Journal of
Agriculture Policy
(JAP)

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CARI Journals

Journal of Agricultural Policy
ISSN xxxx-xxxx (Paper) ISSN XXXX-XXXX (Online)
Vol.2, Issue 1, No.1, pp 1 - 33, 2017

www.carijournals.org

IMPACT OF STRUCTURAL ADJUSTMENT PROGRAMS ON AGRICULTURAL SECTOR GROWTH IN KENYA

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Abstract

Purpose: The study was an examination of the impact of structural adjustment programs on agricultural growth in Kenya.

Methodology: The study examined the short run and long run determinants of agricultural sector performance in Kenya. To achieve this, the study use time series regression modeling for data spanning from 1975 to 2010. Tests of normality, unit roots test and cointergration test was applied to determine the properties of the data. Upon proof of cointergration, an error correction model was estimated to link the short run and the long run relationships.

Results: The results indicated that structural adjustment programme (SAPs) had a negative and significant long run effect on per capita agriculture GDP. The study concluded that Post Election Violence had a negative and significant long run effect on the per capital agriculture GDP. The study also concluded that the lagged per capital agricultural performance had a positive and significant effect on the per capita agricultural performance. The results also led to the conclusion that the long run per capita agricultural growth may be linked to the short run growth by an error correction term of -0.242583 which indicates that 0.242% of the disequilibria in short run per capita agricultural sector GDP achieved in one period are corrected in the subsequent period. The results also led to the conclusion that weather indicators (temperature and precipitation), and per capita infrastructure did not have a significant effect on the short run and long run per capita Agricultural GDP.

Unique contribution to theory, practice and policy: The study recommends that some harmful policies need to be eliminated such as the removal of subsidies. Other policy recommendations are to enhance the adaptation of privatized agricultural institutions; encouragement of value addition in primary agricultural products; non price mechanisms such as infrastructure should be encouraged especially in the rural areas; and enhancement of the political stability of the country especially during electioneering years.

Keywords: *structural adjustment programs, growth, agricultural sector, GDP, short and long run, performance*

1.1 INTRODUCTION

Agriculture in Kenya continues to dominate Kenya's economy. However, only 15-17 percent of Kenya's total land area has sufficient fertility and rainfall to be farmed and only 7-8 percent can be classified as first-class land, that is, land which can support rain fed agricultural production year in year out. The total agricultural land in Kenya is 273,500 square kilometers. The agricultural land as a percentage of total land area currently stands at 48.05%. The agricultural irrigate land as % of total agricultural land currently stands at 0.04%.

In 2006, almost 75 percent of working Kenyans made their living by farming, compared with 80 percent in 1980. About one-half of Kenya's total agricultural output is non-marketed subsistence production. Agriculture is also the largest contributor to Kenya's gross domestic product (GDP). In 2005, agriculture, including forestry and fishing, accounted for about 24 percent of the GDP, as well as for 18 percent of wage employment and 50 percent of revenue from exports (Mwanda, 2008). Other reports, for instance, Kirwa (2006) asserts that agriculture accounts for about 26% of the GDP directly, while the indirect contribution to GDP stands at 27%. These figures are also confirmed by World Development Indicators (2012) which place the contribution of agriculture to GDP at 25.0% in year 2007, 25.8% in year 2008, 27.18% in year 2009, 25.18% in year 2010 and 23.13% in year 2011.

1.1.1 Structure of the Agricultural Sector in Kenya

The agricultural sector in Kenya is mainly constituted of smallholder farms, large mixed farms, plantations (or estates), ranches and pastoralists (mainly in the arid and semi-arid regions). The smallholder sector, accounts for over 95 percent of holdings (using a threshold of 12.5 hectares). This sector is the most dominant. About 8.6 million hectares (i.e. less than 20 percent) of land is considered to be of high or medium potential. Of this, about 2.8 million hectares are under crop production, 2.4 million hectares are under dairy farms, and the remaining 3.4 million hectares under extensive grazing and national parks.

An observed trend in agriculture throughout Africa, including Kenya, has been the steadily declining land-to-person ratio. Arable land is scarce and the problem is compounded by rapid population growth. FAO data shows that between 1960 and 2000, the amount of arable land under cultivation (including permanent crops) rose marginally, but the population of households engaged in agriculture tripled, progressively diminishing the ratio of arable land to agricultural population. This ratio is predicted to keep declining. By 2020, the land-to-agricultural person ratio may be about half as large as it was in the 1960s.

World Bank report (2010) asserts that, within agricultural sector, the shares of crops, livestock, forestry, and fisheries have remained almost constant over the past decade. Crops dominate at 69 percent of total agricultural GDP. Livestock is the next largest component at 24 percent, and the others are relatively smaller. What happens in the crops subsector thus has a large influence on the performance of the agricultural sector as a whole. The World Bank report (2010) further asserts that a deeper look into the structure of the agricultural sector reveals that Kenyan agriculture is diverse relative to agriculture in many other African countries. Export crops and higher-value horticultural crops are as important as cereals and root and oil crops. The main

industrial crops (including the main exports)—tea, coffee, sugar, and cut flowers—account for roughly one-quarter of total agricultural GDP (6.4 percent of the national economy). By contrast, food crop production is dominated by maize, accounting for about 13 percent of agricultural GDP (3 percent of the national economy). Agriculture and food processing are especially important activities for the rural economy, generating two-thirds of rural GDP.

1.1.2 Policy Framework for the Agricultural Sector in Kenya

A number of policies have been formulated to revitalize the agriculture sector. Some of these policies include the Fourth and Fifth Development plans, Millenium Development Goals, Economic Recovery Strategy (ERS), the Strategy for Revitalizing Agriculture (SRA) and the Vision 2030. In addition, the Fourth and Fifth Development Plans which spanned (1979 – 83) and (1983 – 88) respectively were aimed at addressing the incentive structure in the agricultural sector. Specifically, the plans were borne out of the need for a stabilization policy following dramatic changes in the economy. Specifically, the plans which were in the form of structural adjustment programmes led to the phasing out of import restrictions and the waiver of tariff protection (Alila & Atieno, 2006).

The economic recovery strategy (ERS) was launched by GOK in 2003.The strategy outlined the development strategy and policies that the government planned to pursue by 2008. The strategy aimed to reduce the cost of doing business and to reduce poverty by providing people with income earning opportunities. It also took into account existing policy documents, particularly the Poverty Reduction Strategy Paper (PRSP), the NARC Manifesto, and the Post-Election Action Plan. The ERS strongly recognized that economic recovery is primarily the result of improvements in the productive sectors of the economy -agriculture, tourism, trade and industry.

The NARC administration launched the 10-year Strategy for Revitalizing Agriculture (SRA) in 2004. The initiative sought to increase productivity by lowering per unit costs of production, improve the extension service system, strengthen links between research and the farmers, improve access to financial services, reduce agricultural taxation, encourage the growth of agri-business, increase market access, and reform the regulatory system. The Implementing SRA was faced by various challenges. For instance, more than 130 pieces of agricultural-related legislation remain on the statute books. There are more than 30 public agencies set up in agriculture, which, at times, have contradictory or redundant policies (Kenya Investment Authority, 2010).

The importance of agriculture has also been noted in vision 2030. The Government of Kenya launched vision 2030 as the new long term development blue print for the country. The vision is anchored in three pillars: social, economic, and political governance. The economic pillar aims to achieve an economic growth rate of 10 per cent per annum and sustain it until 2030. To achieve this, various sectors of the economy have aligned their vision to that of Vision 2030. On its part, the Agricultural Sector has revised its Strategy for Revitalizing Agriculture (SRA), which was the guiding sector blueprint in the last six years to the new Agricultural Sector Development Strategy (ASDS) (ASCU, 2010).

1.1.3 Structural Adjustment Programs in the Agricultural Sector

To deal with the deteriorating economic conditions, the Kenyan government with the assistance of the World Bank designed a structural adjustment program (SAP) which was to be implemented at the beginning June 1986. The SAP aimed at facilitating economic growth as a means of jump-starting the economy towards sustainable economic growth and development.

