimates of the adjustment coefficient were not made in kere's study. Kere had hypothesised that the price responses differ from region to region and this was confirmed by his study. His study, however does not explain how the results for the different regions could be reconciled and generalised to apply to the response in the whole economy. He ignored the response of the small-scale producers who are also many in these districts. In addition, he does not tell us how he calculated the short- run and the long- run price elasticities.

Maitha, (1974) analysed maize and wheat production response with respect to price in Kenya for the period 1954 to 1969. He used Nerlovian model, in estimating the acreage of wheat and separately, with the difference that fermer's price expectation was specified as a distributed lag model, with a known lag. Wheat and maize were treated as mutually competing crops. However, he used ordinary least squares in estimating the final reduced form, where acreage under the crop in the previous year, a lagged dependent variable, appeared as an explanatory variable. The study did not take into consideration the posibility of autocorrelation. The results indicated that Kenyan farmers do respond to price changes and that in general, the price elasticity is higher for maize compared to wheat.

Cleavers (1988) compared the agricultural growth rates of Sub-Saharan African countries under adjustment policies (with packages of exchange rates adjustment, price and fiscal reforms) with those not under adjustment, one in 1970s and the other in 1980s. He found agricultural growth

in the two groups almost the same slight difference between the two groups began to emerge in the 1980, when adjustment programmes were introduced. The annual growth in those countries under SAPs was found to be close to 1% higher than those with no adjustment programmes. He pointed out the difference between the two groups increased over time, showing the responsiveness of Africas agricultural to policy changes.

A study done by Antonio M. (1991) explores the links between structural adjustment and peasant agricultural in Bolivia. He concluded that the country's stabilisation and adjustment programme, devised in 1985,did not strongly affect peasant production and agricultural incentives. He argued that, this could have been caused by factor market distortions and the fact that macroeconomic adjustment was not accompanied by an increased public expenditure in the agricultural sector.

Similar views were expressed by Ikiara (1992) who said that to increase agricultural production and productivity growth, the adjustment programmes need the complement of government support in particular in the form of more effective government investment in agriculture. He notes that agricultural growth requires an appropriate stream of public goods as well as investment in human capital. He suggest that budgetary savings from cut backs in public expenditure resources obtained through sectoral reforms should be directed towards investment in rural infrastructure, extension services and agricultural research in order to promote long term agricultural growth. He further pointed out that, in view of the importance of agriculture as a source of foreign exchange in Kenya an increase in share of agriculture to total expenditure may be justified in the short to medium term.

Bond (1983) carried out a study to estimate aggregate agricultural response to real producer prices in nine sub-Saharan African countries, which composed of Ghana, Liberia, Cote D'Ivoire,

Kenya, Madagascar, Senegal, Tanzania, Uganda and Bukina Faso. He developed his estimation equation by assuming that the actual changes in output from the previous existing level is only some fraction of the change required to achieve the equilibrium level. She further postulated that equilibrium output depended on the aggregate real producer price a time trend to take into account the effects of long run structural changes on equilibrium output. and a dummy variable to capture the influences of unusual weather patterns. The regression analysis showed that the relative price coefficients were positive in all countries studied and that the long-run elasticity were greater than short-run elasticities in Ghana. Kenya. Liberia, Madagascar. Uganda and Burkina Faso. However. the study can be criticized on the ground that the aggregate function for each country is obtained by adding across the supply functions of individual crops: therefore it ignores the fact that individual crops respond differently to price changes.

Tween and Quance (1969) conducted study to measure positivistic measures of aggregate supply response and prescribed two measures. One that used direct least squares of the aggregate supply funtion and another. which used indirect square of the separate yield and basic production unit components of crops and livestock then aggregate this to form the elasticity of total supply. They found an aggregate supply elasticity of 0.1 in the short run and 0.8 in the long run for decreasing prices. For increasing prices. it was 0.15 in the short run and 1.5 in the long run. Their study could be credited in that it is one of the few that attemted to measure aggregate supply response.

Ssemogere (1990) investigated the effect of structural adjustment policies on supply condition of coffee in Uganda. The study used qualitative data due to lack of quantitative data. She used a supply model, which assumed that acreage under coffee yield is fixed at least in the short-run. and might remain fixed even in the long-run if coffee is grown in densely populated areas

where land is scarce. The study concentrated on the determinant of the changes of output per acre or land productivity, to which variation of labour can be used in short-run, and technological improvement, purchased input and tree planting can be applied in the long-run. The study postulates that output per hectare is affected by the own producer price elasticity of supply (the main target of exchange rate adjustment). The price elasticity of the substitute crop competing with coffee for the same productive resources stock of previous year's output which vary with marketing efficiency: and the land rental ratio. The study concluded that the inefficient marketing system blocked the incentive as the farmer is paid late. An optimal pricing policy administered through an efficient marketing system, taxation reforms, and export diversification appear equally necessary component of a successful adjustment programme. This study can be criticized on the ground of using qualitative evidence quantitative data. For this reason, it is impossible to compute the price elasticty of supply related to higher producer price.

Some amount of consensus on the importance of both price and non-price factors is shared by a good number of economists. Killick (1990), Oyejide (1990), Binswanger (1989) and Chibber (1988) stressed the significance of price and non-price variables for the response of agricultural output. The consensus is also reflected in studies that have investigated empirically the response of agriculture to prices as evidence supporting the relevance of price variables. In Kenya, Maitha (1974), Kabubo (1991), and Kenneth (1997) are among several studies that have provided empirical evidence that some Kenyan crops respond significantly to price incentive. Generally these studies investigate the supply response of either one or two crops. For evaluation of structural adjustment programme, however, the range of crops has to be made wide enough to include both tradeable and non-tradeable. It must also investigate sub-sectoral and sectoral aggregate response and not just individual crop responses.

2.3 LITERATURE OVERVIEW

The literature reviewed above is quite diverse and different approaches have been used to analyse supply response both in developing and developed countries. The factors that have been identified as influencing supply response of agricultural output are previous producer price, acreage, input prices, SAPs, fertilizer and technology among others. The pricing policy is isolated as the single most important factor affecting supply and this has led many researchers to concentrate only on responsiveness of supply to price with little emphasis on the effect of other factors. Besides that, most of the previous studies on agricultural supply response have focused on indvidual crop responses. However, for evaluation of stuctural adjustment programmes, the range of crops has to be made wide enough to include both tradeable and non-tradeable. It must also investigate sub-sectoral and sectoral aggregate response and not just individual crop responses. Indeed, very view studies have been done on aggregate supply of agricultural output in Kenya. Our study therefore, will essentially depart from other studies in that it will investigate sectoral aggregates, non-trdeable and tradeable crops response.