Kimuyu (2005) asserts that Structural adjustment policies (SAPs) pursued introduced in the late 1980s are important events in Kenya's policy history. In particular, SAPs in Kenya consisted of price decontrols, tariff adjustments, the reforming of state corporations and cost sharing in the delivery of social services. Kimuyu (2005) further argues that even though the productivity consequences of most of elements of SAP were positive, the cost sharing element led to a decline in access to health and education. This negatively affected productivity.

Nyangito and Okello (1998) assert that the Kenyan dominance in private business and the consequent inability to continuously supporting the activities financially and technically, after privatization of most activities, led to a decline in agricultural growth and development. Specifically, a lack of harmony and co-ordination of the implementation for the privatization process led to poor agricultural sector performance which translated to the general poor performance of the economy. Nyangito and Karugia (2000) assert that structural adjustment negatively impacted on the performance of the agricultural sector. They argued that the policy reforms had a negative effect on the capacity of KARI to provide research and extension services. For instance, adjustment in the government fiscal policy has meant that KARI has fewer funds to do its research.

1.1.4 Emerging Themes from Studies related to SAPs

Non Kenyan studies that have found a negative impact of SAPs on agricultural sector performance include Igbedioh and Aderiye (1994), Awoyomi (1989), Momoh, (1995); Yamaguchi and Sanker (1998); Qualman and Wiebe (2002); Hazell et al. (1995); Meertens (2000); Baazara (2001) and Bryceson et al (2010). There also a host of studies that have found a positive relationship between the introduction of SAPs and agricultural performance. These include; Van Royen et al. (1996) and Tackie and Abhulimen (2001); Reed, (1996); Nwosu, (1992); Olomola, (1994). The existence of studies that find appositive relationship while others find a negative relationship implies that the empirical areas are riddled with inconclusiveness.

Another area of contention is whether the studies on impacts of SAPs should concentrate of aggregate agricultural production or on individual crops. The advocates of aggregate impact analysis allude to the fact that adjustment policies may induce intra crop tradeoffs. On the other hand, the proponents of Individual crop analysis argues that individual crops do respond strongly to price factors, often with higher price elasticity than aggregate agricultural output (Binswanger, 1989; Oyejide, 1990; Braverman, 1989).

1.2 Statement of the Problem

The agricultural sector in Kenya is the backbone of the economy due to its numerous back and forward linkages in the economy. Policy measures aimed at revitalizing agriculture have been found to have wider distributional effects than policies aimed at any other sector. The performance of the Agricultural sector is crucial for food security. However, the agriculture sector has been performing dismally and this may have impacted negatively on food security.

There are many causes of food insecurity in Kenya. Authors such Nyangito (2004) have cited poor infrastructure as a possible cause of food insecurity in Kenya. Kimani (2011) argued that poor agricultural research systems and poor weather conditions are a possible cause of food insecurity. Onjala (2002) cites lack of trade openness as a possible cause of food insecurity. The World Bank Pro-Poor Agriculture Report (2010) observes that inconsistent policies are partly to blame for the poor agricultural production and the resultant food insecurity. For instance, the

report highlights various policies which are strewn across institutions responsible for agricultural production. Such institutions include the ministry of agriculture, ministry of livestock, ministry of fisheries and ministry of cooperative development. It is also evident that the PRSP and ERS were also biased against agriculture since they favored a model of industry led growth. However, the World Bank Pro-Poor Agriculture Report (2010) asserts that any policy that ignores the role of agriculture in economic growth is misguided. Therefore, World Bank Pro-Poor Agriculture Report (2010) advocates for a balanced growth model which included both agriculture and industry.

Other studies that recognize the role of policy in agriculture and its effect on food sustainability include Tackie and Abhulimen (2001) who investigated the impact of the Structural Adjustment Program on the Agricultural Sector and Economy of Nigeria. The study by Tackie and Abhulimen (2001) found a positive relationship between SAPs and agricultural production as well as the overall economy. Shimanda (1999) investigated the effect of the structural adjustment program on the increased food production in Nigeria from a local level perspective. Mwakalobo (1997) attempted to investigate the effects of price reform measures on smallholder production systems in Rungwe district (Tanzania). The study by Mwakalobo (1997) also investigated responses and changes that have taken place in smallholder agricultural production systems in the study area following the institution of price reform policies in Tanzania. Specific studies focusing on SAP and Kenya are scarce. For instance, Rono (2002) examined the effects of structural adjustment programmes (SAPs) on Kenyan society and linked SAPS to high rate of income inequality, inflation, unemployment, retrenchment, and so on, which have lowered living standards, especially, those relating to the material resources in the family. A study gap is identified in that the studies that concentrate on agricultural policy and its effects on agricultural production as well as economic growth are usually inconclusive. Specifically, the studies either paint a positive or a negative picture about SAPs and their effect on agricultural production. A study to reduce the heat to light ratio in the discourse of the impact of SAPs on agricultural production is therefore necessary. The current study sought to bridge this gap by empirically examining the impact of SAPs on agricultural growth in Kenya.

1.3 Research Objectives

i. To investigate the impact of SAPs on agricultural growth in Kenya
ii. To determine short run determinants of agricultural growth in Kenya
iii. To establish the long run determinants of agricultural growth in Kenya

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 The Classical Theory of Economic Growth and Structural Adjustment Programmes

The classical theory of economic growth was advocated by David Ricardo. He argued that the growth of a country stems from the participation in free trade resulting from the comparative advantage it has in producing goods and services. It therefore made sense to buy those goods that could not be produced at a comparative advantage and produce with an intention of selling goods which could be produced at a comparative advantage. The relevance of this theory to structural adjustment programs is obvious as structural adjustment programmes advocated for liberalization

of trade. Developing countries were therefore guided to open up their local economies to competition from external economies.

2.1.2 The Harrod Dommar Growth Model and Structural Adjustment Programmes

Harrod-Domar Equation of economic growth and development indicates that the rate of growth of GDP (ΔY/Y) is determined jointly by the national saving ratio (usually expressed as a percentage), **s**, and the national capital-output ratio (expressed as an integer), k. Therefore, is a direct linear relationship between economic growth of a country and its savings ratio whereby, the more the savings, the higher the growth in national income. In addition, the growth rate of national income is (negatively) related to the capital-output ratio of an economy, that is higher capital output ratios are associated with low rate of GDP growth.

In equation form;

S = s (Y)……..(1)

Savings is a function of income

ΔK/ΔY = k ……..……(2)

Change in capital in relation to change in income equals capital output ratio (k). K is determined exogenously

ΔK = k (ΔY)…….. (3)

Therefore, change in capital is an increasing function of changes in national income given the capital output ratio

I = ΔK and **ΔK = k (ΔY)**…….. (4)

Investment =change in capital; and change in capital is a function of changes in income given the capital output ratio

I = k (ΔY)…… (5)

Investments is therefore directly related to changes in income given the capital output ratio

Therefore: since S(Y)=I; then s (Y) can be given by;

s (Y) = k (ΔY)…… (6)

Now, divide both sides of the equation above first by **Y** and then by **k**, we obtain the following equation:

s/k= ΔY/Y……..(7)

Note that **ΔY/Y** is equal to the rate of growth of GDP (the percentage change in GDP)

The relevance of the Harrod Dommar model to the introduction of structural adjustment programs stems from the importance of national savings and its role in GDP growth rate. The wisdom behind the model can then be used to support calls in reduced government expenditure.

2.1.3 The Neoclassical Growth Model and Structural Adjustment Programs

Robert Solow and Stewart Swan developed the Solow-Swan Growth Model, which involved a series of equations which showed the relationship between labor-time, capital goods, output, and

investment. Accordingly, the role of technological change became important, far much more important than the accumulation of capital. In equation form the Solow growth model start with a production function;

Y= f(K, AL)……..(8)

After several manipulations, the final Solow swan model is;

$$\frac{d}{dt}k(t) = sf(k) - (g + n + \delta)k(t)$$……(9)

Equation 9 is the expression for the equation of motion of capital in the Solow Growth Model. Equation 9 stipulates that capital will increase (decrease) when the amount of savings $sf(k)$ is larger (smaller) than the combined cost of technology growth $gk(t)$, labor growth $nk(t)$ and capital depreciation $\delta k(t)$.

The relevance of the model to the introduction of structural adjustment programs is that the Bretton woods institution assumed that the only way that developing countries can grow is through capital accumulation. Capital accumulation is achieved through savings. Therefore, they advocated for the reduction of government budgets and the elimination of subsidies to agricultural sectors.

2.1.4 Theoretical Arguments for and Against Structural Adjustment Programs

Structural adjustments policies designed by world financial institutions such as the World Bank and the International Monetary Fund (IMF) were geared at improving the socioeconomic conditions of nations with poor socioeconomic performance. Adoption and implementation of such policies (e.g., currency devaluation, trade liberalization, privatization, and removal of subsidies) in the 1980s and 1990s was seen as a way of reversing the widespread social and economic problems of developing nations. However, the wisdom behind the introducing SAPs is based on neoclassical theories. The opponents of SAPs question the wisdom behind SAPs by critiquing the neoclassical theories.

2.1.5 Schools of Thought Advocating for Structural Adjustment Programs

The school of thought that is positively associated with structural adjustment programs is the neo classical school of thought. The main assumptions of this school of thought are that i) People have rational preferences among outcomes that can be identified and associated with a value ii) Individuals maximize utility and firms maximize profits iii) People act independently on the basis of full and relevant information (iv) diminishing returns (v) equality of sales and purchases (vi) unique equilibrium (vii) Many participants, Freedom of Entry and Exit(viii)Independence of Demand and Supply.

The neoclassical assumptions overall implications is that economic agents are responsive entirely to price variables. In the case, of structural adjustments programmes, farmers are assumed to be responsive to price and non-price incentives. They are assumed to be rational, have perfect knowledge and participate in perfectively competitive markets with freedom of entry and exist. Farming resources are also assumed to be freely transferable and this facilitates the market forces returning the market to its equilibrium. This school of thought has been supported by World Bank (1981), Kuester et al. (1990), Mundlak et al. (1989) and Krueger et al. (1990). This school of thought asserts that though market failures and externalities justify government intervention, especially in less-developed countries, introduction of SAP is appropriate for developing

countries. This is because SAPs are anchored on the grounds that government intervention has distortionary effects in three key areas: resources use, domestic absorption and use of scarce foreign exchange.

Two main questions arise in the discussion on SAPs: 1) Is getting policies right sufficient to counteract all external and other internal constraints? 2) Is getting policies right synonymous with getting prices right? The advocators of SAPs argue that the answers to this two questions are 'yes'. In other words, SAPs are the panacea (cure all) for external factors (factors differentiating developed and developing economies such as dependence on a few primary exports and on capital goods imports, low income elasticities for primary products, competing synthetics, terms of trade deterioration, weak infrastructure of international trade. The proponents of SAPs also argue that SAPs are the answers to internal factors unique to developing countries (policies, climatic vagaries, population growth, political instability, wars).

2.1.6 Schools of thought against Structural Adjustment Programmes

There is a school of thought that argues against SAPs. This school of thought is centred on the new Keynesian economics. The new Keynesian economics were originated by Stanley Fischer, Edmund Phelps, and John Taylor. Their focus was on demonstrating the micro-foundations of price and wage stickiness. According to Gordon (1990), sticky prices imply that real GDP is a residual, and is not determined by agents in the economy. Therefore, the firms optimize by setting prices, and accept quantities (production levels) as given. This runs contrary to the neoclassical and new classical theories, which asserts that the firms are price takers and optimize by setting quantities (production levels).

This school of thought also argues that structural rigidities are dominant characteristics of less developed economies, and therefore, price mechanisms are less capable of inducing significant response among economic agents. Therefore, liberation of markets and leaving the market forces to function alone will lead to market failure especially in the area of unresponsive prices and the lack of smooth and free transference of resources from one productive activity to another(Killick (1990a/b; Yagci et al. (1985). For instance, leaving market forces to determine the price of maize in developing economies may lead to farmers abandoning the activity all together due to poor market prices and high cost of production. The government therefore needs to provide subsidies (which run contrary to SAP). In addition, the assumption that farmers are rational is of course subject to critique. Furthermore, farmers do not have perfect information, and the assumption of perfect competition does not hold. Proponents of this school of thought argue that external factors that make developing countries unique include dependence on a few primary exports and on capital goods imports, low income elasticities for primary products, competing synthetics, terms of trade deterioration, weak infrastructure of international trade, and so on. The internal factors unique to developing economies include policies, climatic vagaries, population growth, political instability, wars. This further implies that policies (SAPs) which are ideal for developing countries may not necessary work for developing economies.

2.2 Empirical Review

This subsection attempts to analyze the empirical studies starting with those studies done for developed economies, followed by emerging economies, African economies and finally the Kenyan Economy. There has been considerable debate about the effects of such SAP measures. A host of researchers (e.g., Reed, 1996; Nwosu, 1992; Olomola, 1994) believe that structural

adjustment policies are essential prerequisites for economic recovery, adjustment to, and development in the new global market place. On the contrary, many other economists and social scientists such as Igbedioh and Aderiye (1994), Awoyomi (1989), and Momoh, (1995) argue that SAP measures have led to recessions and poor standards of living in developing countries. The empirical studies reviewed in the current study attempted to find out the different empirical results on the impact of structural adjustment programs on agricultural growth.

2.2.1 Structural Adjustment Programs and their Impact on Agriculture in Developed Economies

Qualman and Wiebe (2002) conducted a review of the impact of structural adjustment programmes in Canadian Agriculture. The authors asserted that since the 1980s, the canadian government has carefully implemented every component of an IMF program :export expansion; reduced government spending, deregulation , liberalized foreign investment , privatization , term termination of subsidies and prices supports , devaluation of currency, and a general move towards "market oriented " economic reforms. Qualman and Wiebe (2002) identify various specific programs that were implemented in Canadian agriculture to include a federal government cut of $2.8 billion worth of programs from its annual agriculture spending. The authors argue that two decades of structural adjustment have devastated farm families and rural communities. Furthermore, statistics on declining farm incomes and farm numbers tell only half the story. Specifically, the SAPs that supported exported agricultural export expansion led to the concentration of wealth in large corporations and the marginalization of the rural farmer. This in effect widened the gap between the rich and the poor.

2.2.2 Structural Adjustment Programs and their Impact on Agriculture in Emerging Economies

Yamaguchi and Sanker (1998) conducted a study to evaluate the impact of structural adjustment programmes on the Sri Lankans agricultural sector with a focus on the domestic food sector. The paper used the Two Sector Equilibrium Models with Growth Accounting Approach. The two sector identified were agricultural and non-agricultural sector. In their model, agricultural production depended on factors that are fixed in the short term such as land and capital as well as variable factors such as labor and imported input fertilizer. The study concluded that although the impact of SAPs on the growth of the overall agricultural sector was positive, it was negative in relation to domestic food sector. Specifically, the changes in fertilizer prices due to SAPs had a tremendous negative effect on agricultural production and specifically domestic food production. In addition, the liberalization of food imports also negatively affected domestic agricultural food production.

2.2.3 Structural Adjustment Programs and their Impact on Agriculture in African Economies

Tackie and Abhulimen (2001) conducted a study on the Impact of the Structural Adjustment Program on the Agricultural Sector and Economy of Nigeria. The authors used regression analysis and path analysis to link SAPs to agricultural sector and finally to the economy. In their first model of the path analysis, agriculture production was a function of SAPs (dummy variable). In the second model, net agricultural exports were a function of agricultural exports and SAPs. In their third model, contribution of agriculture to GDP was a function of net agricultural exports, agriculture production and SAPs. In their fourth model, real GDP growth

rate was a function of contribution of agriculture to GDP, net agricultural exports, agricultural production and SAPs. The authors found that SAP had a positive impact on agricultural production, which in turn, had a positive impact on net agricultural exports, which in turn, had a positive impact on contribution of agriculture to GDP, which ultimately led to a positive impact on real GDP growth rate. Their results confirmed that SAPs had a positive impact on agriculture and the overall economy.