CHAPTER THREE

3.0 ANALYTICAL AND EMPIRICAL FRAMEWORKS

This section presents the methodology that was used in our study. It starts with a theoretical framework, which forms the basis of this study. Hypotheses to be tested are stated and the econometric model that was used is explained and specified. The section ends with data type and sources.

3.1 THEORETICAL FRAMEWORK

In this study we estimated agricultural supply response to adjustment policies by estimation of elasticities of sectoral aggregates, non-tradeable and tradeable crops and output to price and non-price variables. Most agricultural supply response studies have been influenced by Nerlovian model (1958). In actual estimation the original model has been modified in many diverse ways. Our present study, like the previous studies will employ a modified form of the Nerlovian formulation.

Most studies of agricultural response include some form of price expectaton and partial adjustments. In these studies a distinction is often made between actual and desired level of production and also between actual and expected prices. However such models cannot be estimated because the desired output and expected price are not observable. To overcome this probem, Nerlove (1958) introduced an adjustment mechanism where he assumed that the change in actual output, Q_t from the previously existing level, Q_{t-1} is only a fraction of the change required to achieve the desired output Q_t^*. If we assume that this proportion achieved is, h then the equation can be written as;

$$LnQ_t - LnQ_{t-1} = h\,(LnQ_t^* - LnQ_{t-1}) + e_1. \quad \text{.......................................}(1)$$

Where,

e_1 = the error term in natural logs

Q_t = the actual output

h = the adjustment coefficient $0<h<1$

Making LnQ_t the subject the formula in equation (1) we have;

$$LnQ_t = LnQ_{t-1} + h\,(LnQ_t^* - LnQ_{t-1}) + e_1$$

$$LnQ_t = hLnQ_t^* + (1-h)\,LnQt_{-1} + e_1. \qquad (2)$$

Now from the literature review the factors identified to influence agricultural ouput supply are; previous producer price, SAPs, Public expenditure on agriculture sector. weather patterns and acreage of land planted. We can therefore specify our theoretical model as:

$$Q_t^* = f(P_{t-1}, SAPs_t, PEA_t, W_t, X_t) \qquad (3)$$

Where,

Q_t^* = the desired output at period t

P_{t-1} = the previous producer price at priod t-1

SAP_t = the structural adjustment programme at period t

PEA_t = the public expenditure on agriculture at period t

W_t = weather patterns at period t

X_t = acreage of land planted at period t

3.2 MODEL SPECIFICATION

From equation (3) we can specify a modified Nerlove model to enable us to estimate the response of sectoral aggregates to reform and adjustment policies. By taking natural logs on both sides of equation (3) we have;

$$LnQ_t^* = k_o + k_1 lnP_{t-1} - k_2 lnX_t + k_3 lnPEA_t + k_4 D_1 + k_5 D_2 - e_2 \quad \ldots\ldots(4)$$

Equation (4) cannot be estimated because the desired output, Q_t^* is not observable. To overcome this problem we substitute equation (4) into equation (2) and solving for, LnQ_t to give us;

$$LnQ_t = hk_0 + hk_1 lnP_{t-1} + (1-h)\, k_2 lnQt_{-1} + hk_3 lnPEA_t + hk_4 lnX_t - hk_5 D_1 - hk_6 D_2 + v \quad \ldots\ldots(5)$$

Where, $v = e_1 + e_2$ (error term)

Using equation (5) above we further simplify it to come up with a modified Nerlove type of model that enables us to estimate sectoral aggregates, non-tradeable and tradeable crops. The specification in the models below forms a modified Nerlove type of model.

MODEL A: SUB- SECTORAL AGGREGATES

This model estimates sub-sectoral aggregates to enable us to assess the general impact of the multiple targets of adjustment policies on agriculture sector.

$$LnVAC_t = m_0 + m_1 lnPNT_t + m_2 lnPNT_{t-1} + m_3 lnPT_t + m_4 lnPT_{t-1} + m_5 lnPEA_{t-1} + m_6 lnLA_{t1} - m_7 lnXAC_t + m_8 lnVAC_{t-1} + m_9 D_1 - m_{10} D_2 - e_3 \quad \ldots\ldots(6)$$

Where,

$LnVAC_t$ = Value of output of all crops (both tradeable and non-tradeable)

$LnVAC_{t-1}$ = Value of previous output of tradeable and non-tradeable.

$LnPNT_t$ = Current output price of non-tradeable crops

$LnPNT_{t-1}$ = Price of non-tradeale crop at period t-1

$LnPT_t$ = Current output price of tradeable crops

$LnPT_{t-1}$ = Price of tradeable crop at period t-1

D_1 = Dummy variable to capture weather patterns (assumes the value of unity for the drought year 1974, 1975, 1979, 1980, 1983, 1984 and zero for the other years)

D_2 = SAP Dummy to capture the effects of SAPs (takes the value of zero for pre-SAP and unity for SAP period).

LA_t = Loans to agriculture from Commercial Banks

PEA_{t-1} = Previous public expenditure on agriculture

e_3 = The error term to capture the effects of other exogenous variables not included in the model.

MODEL B; ESTIMATION OF NON-TRDEABLE CROPS

In this model we estimate the response of value of output supply of nontradeable crops to adjustment policies. The specification of the model takes the following form:

$$LnVNT_t = a_0 + a_1 lnPNT_{(t-1)} + a_2 lnPEA_{t-1} + a_3 lnLA_{t-1} + a_4 lnXNT_t + a_5 lnVNT_{t-1} + a_6 D_1 + a_7 D_2 + e_4 \ldots\ldots(7)$$

Where,

VNT_t = Output value of non-tradeable crops

XNT_t = Area planted to non-tradeable crops

e_4 = Error term

The other variables are as defined above in model A.