Meertens (2000) undertook a study on the impact of Agricultural performance in Tanzania under structural adjustment programs. Meertens (2000) compared the performances in the food and cash crop sectors and the availability and consumption of agricultural inputs in Tanzania during structural adjustment programs (1986–1996) with periods prior to this IMF/World Bank backed reform. The authors argued that the positive developments in the first five years of reform in South Africa appeared to be not sustainable. The authors noted that the present productivity levels per rural capita for important food and cash crops was declining. In addition, there were no further improvements in the availability and consumption of agricultural inputs. This was attributed to removal of subsidies on agricultural inputs from 1991 onwards. The removal of subsidies was crucial in explaining the decline in maize production, the main food crop in Tanzania. Structural adjustment programs had gone too far in reducing the role of the government and the involvement of government might be necessary to ensure a higher consumption of agricultural inputs and thus a better performance of the agricultural sector in Tanzania.

Bryceson et al. (2010) investigated structural adjustment programmes in Africa. The authors examination of the structural adjustment programmes in African countries suggest that African agriculture's poor performance was not necessarily due to the negative effect of internal factors such as poor governance found in African governments, but could also, in large part, be attributed to the structural adjustment policies advocated by the international financial institutions and donor countries. The author argued that the solution of the problems associated with these structural adjustment policies lay in improving the ability of African farmers to benefit from new agricultural technologies that raise staple food productivity and thereby enhance food security and national stability.

2.2.4 Structural Adjustment Programs and their Impact on Agriculture in Kenya

Nyangito and Okello (1998) conducted a study on the Kenya's agricultural policy and sector performance from 1964 to 1996. The authors argue that during the era of controls, the Kenyan government dominated the production and marketing activities. This domination stifled the development of the private sector. However, government inability to continuously support the activities financially and technically, led to a decline in agricultural growth and development. In addition, government started initiative to offload the activities to the private sector and let the free markets guide production and marketing activities were also not successful. This is because there was a lack of harmony and co-ordination of the implementation for the privatization process. This resulted in stagnation of agricultural growth primarily because of the vacuum that existed as a result of a poorly developed private sector which also had poor capacity in production and marketing

Nyangito and Karugia (2000) conducted a study on the impact of recent changes in Kenyan agricultural sector and public agricultural research in Kenya. The authors used secondary data

from previous research reports and also used primary data from a questionnaire administered to management in KARI. The authors argue that the policy reforms had a negative effect on the capacity of KARI to provide research and extension services. For instance, adjustment in the government fiscal policy has meant that KARI has fewer funds to do its research. The findings imply that SAPs which advocated for the reduction in research activities had a negative effect on the productivity of the agricultural sector.

Nyangito, Nzuma, Ommeh, Mbithi (2004) in Kippra discussion paper no 39 conducted a study on the Impact of Agricultural Trade and Related Policy Reforms on Food Security in Kenya. The authors analyzed the impact of specific reforms on agricultural production, performance and trade, and therefore food security. The study used secondary data from the Central Bureau of Statistics and the Ministry of Agriculture. Welfare Monitoring Surveys of 1982, 1992 and 1997 were used as sources of regional cross-sectional household data. The authors analyzed trends in production and trade, the resultant impact of policy instruments such as prices and market access, household incomes and expenditures, and food security trends using various indicators for both the pre- and post-reforms periods. The analysis indicated that agricultural prices and productivity have generally declined in the post reform period. Specifically, the authors noted that the performance of the agricultural sector in the 1990s was dismal, with annual growth in agricultural GDP averaging 2% compared with 4% in the 1980s. Agricultural export growth after the reforms had shown mixed trends due to market access limitations for Kenyan exports. Market access for imports into the Kenyan market had improved since the reforms, occasioning a tremendous import growth. However, the report argued that the capacity to import food had declined, which made Kenya more food insecure. Reforms had also negatively affected the balance of trade between Kenya and the rest of the world. After the reforms, the country moved from broad self-sufficiency in production of most food staples to a net importer, a situation that begged for a re-thinking of the policy framework on agriculture.

Rono (2002) study examined the effects of structural adjustment programmes (SAPs) on Kenyan society. The authors noted that the economic and political reforms initiated by the World Bank and International Monetary Fund in Kenya since 1988 and especially after 1991 had transformed many aspects of the daily life of Kenyan people. The SAPs had been linked to the high rate of income inequality, inflation, unemployment and retrenchment. This had led to the unintended consequences of lowered living standards, especially, those relating to the material resources in the family. Furthermore, Rono (2002) argues that the SAPs in Kenya have been linked to the increasing social problems such as deviant and crime rates, ethnic hatred and discrimination and welfare problems, especially in the areas of education and health. However, Rono (2002) failed to systematically address the impact of SAPs on the agricultural sector productivity in Kenya.

3.0 RESEARCH METHODOLOGY

3.1 Economic Model

The neoclassical growth models demonstrate the importance of the accumulation of capital to the growth of an economy. Robert Solow and Stewart Swan developed the Solow-Swan Growth Model (neoclassical growth model), which involved a series of equations which showed the relationship between labor-time, capital goods, output, and investment. In equation form, the Solow swan growth model starts with a simple production function;

Y= f (K, AL)…….. (1)

The relevance of the model to the introduction of structural adjustment programs is that the Bretton woods institution assumed that the only way that developing countries can grow is through capital accumulation. Capital accumulation is achieved through savings. Therefore, they advocated for the reduction of government budgets and the elimination of subsidies to agricultural sectors.

However, the production or productivity of a sector is shown by the original Cobb Douglass model. Given the intuition behind the advocacy of the SAPs, statistical relationship between structural adjustment programs and agricultural productivity is exemplified in a Cobb Douglas production function setting where production is a function of labour and capital. In its most standard form for production of a single good with two factors, the function is;

$Y = AL^{\alpha}K^{\beta}$…… (2)

Where:

Y = total production (the monetary value of all goods produced in a year)

L = labor input

K = capital input

A = total factor productivity

α and β are the output elasticities of labor and capital, respectively. These values are constants determined by available technology. Output elasticity measures the responsiveness of output to a change in levels of either labor or capital used in production, ceteris paribus. The two factor Cobb Douglas model can be extended by introducing the structural adjustment policies.

3.2 Empirical Model and Data

The current study used a modified form of a Cobb Douglas production function setting as follows;

$AgricGDP = b_0 + b_1 Capital + b2Labour + b3Weather + b4Infrastructure + b5SAP + b6Postelecton\,Vioence + e$……3

The above model can be converted into per capita terms

$KAgricGDP = b_0 + b_1 KCapital + b3Weather + b4KInfrastructure + b5SAP + b6Postelecton\,Vioence(1992,1998,2002,2007) + e$……..(4)

Where;

KagricGDP= total production in crop and livestock sector divided by labour

KCapital (+) = Capital divided by labour

KInfrastructure (+) =Government Infrastructural spending divided by labour

Weather(+) = Weather as represented by rainfall and temperature

DummySAP(+) =Dummy representing the introduction of SAPS in Kenya

DummyPEV (1992, 1998, 2002, 2007) (-) =Dummy for Post-election violence in the year 1992, 1998, 2002 and 2007

The expected conceptual relationships between each explanatory variable and Per capita agricultural GDP are as given in the following section;

KagricGDP: Agricultural output in its per capita form is derived from the gross marketed production at current prices for the following agricultural subsectors, cereals, temporary crops, permanent crops, and marketed livestock production. The rationale for using marketed production is because data is easily available compared to non-marketed/ own consumption production. The data is readily available from the Kenya Agricultural Sector Data Compendium (KASDC website). The data was then be divided by labour to get the per capita agricultural output.

DummySAP: The variable took the form of a dummy. The variable took the value of 0 in years before the introduction of structural adjustment programmes and the value of 1 during the years of SAPs. Theoretically, the introduction of SAPs is supposed to have a positive impact on Agricultural output (The World Bank (1981), Kuester et al. (1990), Mundlak et al. (1989) and Krueger et al. (1990)).

DummyPEV (1992/1993, 1997/1998, 2002/2003 and 2007/2008). The 1992 and 1998, 2002 and 2007post election violence may have had a negative impact on agricultural output. Primarily, Rift Valley Province, which is Kenya's food basket, was heavily affected, with the production of maize and other food crops dropping to an all-time low. However, this effect has not been captured by any other variable in the study. It is therefore important to capture this hypothetically negative effect with the use of a dummy. A dummy variable is therefore used to capture the effect of the post-election violence.

Weather (rainfall and temperature). Under the agricultural productivity framework, weather or climate variation is a crucial component in evaluating changes in output (Evenson, 2001). Good weather such as more rainfall or less occurrence of drought or flooding should raise agricultural production and productivity. Weather factors are represented by annual average rainfall measured in millimeters (*Precipitation)* and temperature in degree Celsius, using data obtained from the Kenya Agricultural Sector Data Compendium. The relevant weather stations were Kericho, Garrisa, Kajiado, Nyahururu, Meru, Mombasa, Embu and Kiambu which represent the national rainfall received in Kenya. These stations are located near agriculturally productive areas.

KInfrastructure consists of Government Spending on agricultural infrastructure. Infrastructure is considered a fixed factor that contributes positively to agricultural growth and productivity (Evenson & Pray, 1991; Evenson, 2001). It is typically not included among the conventional inputs in Cobb Douglas production function since it is lumped together with capital (k). However, in the case of agriculture, it is important to make a distinction of the two variables; infrastructure and capital. While infrastructure mainly features rural roads and irrigation projects, telecommunication network and power network indicators, capital focuses on short to medium term outlays such as fertilizers, seeds, herbicides, machinery with a useful life of less than 5 years. Government spending on agricultural infrastructure was used as a proxy for agricultural infrastructure. A positive relation is expected between infrastructure and agricultural output .The data was obtained from various statistical abstracts.

Kcapital: The study used both crop and livestock inputs such as seeds, fertilizers, pesticides, fuel, power, spares machinery and maintenance, bags, service inputs, livestock drugs and

medicines, manufactured feeds. The data was then converted into per capita terms. A positive relation is expected between capital and agricultural output. The data was obtained from the KASDC website.

3.3 Estimation and Hypothesis Testing

This study used a time series regression model to evaluate the effect of SAPs on agriculture production in Kenya. Applying the standard OLS method to non-stationary data series can produce 'nonsense correlation' or 'spurious regression' (Inder, 1993). That is, the OLS regression can give high Rsquared, low Durbin Watson (DW) statistics and significant t-values of the estimated coefficients suggesting a significant relationship between dependent and explanatory variables when in fact they are completely unrelated. A time series approach is therefore preferred.

In order to guard against the possibility of a spurious relationship while maintaining the level information, two main approaches offer reasonable solutions. First is the unrestricted error correction modeling (ECM) developed by Hendry and his co-researchers (Davidson et al., 1978, Hendry et al., 1984, Hendry, 1995). Second method is the co-integration approach pioneered by Engle and Granger (1987) and later improved by Johansen (1988) and Phillips and Hansen (1990). The Engle and Granger pioneering method is appropriate when dealing with non-stationary data that are integrated of the same order, that is, all data series are integrated processes of order 1. On the other hand, the ECM method developed by Hendry (1995) can be applied to data series that are integrated of different orders (Hendry, 1995).

3.3.1 Step 1: Normality Tests

Therefore, the first step of the data analysis process was to check for the normality of the data by conducting skewness, kurtosis tests and the jarque bera test of normality. It is at this point, the study decided whether to convert the data into log form or not.

3.3.2 Step 2: Unit roots

The second stage was to conduct unit root tests on each variable. If variables are a mixture of stationary and non-stationary series, then the first step is to conduct first differences for the non-stationary series until the state of stationarity is achieved. The Augmented Dickey-Fuller (ADF) test is employed in this study to test the time-series properties of the data series. The ADF tests the null hypothesis of non-stationarity against the alternative hypothesis of stationary. The p-Perron tests are also useful in testing or unit roots.

The ADF and p-Perron test assume the following null hypothesis;

Ho: The variable is non-stationary (i.e. it has a unit root)

Ha: The variable is stationary (i.e. it has no unit root)

It is at this stage that first and second differences were conducted.

3.3.3 Step 3: Testing for co integration

The third stage involved the testing of the existence of cointegrating equations. The long run relationship can be established by conducting co integration tests for the mixture of stationary and nonstationary series. Two methods are available for this. The first method was the two step Engel granger method. Co integration using the two step Engel granger method involved

generating residuals from the long run equation of the non-stationary variables. To establish whether variables are co integrated, the stationarity of the residuals is established by applying the ADF and PP tests. If the residuals are stationary at levels, then it can be concluded that there is both a short run and a long run relationship among the variables.

The second method was the Johansen co integration test. However, the Johansen co integration has been cited as more robust and more accurate in identifying the presence of co integration. The Johansen test requires that the appropriate lag length to be known. The lag length (p) is determined by the Schwarz criterion to ensure that the residual is white noise.

3.3.4 Step 4: Error Correction Model

The fourth step was to establish the short run relationship between the variables. However, the short run relationship is only established a) after converting all nonstationary series into stationary series (either by differencing or by de trending) b) after successfully testing for co integration and after using the residuals from the cointegration model to generate an error correction term(ect), c) which is inserted into the short run model.

This study employed the error correction modeling (ECM) procedure of Hendry (1995). This approach minimized the possibility of estimating spurious relationships while retaining long-run information without arbitrarily restricting the lag structure (Hendry, 1995). The ECM also provides estimates with valid t-statistics even in the presence of endogenous explanatory variables (Inder, 1993).

3.3.5 Step 5: Granger Causality tests

Granger causality is employed if and only if no co integrating vectors were found in step 3. Otherwise, if co integrating vectors were found to exist, then the most appropriate analysis is error correction modeling.

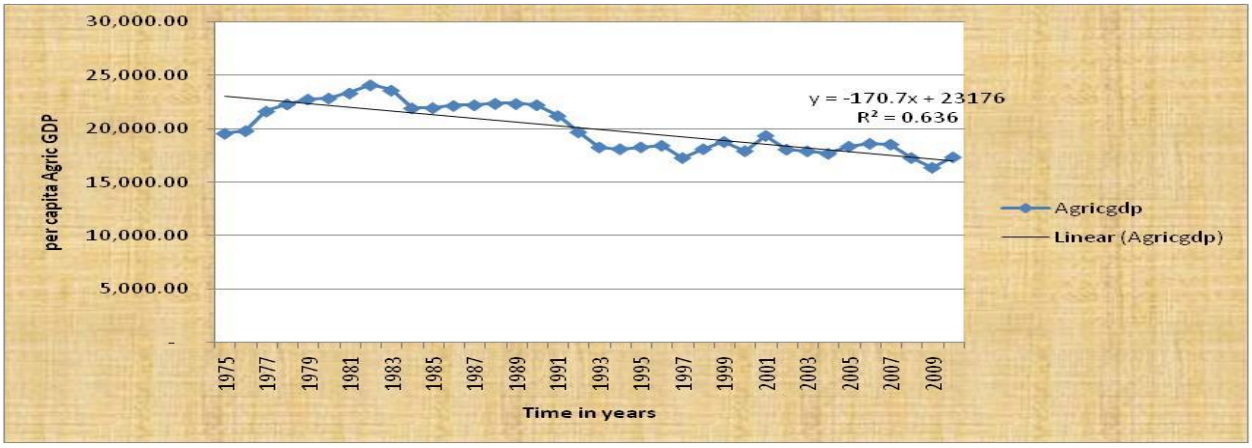
4.0 RESULTS AND DISCUSSIONS

The purpose of this study was to establish the impact of structural adjustment programs on agricultural Sector growth in Kenya. The per capita agricultural GDP in Kenya was modelled against several determinants such as per capita capital, Structural adjustment programs (SAP), Post-Election Violence (PEV) and per capita infrastructure.