MODEL C; ESTIMATION OF TRADEABLE

In this model we estimate the response of value of output supply of tradeable crops to adjustment policies. The specification of the model takes the following form:

$$LnVT_t = b_0+b_1lnPT_{(t-1)}+ b_2lnPEA_{t-1}+ b_3lnLA_{t-1}+b_4lnXT_t+b_6lnVT_{(t-1)}+ b_7D_1+ b_8D_2 +e_5 \ldots\ldots\ldots\ldots\ldots(8)$$

Where,

VT_t = Output value of tradeable crops at period t

XT_t = Area planted to tradeable crops at perod t

e_5 = Error term

The other variables are as defined in model A.

3.3 HYPOTHESIS TESTING

Hypothesis one. A positive relationship exists between structural adjustment policies and the output of both tradeable and non-tradeable. This will be tested against the alternative hypothesis that no ralationship between the two.

Hypothesis two. A positive relationship exists between previous producer price and the output of both tradeable and non-tradeable. This will be tested against the alternative hypothesis that no relationship between the two.

3.4 DEFINITION OF VARIABLES AND MEASUREMENT

Depedent variables:

VAC = Value of Output of allcrops in Kenya million pounds

VNT = Value of non-tradeable crops in Kenya million pounds

VT =Value of output of tradeable in Kenya million pounds.

Independent variables;

PEA = Public expenditure on agriculture sector. in Kenya million pounds. This constitutes recurrent and capital expenditure. It is hypothesised to have a positive effect on both tradeabsle and non-tradeable.

X = Acreage (X), the size of the land planted in '000 hectares. This is hypothsized to have a positive effect on output supply of both tradeable and non-tradeable crops.

D1 = Dummy to capture weather patterns. It is hypothesised to have a negative effect on output supply of both tradeable and non-tradeable crops.

LA = Loan to agriculture sector from commercial Banks in Kenya million pounds. It is expected to have a positive effect on output supply.

3.5 ESTIMATION TECHNIQUE

The appropriate estimation technique that was used in this study was the ordinary least square (OLS). This method was applied on a time-series annual data for the period 1970-1999. This technique of estimation is useful because ordinary least square gives linear, unbiased and efficient estimates. There are special problems related to time series data when it comes to estimation. This is because most macro-economic data is integrated or trended. This means that the variables may have a mean that change with time and have a non-constant variance. There is therefore likelihood of obtaining promising diagnostic test statistics but of spurious regression results if the data analysis was done on the level form of the variables. To overcome this problem the first step is to test whether the variables are stationary or test the level of integration through the unit root tests. A series Y_t is said to be integrated of order d if it becomes stationary after differencing (Δ) d times.

Such a series is denoted $Y_t \sim I$ (d). A stationary series is an I (0) series but most non-stationary series have a random walk of order I (1) although there are also series of higher order.

3.6 TESTING FOR THE ORDER OF INTEGRATION

Dickey and Fuller (1981) present a simple method of testing for the order of integration: the Dickey-Fuller (DF) method or the unit root. This tests the hypothesis that the variance of Y_t is integrated of order 1 or more against the hypothesis that it is integrated of order zero. This test is based on a random walk variable i.e. a variable that assumes the same value as the last period modified by the current shocks only. The equation

$$Y_t = Y_{t-1} + \epsilon_t$$

Can be represented in general as

$$Y_t = \propto Y_{t-1} + \epsilon_t \quad \text{..........(9)}$$

So that $|\propto| = 1$. then the equation represents a pure random walk process and Y_t is non-stationary. But if $|\propto| < 1$. then the process generating Y_t is integrated of order zero and hence stationary. If we subtract Y_{t-1} from both sides we get

$$Y_t - Y_{t-1} = \epsilon_t \quad \text{..........(10)}$$

$\Delta Y_t = \epsilon_t$ that is we difference Y_t. ΔY_t is now stationary.

The Dickey-Fuller test (test for unit root) is formulated as:

$$\Delta Y_t = \beta Y_{t-1} + \epsilon_t \quad \text{..........(11)}$$

Where $\Delta Y = Y_t - Y_{t-1}$. By substituting ΔY_t and making Y_t the subject of the formular, equation (10) can be re-written to resemble equation (9) as

$Y_t = (1+\beta)Y_{t-1} + \epsilon_t$.....(12)

where, $\propto = (1+\beta)$. The DF tests for the negatively of $\propto$ in the OLS regression equation (9). In it we test the hypothesis that

H_0: $\beta = 0$

H_1: $\beta < 0$

If $\beta < 0$ in equation 11, then $\propto < 1$ in equation (9), if the null hypothesis is rejected in favour of the alternative hypothesis, the implication is that $\propto < 1$ and Y_t is integrated of order zero (is stationary) There are four DF tests for the order of integration I (d). In our analysis we used Augmented Dickey Fuller test (ADF), which is widely used technique, as it takes into account of the autocorrelation in the error term and efficient in testing the cointegration of the error term.

3.7 COINTEGRATION AND ERROR CORRECTION MODEL

Two time series X_t and Y_t are said to be cointegrated of order p.q where $p \geq q \geq 0$. written as X_t $Y_t \sim I(p.q)$

If both X_t and Y_t are cointegrated of order q; and there exists a linear combination of X_t and Y_t which is integrated of order q-p. Cointegration facilitates analysis of long- run economic relationship associated with time series data. Data observed over a considerable period of time tend to trend up in a non-stationary manner but when analysed as a group, this data may tend to drift together. Test for cointegration are similar to those of unit root tests (DF and ADF tests) except that these tests are performed on the regression model residuals derived from regressing the static model at levels. In order to have meaningful long-run relationships it is necessary that the error

term of the long-run model be stationary (Deadman et al, 1993). This would be the case for the bivariate and the multivariate case when, the two variables are integrated of the same order; or the order of integration of the dependenrt variable is not greater than the order of integration of any of the explanatory variables integrated to an idendical order or higher than that of the depedent variable.

It is only when the residuals are I (0) that we can accept cointegration and thus include the fitted residuals lagged once as one of the explanatory variables along side other variables at their orders of integration. Macroeconomic theory predicts that there should be a stable relationship among variables in the long-run. Lack of cointegration among non-stationary variables therefore suggests that such variables would have no long-run link (Rao, 1994).

3.8 DATA TYPE AND SOURCES

Our study utilised secondary data on annual basis for the period 1970-1999. Most of the data was collected from Government of Kenya official documents such as Economic Surveys and Statistical Abstract, Ministry of Agriculture and World Bank Publications.