4.1 Descriptive Statistics

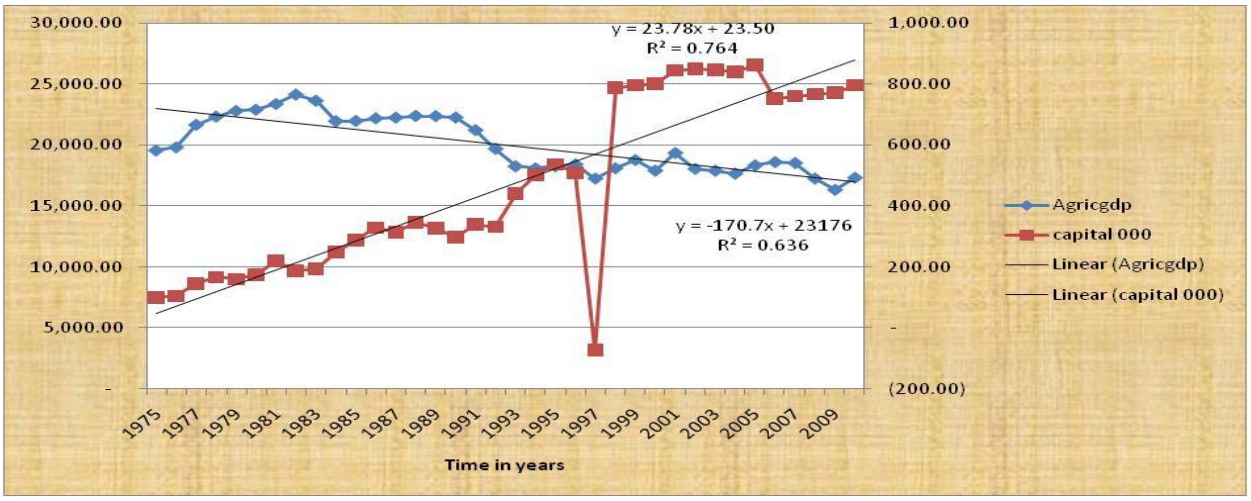
Results indicate that the mean per capita agricultural GDP was KShs 20,094.49 while the maximum was KShs 24,101.71 and the minimum was KShs 16,344.08. A graph representation indicated that there has been a consistent decline over time in per capita agricultural sector GDP. This is consistent with expectations as the labour force has risen at a faster rate than the agricultural value GDP.

Figure 1: Trend in Per Capita Agriculture Sector GDP



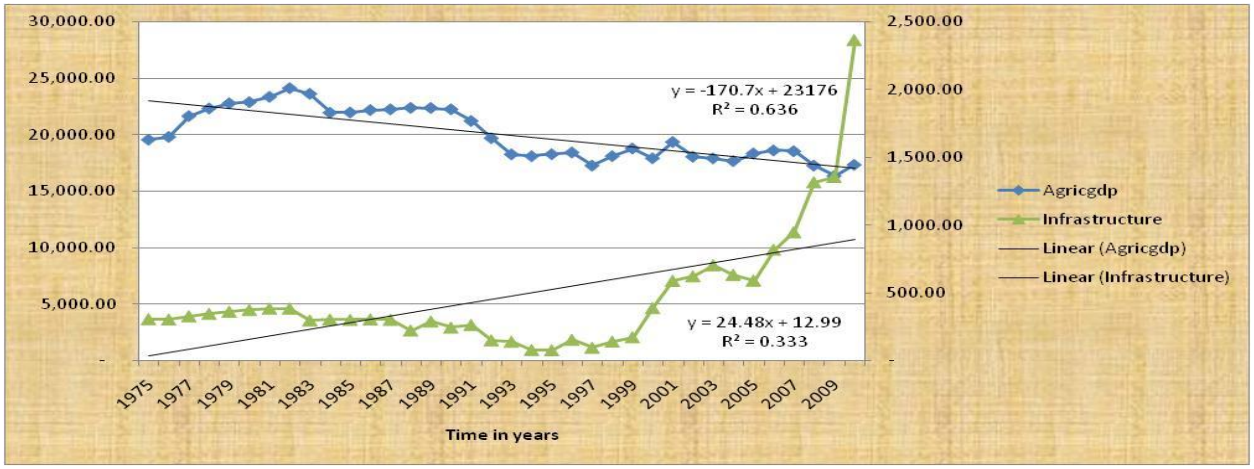
Results in table 1 indicate that the mean per capita capital (k-capital) was KShs 478.8 while the maximum was KShs 863.4 and the minimum is ksh100.4. A graphical representation of the per capita capital in figure 2 indicates that the per capita capital has been on the rise since 1975. This further indicates that farmers have continued to use more inputs such as fertilizers, seeds, energy despite a downward trend in the per capita agricultural sector GDP.

Figure 2: Trend in per capita (kcapital)



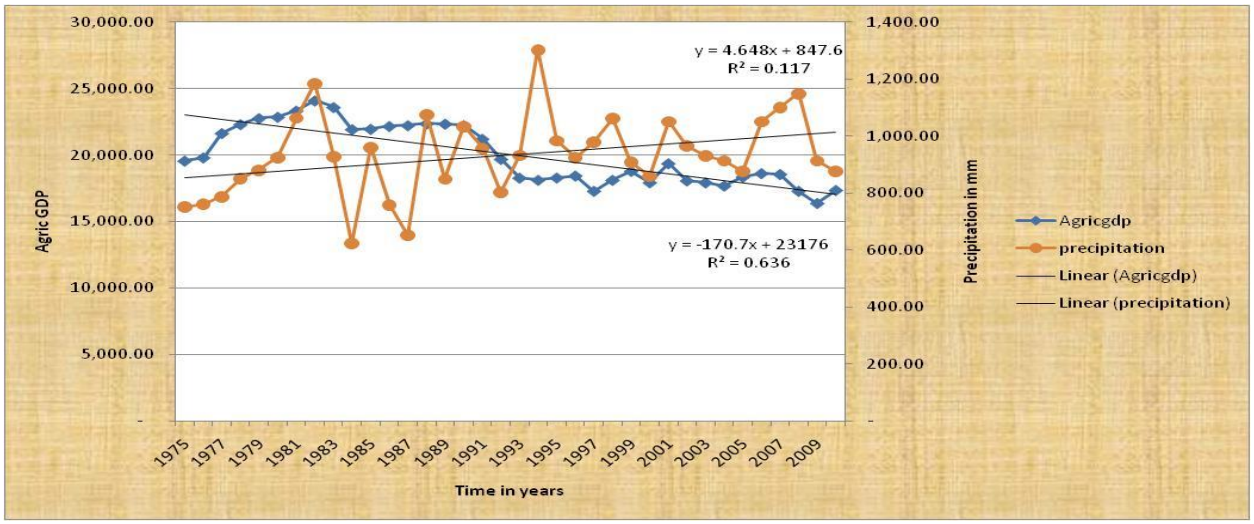
Results in table 1 indicate that the mean per capita infrastructure (kinfrast) was KShs 476.3 while the maximum was KShs 2366 and the minimum is ksh80.45. A graphical representation of the per capita infrastructure in figure 3 indicates that the per capita infrastructure has been on the rise since 1975. This further indicates that public expenditure towards agricultural inputs such as fertilizers, seeds, energy has gradually risen despite a downward trend in the per capita agricultural sector GDP.