CHAPTER FOUR

DATA ANALYSIS AND EMPIRICAL TESULTS

4.1 INTRODUCTION

In this chapter we present the main findings of our study. First we present results on order of integration (unit root test) of the variables used in the study and ADF test on the error term i.e. testing for cointegration. This is followed by discussion on the regression results based on the models presented in chapter three.

4.2 ORDER OF INTEGRATION

Table 2: Unit Root Results

VARIABLE		t-ADF VALUE	ORDER OF INTEGRATION
LnVAC	(value of all crops)	-3.1796	I(>0)
LnVNT	(value of non-tradeable crops)	-3.1893	I(>0)
LnVT	(value of tradeable crops)	-3.4620	I(>0)
LnPEA	(public expenditure on agriculture)	-3.0988	I(>0)
LnLA	(loan to agriculture sector)	-2.9291	I(>0)
LnPNT	(price of non-tradeable crops)	-1.9817	I(>0)
LnPT	(price of tradeable)	-2.6162	I(>0)
LnXAC	(area planted to all crops)	-2.4268	I(>0)
LnXT	(area planted to tradeable crops)	-1.8006	I(>0)
LnXNT	(are planted to non-tradeable crops)	-2.1222	I(>0)

SOURCE PCGIVE OUTPUT

Critical values: 5%=-3.594 1%=-4.355

From the results shown above (table 2) on unit root test, it is clear that, all the variables have non-stationary series at their levels. This is because the t-ADF calculated values are less than the t-ADF critical value for all the variables at both levels of significance. Thus there was need to diference the variables to make them stationary series. Table 4.2 gives a summary of the stationary series after taking the first and the second difference. The results indicates that most of the variables are integrated of order two with the exception of value of all crops (VAC), value of non-

tradeable(VNT) and value of tradeable crops (VT).

Table 2: Stationary Variables

VARIABLE	t-ADF	ORDER OFINTEGRATION
DLnVAC	-5.4307**	I(0)
DLnVNT	-5.1946**	I(0)
DLnVNT	-5.9063**	I(0)
DDLnPEA	-4.9719**	I(1)
DDLnLA	-4.8948**	I(1)
DDLnPNT	-6.9320**	I(1)
DDLnPT	-5.2257**	I(1)
DDLnXAC	-6.1808**	I(1)
DDLnXT	-5.8922**	I(1)
DDLnXNT	-5.3560**	I(1)

Source PCGIVE OUTPUT

Critical values: 5%=-3.603 1%=-4.374:

**Significant at both 5% and 1% level

4.3 COINTEGRATION RESULTS

The test on the residuals of the error term in all estimation (i.e.value of all crops, value of non-tradeable and tradeable crops) was done to test whether there was cointegration of the variables of order zero so as to enable us to use error correction mechanism (ECM_1) see Adam (1992). The results in table 3 indicates that. t-Augmented Dickey Fuller (t-ADF) tests on the error term rejected the null hypothesis in favour of the alternative indicating existence of cointegration. This means that our three models had to make use of the ECM to capture the long –run relationship of the variables.

TABLE 3: Results on Dickey-Fuller test on the error term tests for cointegration.

VARIABLE	t-ADF VALUE	DECISION
ECM1 for VAC	-3.3548*	Reject H_0, implying there is cointegration
ECM2 for VNT	-3.5640*	Reject H_0 implying there is cointegration
ECM3 for VT	-3.5819*	Reject H_0, implying there is cointegration

SOURCE : PC-GIVE OUTPUT

Critical values: 5%=-2.975 1%=-3.696

* Significance at 5% level

REGRESSION RESULTS

4.4 ESTIMATION OF VALUE OF OUTPUT OF ALL CROPS (AGGREGATE)

In order to identify the main dynamic patterns of the three models an over- parameterized model was first estimated, using ordinary least squares (OLS), with a three-lag length for all variables in the model. The regression results for the over-parameterized model is reported in the Appendix 1.

The over-parameterized model was further simplified into a parsimonious model. The simplification process was guided by insignificance of the t-values against the critical. Dropping the lagged insignificant variables led to improved t-values for the remaining regressors. The rationale of dropping the insignificant variables also emanates from our concurrence with Adam (1992) that a model with many regressors is intuitively less powerful than a model that can explain the same amount on the basis of a simple model. Adam says, "in the limit, of course, a model that describes everything, explains nothing" (Adam 1992p. 17)

The final model produced by the simplification process is reported in Equation 1. This model performed better than the over-parameterized model. The simplification resulted in an

improvement in Scwartz information criterion (SC) compared with over parameterized. It improved from 3.8872 to 2.6064(i.e. the smaller the value of Scwartz criterion the better the model). The Durbin-Watson (DW) indicate no serious serial correlation in the error term. The entire estimated coefficients have the expected sign.

The SAP dummy has a negative sign and insignificant. This shows that the structural adjustment implemented have had negative impact on agricultural output supply. The negative sign and insignificant of the SAP dummy may be due to the fact that the government has been reluctant to implement these policies. Also the disagreement between the government and the World Bank concerning the modalities of implementing these policies may have slowed down the implementing process as well as lack of supporting funds. Another possible explanation for the insignificance of the dummy is the period we have chosen to anlyse the impact of these policies may be too short to allow us analyse the effects on the sector. Since the policy reforms are still in operation the impact may explicitly be felt in the future. Hence the combination of the above possible reasons may have contributed to the insignificance of the variable. Thus we can attribute agricultural output supply to the other crucial variables included in the model discussed below.

The output prices are positive as expected and significant at 1%. This implies that farmers are sensitive to output prices. The results show that a one per cent increase in output prices all things being equal is associated with a 1.6520% from non-tradeable and 0.68392% from tradeable crops increase in value of output. Interestingly non-tradeable crops seem to be more sensitive to output prices than tradeable as can be seen from their elasticities.