Figure 3: Trend in Per Capita Infrastructure (kinfrast)



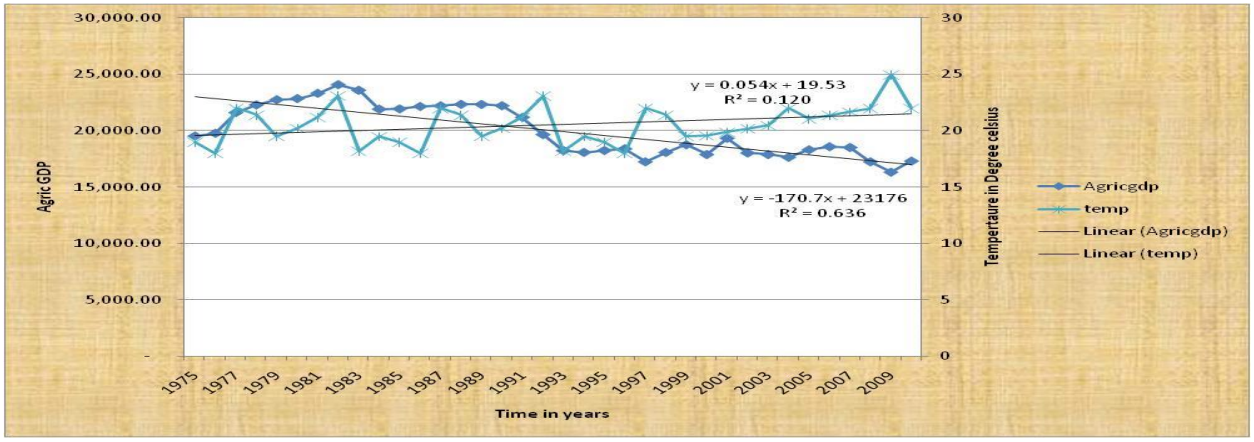
Results indicate that the mean precipitation was 932.3 mm while the maximum was 1304mm and the minimum is 621.9mm. A graphical representation of the precipitation in figure 4 indicates that the trend in precipitation has been inconsistent since 1975. This further indicates that the agricultural sector has experienced dramatic swings in rainfall with some years experiencing high rainfall while some years experienced low rainfall. The dramatic changes in precipitation may have been responsible for the decline in per capita agricultural GDP.

Figure 4: Trend in Precipitation since 1975



Results indicate that the mean temperature was 20.5 ^{0}c while the maximum was 24.98 ^{0}c and the minimum is 18 ^{0}c. A graphical representation of the temperature in figure 5 indicates that the trend in temperature has been inconsistent since 1975. This further indicates that the agricultural sector has gradually experienced rising temperatures since 1975. The gradual rise in temperature may have been responsible for the decline in per capita agricultural GDP.

Figure 5: Trend in Temperature since 1975



4.1.1 Normality Tests

The skewness coefficients displayed in table 1 reveals that the distribution of the variables KAGRICGD, SAP, KCAPITAL, PRECIPITATION and TEMP was normal. This conclusion was arrived after since all the skewness coefficients were between +1 and -1 for these variables. However, the kurtosis coefficients indicate that all the variables had a leptokurtic distribution (sharp peak compared to a normal distribution) since the reported excess kurtosis was more than the rule of the thumb of -1 and +1. The high peakedness indicated lack of normality. Since skewness and Kurtosis coefficient were not conclusive on whether the data was normal or not, the Jacque Bera test offered a more conclusive test on normality.

Table 1: Descriptive Results before Natural Logs

	KAGRICGD	SAP	PEV	KCAPITAL	KINFRAST	PRECIPITATION	TEMP
Mean	20094.49	0.686	0.229	478.8	476.3	932.3	20.50
Median	19552.35	1.00	0.00	347.5	309.7	925.0	20.23
Maximum	24101.71	1.00	1.00	863.4	2366.	1304.	24.98
Minimum	16344.08	0.00	0.00	100.4	80.45	621.9	18.00
Std. Dev.	2237.916	0.471	0.426	275.6	448.4	144.6	1.655
Skewness	0.196	-0.800	1.293	0.188	2.589	0.179	0.398
Kurtosis	1.573	1.640	2.671	1.401	10.52	3.248	2.900
Jarque-Bera	3.194	6.431	9.907	3.933	121.6	0.277	0.938
Probability	0.203	0.040	0.007	0.140	0.000	0.871	0.626
Observations	35	35	35	35	35	35	35

The Jarque-Bera test statistic tested the null hypothesis that the distribution of the variables was not significantly different from a normal distribution. The test reveals that KAGRICGD, KCAPITAL, PRECIPITATION and TEMP were normally distributed as the reported p values were more than the critical p value of 0.05. High p values indicate that there is a very high probability that the distribution of the data is normal. The results indicate SAP, PEV and

KINFRAST are not normally distributed as the reported p values are less than the critical p values. The results in table 1 indicated that it was necessary to convert the variables in an effort to introduce normality. However, the study did not convert the two dummies (SAP and PEV) into their log form. The results in table 2 indicate that the natural log of KINFRAST is normally distributed.

Table 2: Descriptive Results after Natural Logs

	LNKAGRICGDP	LNKCAPITAL	LNKINFRAST	LNPRECIPITATION	LNTEMP	PEV	SAP
Mean	9.902	5.973	5.875	6.826	3.017	0.229	0.686
Median	9.881	5.851	5.736	6.830	3.007	0.000	1.000
Maximum	10.09	6.761	7.769	7.173	3.218	1.000	1.000
Minimum	9.702	4.609	4.388	6.433	2.890	0.000	0.000
Std. Dev.	0.111	0.678	0.746	0.158	0.080	0.426	0.471
Skewness	0.106	-0.362	0.314	-0.332	0.206	1.293	-0.800
Kurtosis	1.576	1.898	3.237	3.315	2.590	2.671	1.640
Jarque-Bera	3.023	2.537	0.658	0.788	0.492	9.907	6.431
Probability	0.221	0.281	0.720	0.675	0.782	0.007	0.040
Observations	35	35	35	35	35	35	35

4.1.2 Multicollinearity test using Bivariate Correlation and Variance Inflation Factor (VIF)

The next step was to check for Multicollinearity among independent variables. However, even extreme Multicollinearity (so long as it is not perfect) does not violate OLS assumptions. OLS estimates are still unbiased and BLUE (Best Linear Unbiased Estimators) in the presence of Multicollinearity. Bivariate correlation results presented in table 3 indicate that there is a very strong and significantly positive correlation between SAP and per capita Capital (lncapital) ($r=0.828$, p value <0.05). This implies that the two variables could be multi correlated.

Table 3: Multicollinearity Test using Bivariate Correlation

	lnkagricgdp	lnkcapital	lnkinfrast	lnprecipit~n	lntemp	pev	Sap
lnkagricgdp	1						
lnkcapital	-0.7577*	1					
lnkinfrast	-0.1889	0.3066	1				
lnprecipit~n	-0.1989	0.3676*	-0.0082	1			
lntemp	-0.1793	0.2425	0.4106*	0.1898	1		
pev	-0.4018*	0.4300*	0.0422	0.1922	0.0956	1	
sap	-0.6386*	0.8280*	0.0165	0.2538	0.1792	0.3546*	1

*Significant at 0.05 2 tailed

Source: Stata 11 computations

A more objective test of Multicollinearity is the variance inflation factor (VIF). The VIF is easiest calculated in Stata. As a rule of the thumb, a VIF factor of more than 64may imply serious Multicollinearity. Thus further implies that as a rule of the thumb, a tolerance level (the reciprocal of VIF) should be less than 0.25. A result in table 4 indicates that lnkcapital introduces serious Multicollinearity and it may be wise to drop it from the regression model.

Table 4: Multicollinearity Test using Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
Lnkcapital	5.02	0.199361
Sap	3.93	0.254725
Lnkinfrast	1.75	0.57135
Lntemp	1.39	0.717408
Pev	1.26	0.795074
lnprecipit~n	1.25	0.797798
Mean VIF	2.43	

Source: Stata 11 computations

4.2 Unit Root Tests

Prior to testing for a causal relationship and cointegration between the time series, the first step is to check the stationarity of the variables used in the model. The aim is to verify whether the series have a stationary trend, and, if non-stationary, to establish orders of integration. The study used both Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests to test for stationarity. The test results of the unit roots are presented next. Results in table 5 indicated that all variables are non-stationary (i.e. presence of unit roots) at 1%, 5% and 10% levels of significance. This calls for first differencing of the non-stationary variables.