Public expenditure on agriculture (PEA) has expected sign and insignificant for the lagged. A possible explanation for this is that government commitment to agricultural development declined considerably during the SAP period than the pre-SAP period. Hence agricultural

allocation have not been adequate to provide the required agricultural services as well as in the implementation of agricultural activities such as investing in crop development, seed production and distribution, fertilizer procurement and distribution, agricultural mechanization, irrigation, research, paying staff salaries and agricultural training. Another possible explanation is that could be the little PEA that goes to agriculture is not utilized for the intended purpose. This could be as a result of lack of close supervision of the usage of the recurrent expenditure and also lack of well-designed budget structure process as well as poor financial management. Some of the recurrent expenditure may be used to pay agricultural workers who are not actively involved in the agricultural activities directly. The combination of these factors could have contributed to low productivity on the sector. The reduction of PEA is likely to affect mainly the small-scale farmers who have inadequate financial resources. Besides this group of farmers, instability in government expenditure will affect planning by the government on the sector and even the private sector. This in turn would affect the entire economy owing to the fact that the sector plays an important role in income generation, employment and provision of food to the entire nation.

The loan extended to agriculture sector was found to be significant at 10% and shows that a one per cent increase in credit to agriculture sector all other factors being equal is associated with 0.064867% increase in value of output of all crops. This implies that the farmers use the credit for the intended purpose. There is need therefore for the government to devise a more effective way of allocating loans to the farmers.

The dummy D_1 for the weather pattern has the expected sign and significant at 5% level. This suggests that rainfall is an important factor in determining value of aggregate agricultural output in Kenya. This implies that policy actions need to be extended to the area of meteorological services. Adequate weather forecasts regarding the amount and distribution of rainfall will guide

farmers in starting their farming operations during the production season. This will also prevent losses often associated sustained by some farmers when they have to embark on replanting their fields having been misguided by unsteady patterns of rainfall.

The error correction term (ECM_1). This shows the rate at which the loss of information is corrected emanating from differencing of the variables to make them stationary. It has the expected sign and significant at 5% level implying that at each period t. agricultural output adjusts by 61.83% of the gap between its current level and that which it attains in the long-run equilibrium. By rule of thumb the coefficient of error correction term should be negative and less than unity. This is because we do not expect 100% adjustment.

The explanatory power of the model is high, this is because the R^2 is 92.67% meaning that the twelve variables included in the model jointly explains 92.67% of the variation in the value of output supply for all crops.

EQ(1) Modelling DLNVAC by OLS

Variable	Coefficient	Std.Error	t-value	t-prob
Constant	0.32535	0.15126	2.151	0.0509
DDLnPNT	1.6520	0.26443	6.247*	0.0000
DDLnPNT_1	0.74087	0.31016	2.389**	0.0328
DDLnPNT_2	0.55888	0.29922	1.868***	0.0843
DDLnPT	0.68392	0.14223	4.809*	0.0003
DDLnPT_1	0.96209	0.17602	5.466*	0.0001
DDLnPEA_1	0.11236	0.089799	1.251	0.2329
DDLnLA	0.064867	0.035663	1.819***	0.0920
DDLnXAC	0.73344	0.31714	2.421**	0.0298
DLNVAC_2	0.38483	0.16687	2.306**	0.0382
D1	-0.27325	0.12211	-2.238**	0.0434
D2	-0.172579	0.14138	-1.513	0.1163
ECM1_1	-0.61834	0.28684	-2.156**	0.0504

R^2 = 0.9267 F(12, 13) = 13.709 [0.0000] $\hat{\sigma}$ = 0.194688 DW = 2.08

RSS = 0.4927

*significant at 1% level

**significant at 5%% level

***significant at 10% level

Where,

PNT = Price of non-tradeable crops

PT = Price of tradeable crops

PEA = Public expenditure to agriculture sector

LA = Loan to agriculture sector

XAT = Area planted to all crops (tradeable and non-tradeable)

VAC = Value of all crops

D_1 = Dummy to capture weather pattern.

D_2 = SAP dummy to capture adjustment policies (takes the value unity during SAP period and zero for pre-SAP period)

ECM_1 = Error correction term

4.5 ESTIMATION OF VALUE OF OUTPUT OF NON-TRADEABLE CROPS

The model below shows the estimation of value of non-tradeable crop. We have estimated an over- parameterized model, which is reported in the Appendix 2. This allows us to identify the dynamic patterns of the model. The model is further simplified into a more interpretable Nerlovian adjustment mechanism. The simplification is guided by data admissibility with the main concern that the model remains theory consistent. Dropping the lagged insignificant variables led to improved t-values for the remaining regressors. The final model produced by simplification is reported in Equation 2.

The result shows that the SAP dummy D2, has a negative sign and insignificant. This implies that the adjustment policies affected non-tradeable crops negatively and hence we can attribute output supply to other variables included in the model.

The coefficients for price and lagged price are positive and significant at 5% and 1% significant level respectively. This indicates that non-tradeable farmers are sensitive to both current and previous price. The results implies a one per cent increase in current and previous price all other factors being equal leads to 0.56768% and 1.0905% increase in value of output respectively. It

is therefore a clear indication that output price is a major determinant of agricultural output supply in Kenya just as in other countries.

The public expenditure on agriculture sector has expected sign and significant at 5% level. A possible explanation for the positive sign is that funds allocated to the sector is used for the intended purposes. This could suggest that there is no action lag and appropriate choice of agricultural infrastructure is chosen carefully. The results indicate that a one percent increase in government expenditure to the sub-sector all other factors constant is associated with 0.43890% increase in value of output supply of non-tradeable.

The credit or loans to the sector (LA) has a positive sign as expected and significant at 5% level. This implies that non-tradeable farmers utilize the loan for the intended purpose. The positive sign suggest loan is an important factor in determining the value of output supply of non-tradeable crops in Kenya. The results shows that a one per cent increase in the previous loan to non-tradeable farmers all other factors being equal is associated with 0.13511% increase in value of output supply of non-tradeable crop. There is need there for the government to increase credit to this sub-sector since it plays a crucial role in producing food hence ensuring food security in our country. Improvement in credit represents additional resources to the sector and will enable non- tradeable farmers to adopt new and more productive techniques that are capital intensive thus increasing output supply.

The dummy D1 for the weather pattern has the expected sign and significant at 10% level. This suggests that rainfall is an important factor in determining value of non-tradeable output supply in Kenya.

The error correction model (ECM_2). This shows the rate at which the loss of information is corrected emanating from differencing of the variables to make them stationary. It has the expected

sign and significant at 1% level implying that at each period t, agricultural output adjusts by 59.62% of the gap between its current level and that which it attains in the long-run equilibrium. The general guideline states that the coefficient of error correction term should be negative and less than unity. This is because we do not expect 100% adjustment.

The explanatory power of the model is high, R^2 is 82.42%. This implies that, the eleven variables included in the model jointly explain 82.42% of the variation in the value of output supply for non-tradeable crops.

EQ(2) Modelling DLnVNT by OLS

Variable	Coefficient	Std.Error	t-value	t-prob
Constant	0.26682	0.087486	3.050	0.0087
DDLnPNT	0.56768	0.24110	2.355**	0.0337
DDLnPNT_1	1.0905	0.23114	4.718*	0.0003
DDLnPEA	0.43890	0.19739	2.223**	0.0432
DDLnLA_2	0.13510	0.057183	2.363**	0.0332
DDLXNT	1.7234	0.48200	3.576**	0.0030
DDLXNT_1	1.1216	0.48839	2.297**	0.0376
DDLXNT_2	1.1744	0.39879	2.945**	0.0107
DLnVNT_2	0.21181	0.18548	2.142**	0.0726
D1	-0.17433	0.096933	-1.798***0.1007	
D2	-0.12418	0.080503	-1.543***0.1481	
ECM2_1	-0.59623	0.23584	-2.528**	0.0341

R^2 = 0.8242 F(11, 14) = 5.97 [0.0013] $\hat{\sigma}$ = 0.145237 DW = 1.70

RSS = 0.295

*significant at 1% level

** significance at 5% level

*** significant at 10% level

4.6 ESTIMATION OF VALUE OF OUTPUT OF TRADEABLE CROPS

In estimation of value of output of tradeable crops, just as the two models above we estimated an over-parameterized model, which is reported in the appendix 3. In order to identify the main dynamic patterns of the model using ordinary least squares (OLS), with a three-lag length for all variables in the model.

The model was further simplified into a more interpretable Nerlovian adjustment mechanism. The simplification was guided by insignificance of t-values against t-critical with the main concern that the model remains theory consistent. Dropping the lagged insignificant variables led to improved t-values for the remaining regressors.

The final model produced by simplification is reported in Equation 3. The result indicates that the SAP dummy D_2, has a negative sign and insignificant. This shows that the structural adjustment policies implemented have had negative impact on output supply of the tradeable crops.

The coefficient for current and previous price has the expected positive sign and they are significant at 1% level. This indicates that tradeable farmers are sensitive to both current and previous price. A one per cent increase in current and previous price all other factors being equal is associated with 0.82546% and 0.77122% increase in value of output of tradeables respectively. Thus we reject the null hypothesis and conclude that price is a significant factor in influencing output supply of tradeable crops.

Public expenditure on agriculture sector has a positive sign and significant at 5% level. A possible reason for the positive coefficient is that the funds allocated to the sub-sector are utilized for the intended purpose. The estimates show that a one percent increase in government expenditure on agriculture sector all other things equal leads to 0.[illegible]098% increase in value of output supply of tradeable crops.

The coefficient of loan to agriculture sector is positive as expected and significant at 5% level, implying that tradeable farmers are responsive to credit. The results show that tradeable farmers are more sensitive to credit than non-tradeable farmers this could be because the former is more accessible to credit facilities than the latter. A one percent increase in loan to this sector ceteris paribus is associated with 0.086846% increase in value of output of tradeable.

The dummy D1 for the weather pattern has the expected sign and significant at 10% level. This suggests that rainfall is an important factor in determining the value of output supply of tradeable crops in Kenya. A one percent increase in the amount of rainfall ceteris paribus is associated with -0.034120% increase in value of output of supply tradeables.

The error correction model (ECM_3). This shows the rate at which the loss of information is corrected emanating from differencing of the variables to make them stationary. It has the expected sign and significant at 10% level implying that at each period t, agricultural output adjusts by 42.30% of the gap between its current level and that which it attains in the long-run equilibrium. By rule of thumb the coefficient of error correction term should be negative and less than unity. This is because we do not expect 100% adjustment.

The explanatory power of the model is high, R^2 is 92.23%. This means that the variables included in the model jointly explain 92.23% of the variation in the value of output supply for tradeable crops.

EQ(3) Modelling DLnVT by OLS

Variable	Coefficient	Std.Error	t-value	t-prob
Constant	0.31339	0.088634	3.536	0.0037
DDLnPT	0.82546	0.10013	8.244*	0.0000
DDLnPT_1	0.77122	0.10879	7.089*	0.0000
DDLnPT_2	0.42213	0.10655	3.962*	0.0016
DDLnPEA	0.57098	0.16603	3.439*	0.0044
DDLnPEA_1	0.43432	0.13955	3.112*	0.0082
DDLnLA	0.064178	0.029995	2.140**	0.0514
DDLnLA_1	0.086846	0.035645	2.436**	0.0300
DDLXT_1	0.60438	0.23918	2.527**	0.0253
D1	-0.034120	0.086068	-2.396**	0.0[illegible]2
D2	-0.14747	0.092891	-1.588***0.1364	
ECM3_1	-0.42297	0.20597	-2.054***0.0[illegible]7	

R^2 = 0.9223 F(11, 13) = 14.03 [0.0000] $\hat{\sigma}$ = 0.1523 DW = 1.73

RSS = 0.3016

* significant at 1% level

** significance at 5% level

*** significant at 10% level

4.7 DIAGNOSTIC TEST

JARQUE-BERA (JB) NORMALITY TEST

The results from the three regression shows that error term are normally distributed in all the regression because the chi-square calculated (5.3535 for VAC, 2.1923 for VNT and 0.98808 for VT) is less than the chi-square crit (5.99) at 5% level of significance.

RESET TEST

Sometimes it is possible to specify a model as linear when there are non-linearities in the model. To test whether there is misspecification of non-linearities. the reset test is utilized. The reset test is reported as F -distribution. The linear model specification is accepted once the F-cal is less than F-crit. From our three regressions carried above the results show that the models are correctly specified since the F-cal (0.66521 for VAC, 8.5202 for VNT and 2.7253 forVT) is less than F-crit(4.84 for VAC, 4.60 for VT) at 5% level of significance and F-crit(8.86) for VNT at 1% level of significance.

HETEROSCEDACITY TEST

ARCH (Autoregressive conditional heteroscedasticity test) is a test used to test for the existence of heteroscedaticity. If F-cal is less than F-crit at a given level of significance indicates the presence of heteroscedasticity. From the regression above the results indicates absence of heteroscedasticity since the F-cal (4.8322 for VAC, 0.90371 for VNT and 1.35615 for VT) in the three regression is less than F-crit (4.96 for VAC, 4.67 for VNT and VT) at 5% level of significance.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIOS

5.1 CONCLUSIONS:

The prime objective of this study was to investigate the response of agriculture sector to adjustment policies in Kenya. The results show that the policies implemented generally have contributed negatively to agricultural supply output in the three models estimated. This result supports supply response literature, thus we attribute the response of the sector to the other variables included in the model.

In all the three regression estimated i.e. value of output supply for all crops (VAC), value of output of non-tradeable crops (VNT) and value of tradeable crops (VT) output price was found to be an important factor in influencing agricultural output supply. The loan extended to agriculture sector was found to be a significant factor in influencing output supply in the sub-sector considered. It's effect show that non- tradeable farmers are more responsive to credit facilities than the tradeable farmers. The public expenditure on agriculture sector (PEA) variable was found to be positive and significant in two regression estimated i.e. value of non-tradeables and value of tradeables indicating that public expenditure is a crucial factor in determining agricultural output supply. The results also manifests that the rainfall variable plays a crucial role in influencing agricultural output supply in a given period. Area planted was also found to be positive as expected and significant in influencing output supply in the three models estimated.

There are some other factors, which were not included in the three models but may play, an important role in determining output supply. The factors are as follows:

First, infrastructural constraints arise especially in new and potentially agricultural production areas, which are not adequately served with roads, making it difficult for the machinery

and inputs to be accessible to the farmers and further increasing their cost. Such constraints also delays transportation and marketing of output. Infrastructural problem is further worsened by imperfect market for inputs, mostly fertilizers and agro-chemicals which necessitate distant and costly transportation to farms in addition to their retail prices.

Secondly, lack of a technolgical package for agricultural farming in marginal areas and this has posed a serious problem to production. The farmers in such areas employ rudimentary technolgy like hoes and animals to perform agricultural operations.

Thirdly, extension services do not really benefit the farmers as expected. Extension officers lack technical packages to sale to the farmers and the situation is aggravated by lack of funds, which results in insufficient mobility, and hence only few farmers are visited.

The first three objectives of our study have been made and thus the fourth objective is to make policy recommendations for improving agricultural production.

5.2 POLICY RECOMMENDATIONS

The emerging empirical results have policy implication for policy reforms, policy design and implementation, and the future development of agriculture in the country.

The output price was found to be an important factor in determining agricultural output supply. This implies therefore that output price should be made more favourable to the farmers. This could be done by the government, which is currently an observer by reviewing the output prices annually to ensure that they are in line with import prices.

Rainfall was also found to be an important variable in influencing agricultural output supply. Therefore, policy actions have to be extended to the area of meteorological services. Adequate weather forecasts regarding the amount of rainfall will guide farmers in starting their

farming operations during production season. This will also help farmers to seek other alternative means such as irrigation to prevent losses often sustained by some farmers when they have to embark on replanting fields having been misguided by unsteady patterns of rainfall.

Public expenditure on agriculture was found to be positive as expected and insignificant for value of all crops. A possible explanation for this is that the government commitment to agricultural development diminished considerably during SAP period. Policy makers need to restrain themselves from implementing across the board cuts in public expenditure that affects such a critical area of production as agriculture. This is crucial because such cuts have adverse consequences on extension services and the adoption of technological innovation among the small-scale farmers in the country. With disproportionate cuts in public expenditure on agriculture, especially capital expenditure on agriculture, farmer's access to modern inputs such as fertilizer, irrigation water, improved seed varieties and others will be greatly impaired. Also reduction in recurrent expenditure may lead to shortage of staff and inability to upgrade staff quality and productivity. This impediment may, in turn, have deleterious effects on agricultural project implementation and on effective delivery of extension services to the farmers.

Furthermore, we should not consider expenditure reduction as a panacea to structural bottlenecks that have militated against improved agricultural performance over the years. To date, majority of farmers in Kenya depend on rudimentary technology like hoes and animals for carrying out major farming operations. Only few have access to formal credit facilities. In addition only few farmers use chemical fertilizers. Even for these groups, access to fertilizers proves more difficult because the distribution network is beset myriads of impediments leading to late arrivals, misapplication and wastage. Unfortunately the private sector cannot be relied upon to remedy the

situation completely due largely to the associated risk, low returns as well as the limited capacity and unwillingness of private investors with regard to agriculture.

The high instability of public expenditure on agriculture will also have to be addressed if the desired results are to be accomplished. This however requires a more effective planning and the release of funds on a timely and regular basis than ever before. Timeliness is also required in the delivery of essential services and farm inputs being procured with public funds.

Loan extended to agriculture sector was found to be a significant factor in influencing agricultural output supply. This implies that farmers utilize the loan for the intended purpose. In regard of this therefore, the government need to devise effective means of generating the socially optimal allocation of loan facilities to both tradeable and non-tradeable farmers. Improvement in credit represents additional resources to the sector and will enable farmers to adopt new and more productive techniques that are capital intensive thus increasing output supply.

Acreage under crops was found to positive and significant in the three models estimated in influencing quantity supplied in Kenya. This implies that area under crops should be expanded so as to increase output supply. Another method where output under production can be increased is by practicing intensive rather than extensive mode of production. In addition to this the rights to own land and use should be legally protected and an appropriate land market developed in a bid to allow willing farmers to engage in farming. To discourage owning of land for speculative purposes and to encourage landowners to lease land for agriculture, a tax system should be introduced on idle land based on the potential of that land.

The constraints outlined above need to be addressed if agricultural output has to be increased. First, the infrastructural constraints need to be solved effectively especially agricultural

potential areas. This can be solved by ensuring that the feeder roads are passable throughout the year so as to facilitate movement of inputs and output.

Secondly, a technological package for small-scale farmers and the marginal areas need to be devised so as to encourage expansion area under agricultural production. It is also crucial to introduce new seed varieties suitable for marginal areas and this should be made available at subsidized prices in order to encourage farmer's especially small-scale farmers to engage in farming activities.

There is need to enhance the workings of the market by removing all the direct or indirect controls on the interference with the production and the marketing of agricultural commodities. This can be done trough government creation of an adequate legal framework and development of regulatory institutions and appropriate infrastructure in order to ensure fair competition between market participants. The required legal framework e.g. weight and measures act should spell out regulations and rules regarding fair competition, including penalties for malpractice's, between participants in the sector. Competent (regulatory institutions) should ensure that laws are strictly adhered to and that culprits are penalized once breach the laws. Appropriate infrastructure developments are required to remove market failures, which would otherwise inhibit the workings of an efficient free marketing system.

Finally, if the policy options recommended above are implemented effectively then agricultural ouput supply may increase substantially. The options suggested in our paper to improve agricultural development are general and apply to the agriculture as a whole. However, it must be realised that the agricultural sector is diverse. Hence, detailed policies for specific programmes are required to deal with each sub-sector.

5.3 LIMITATION OF THE STUDY

The major limitation of our study is that it focuses on effects of SAP that have significant effect on agricultural sector, detaching the sector from the rest of the economy for purpose of analysing it's response structure. Hence a sectoral analysis is unable to include all indirect impact channels, all types of trade-offs and all multiple effects of economy-wide policies. Another problem is the inconsistency of the data used, because data for some years go unrecorded and also the model does not cover all the crops.

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APPENDIX 1.

OVER-PARAMETERIZED MODEL FOR VALUE OF ALL CROPS

EQ(1) Modelling DLNVAC by OLS

Variable	Coefficient	Std.Error	t-value	t-prob	PartR²
Constant	0.17332	0.24003	0.722	0.4865	0.0496
DDLnPNT	1.8420	0.45313	4.065	0.0023	0.6230
DDLnPNT_1	0.78683	0.45426	1.732	0.1139	0.2308
DDLnPNT_2	0.51109	0.34290	1.491	0.1669	0.1818
DDLnPT	0.72725	0.20979	3.467	0.0061	0.5458
DDLnPT_1	0.88433	0.19149	4.618	0.0010	0.6808
DDLnPEA	0.17799	0.26261	0.678	0.5133	0.0439
DDLnPEA_1	0.11528	0.10294	1.120	0.2889	0.1115
DDLnLA	0.079662	0.042932	1.856	0.0932	0.2561
DDLnLA_1	0.014750	0.064225	1.230	0.8230	0.0052
DDLXAC	0.26740	0.33740	1.793	0.4465	0.0591
DLNVAC_1	0.20478	0.19942	1.027	0.3287	0.0954
DLNVAC_2	0.42267	0.17226	2.454	0.0340	0.3758
D1	-0.28602	0.17255	-1.658	0.1284	0.2155
D2	-0.022631	0.18268	-1.124	0.9039	0.0015
ECM1_1	-0.82503	0.36092	-2.286	0.0453	0.3432

R^2 = 0.94159 F(15, 10) = 10.747 [0.0003] $\hat{\sigma}$ = 0.198238 DW = 2.24

RSS = 0.392981484

APPENDIX 2

OVER-PARAMETERIZED MODEL FOR THE VALUE OF NON-TRADEABLE CROPS

EQ(2) Modelling DLnVNT by OLS

Variable	Coefficient	Std.Error	t-value	t-prob	PartR²
Constant	0.17597	0.15402	1.143	0.2843	0.1403
DDLnPNT	0.94348	0.35355	2.669	0.0284	0.4709
DDLnPNT_1	1.2246	0.27638	4.431	0.0022	0.7108
DDLnPNT_2	0.17379	0.25119	1.692	0.5036	0.0565
DDLnPEA	0.46305	0.27900	1.660	0.1356	0.2561
DDLnPEA_1	0.010296	0.13362	1.077	0.9413	0.0007
DDLnPEA_2	0.054712	0.080551	1.679	0.5162	0.0545
DDLnLA	0.040720	0.033597	1.212	0.2611	0.1551
DDLnLA_1	0.083120	0.055375	1.501	0.1717	0.2197
DDLnLA_2	0.17050	0.091345	1.867	0.0939	0.3034
DDLANT	1.7630	0.56218	3.136	0.0139	0.5514
DDLANT_1	0.87350	0.63786	1.369	0.2091	0.1899
DDLANT_2	1.2478	0.47088	2.650	0.0293	0.4674
DLnVNT_1	0.31691	0.31497	1.006	0.3438	0.1123
DLnVNT_2	0.38192	0.26339	1.450	0.1831	0.2081
D1	-0.25091	0.10469	-2.397	0.0434	0.4180
D2	-0.089933	0.10730	-1.838	0.4263	0.0807
ECM2_1	-1.0885	0.42402	-2.567	0.0333	0.4517

R^2 = 0.9028 F(17, 8) = 4.3709 [0.0199] $\hat{\sigma}$ = 0.142866 DW = 1.72

RSS = 0.1632866927

APPENDIX 3

OVER-PARAMETERIZED MODEL FOR VALUE OF TRADEABLE

EQ(3) Modelling DLnVT by OLS

Variable	Coefficient	Std.Error	t-value	t-prob	PartRy
Constant	0.21243	0.13725	1.548	0.1561	0.2102
DDLnPT	0.79916	0.16930	4.720	0.0011	0.7123
DDLnPT_1	0.88834	0.19739	4.500	0.0015	0.6923
DDLnPT_2	0.40519	0.13906	2.914	0.0172	0.4854
DDLnPEA	0.42898	0.19151	2.240	0.0518	0.3579
DDLnPEA_1	0.41292	0.15818	2.610	0.0282	0.4309
DDLnLA	0.11300	0.045079	2.507	0.0333	0.4111
DDLnLA_1	0.14788	0.052141	2.836	0.0198	0.4720
DDLXT_1	0.79453	0.29467	2.696	0.0245	0.4469
DDLXT_2	0.72261	0.47849	1.510	0.1663	0.2022
DDLXT_3	0.50609	0.42120	1.202	0.2602	0.1382
DLnVT_1	0.0026347	0.19635	0.013	0.9896	0.0000
DLnVT_2	0.22571	0.20877	1.081	0.3077	0.1149
D1	0.0016981	0.091516	0.019	0.9856	0.0000
D2	-0.089722	0.11518	-0.779	0.4561	0.0632
ECM3_1	-0.46295	0.25858	-1.790	0.1171	0.2626

R^2 = 0.949565 F(15, 9) = 11.297 [0.0005] $\hat{a}$ = 0.147489 DW = 2.47

RSS = 0.1957759007