Table 5: Unit Root Tests-Level

Variable name	**ADF test**	**PP test**	**1% Level**	**5% Level**	**10% Level**	**Comment**
lnkAgricGDP	-0.478368	-0.478368	-2.6300	-	-	Non Stationary
LAGLNKAGRICGDP	-0.723092	-0.723092	-2.6321	-	-	Non Stationary
lnkinfrast	1.190425	1.190425	-2.6300	-	-	Non Stationary
lntemp	0.150516	.150516	-2.6300	-	-	Non Stationary
lnprecipit~n	0.048188	0.048188	-2.6300	-	-	Non Stationary

Source: Eviews computation

Table 6 displays the unit root tests after first differencing. It is clear from the results in table 6 that all the variables become stationary (unit root disappears) on first differencing.

Table 6: Unit Root Tests-First Differences

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
DlnkAgricGDP	-5.143689	-5.143689	-2.6321	-	-1.6209	Stationary
DLAGLNKAGRICGDP	-4.777693	-4.777693	--	-	-1.6211	Stationary
Dlnkinfrast	-5.257330	-5.257330	-2.6321	-	-1.6209	Stationary
lntemp	-8.470068	-8.470068	-2.6321	-	-1.6209	Stationary
Dlnprecipit~n	-8.280664	-8.280664	-2.6321	-	-1.6209	Stationary

4.3 Long Run Results

The long run results presented in table 7 are generated from the nonstationary variables. An additive model was used to check the explanatory power of adding variables one after the other. Results in table 7 indicated that the R squared of the regression between LNKAGRICGDP and PEV had an R squared of 16.1%. The Rsquared improved to 44.2% once the SAP dummy was introduced. The r squared increased marginally from 44.2% to 47.2% upon the introduction of LNKINFRAST. There was no observed change in R squared when LNPRECIPITATATION and LNTEMP were introduced. The introduction of the LAGLNAGRICGDP significantly improved the R squared from 47.2% to 89.09%

In all models, the f statistic indicated that the independent variables were good joint predictors of LNKAGRICGDP.

Results in table 7 (model 1 and Model 5) indicated that PEV had a negative and significant relationship with LNKAGRICGDP (-0.106, p value 0.015; -0.0321, p value= 0.0838). This implies that an increase in PEV by one unit leads to a decrease in LNKAGRICGDP by 0.106 and 0.0838 units respectively. The results agree with those in Bigsten & Kimuyu, (2002) who noted that the political agitation for multipartism in 1991, led to a decline of both the agricultural GDP growth and the aggregate GDP indicators, with both indicators establishing a new low in 1992. The authors also noted that in 1998, the political turmoil and the rigged general election led to a sharp decline in the two indicators. The results also agree with those in Bigsten & Kimuyu (2002) and Kimani (2011) who noted that the agricultural GDP growth and the aggregate GDP indicators sharply declined in the year 2002 as a result of political elections which saw the entry of the NARC regime and a change of guard in the governance of the country. The authors also noted that, the post-election of year 2007 led to a sharp decline in the two indicators in the year 2008 and this drop was compounded by the global financial crises of year 2009.

Results in table 7 (model 2, 3, 4 and Model 5) indicated that SAP had a negative and significant relationship with LNKAGRICGDP (-0.136, p value=0.0003; -0.135, p value=0.0002; -0.135, p value= 0.0005; -0.036, p value=0.0768). This implies that the introduction in sap by one unit leads to a decrease in LNKAGRICGDP by 0.136, 0.135, 0.135, 0.036 units respectively.

Table 9: Long Run Results

LNKAGRICGDP	Model 1	Model 2	Model 3	Model 4	Model 5
PEV	-0.106 (t= -2.55, p value = 0.015)*	-0.053 (t=-1.44, p value= 0.1582)	-0.051 (t=-1.407, p value= 0.1688)	-0.0507 (t=-1.338, p value =0.1909)	-0.0321 (t=-1.792, p value= 0.0838)**
SAP		-0.136 (t=-4.08, p value= 0.0003)*	-0.135 (t=-4.129,p value= 0.0002)*	-0.135 (t=-3.868, p value= 0.0005)*	-0.036 (t=-1.837, p value= 0.0768)**
LNKINFRAST			-0.025 (t=-1.333, p value =0.1918)	-0.026 (t=-1.225, p value =0.230)	0.0019 (t=0.189, p value = 0.8511)
LNPRECIPITATION				-0.017 (t=-0.169, p value =0.866)	0.0323 (t=0.667, p value = 0.5101)
LNTEMP				0.0257 (t=0.122, p value= 0.903)	-0.0282 (t=-0.282, p value = 0.7793)
LAGLNKAGRIGDP					0.829 (t=9.830, p value = 0.0000)*
Constant	9.92 (t=504.4; p value=0.000)	10.004 (t=385.36, p value =0.000)	10.150 (t= 90.25, p value =0.000)	10.195 (t=12.361, P value =0.000)	1.571 (t=1.590, p value = 0.1229)
R squared	0.161	0.442	0.472	0.472	0.8909
F statistic	6.54 (p value=0.015)	13.12 (p value= 0.0064)	9.54 (p value= 0.00018)	5.384 (p value=0.0011)	38.137 (p value =0.000)
Observations	36	36	36	36	35

*Significant at 0.05 level -2 tail

**Significant at 0.10 level -2 tail

The results agree with those in Nyangito et al. (2004) whose analysis indicated that agricultural prices and productivity have generally declined in the post reform period. Specifically, the authors noted that the performance of the agricultural sector in the 1990s was dismal, with annual growth in agricultural GDP averaging 2% compared with 4% in the 1980s. Agricultural export growth after the reforms had shown mixed trends due to market access limitations for Kenyan exports. The authors further noted that after the reforms, the country moved from broad self-sufficiency in production of most food staples to a net importer, a situation that begged for a re-thinking of the policy framework on agriculture. The findings also compare well with those in Nyangito and Karugia (2000) who conducted a study on the impact of recent changes in Kenyan agricultural sector and public agricultural research in Kenya and concluded that the policy reforms had a negative effect on the capacity of KARI to provide research and extension services. The authors also noted that, adjustment in the government fiscal policy has meant that KARI has fewer funds to do its research. The findings imply that SAPs which advocated for the reduction in research activities had a negative effect on the productivity of the agricultural sector. The findings also agree with those in Rono (2002) who examined the effects of structural adjustment programmes (SAPs) on Kenyan society and concluded that the SAPs in Kenya have been linked to the increasing social problems such as deviant and crime rates, ethnic hatred and discrimination and welfare problems, especially in the areas of education and health.

Results in table 7 (model 5) indicated that the lagged per capita income had a positive and significant relationship with LNKAGRICGDP (0.829, p value = 0.0000). This implies that an increase in the previous year per capita agricultural GDP by one unit leads to an increase in the current year per capital agricultural GDP by 0.829 units. Results in table 7 indicate that the other variables (LNKINFRAST; LNPRECIPITATION and LNTEMP) had insignificant causal relationships with LNKAGRICGDP.

4.4 Cointegration Tests

The two step Engle granger test was conducted and results presented in table 8. First a long run equation was run after which the residuals were generated. The residuals were then lagged. The second step was to test for stationarity of the residuals using the ADF test. Results indicated that the lagged residuals were stationary at 5% and 10% levels. This implies that the lagged residuals were stationary. This further implies that there is cointergration among the long run variables. This also implies that the variable converge to a long run equilibrium.

Table 8: Engle Granger Cointergration Test

ADF Test Statistic	-2.230841	1% Critical Value*	-2.6321
		5% Critical Value	-1.9510
		10% Critical Value	-1.6209

*MacKinnon critical values for rejection of hypothesis of a unit root.

The Johansen Cointegration test was also conducted since it is more accurate and superior to Engle granger test of Cointegration. Johansen Results at the table 9 indicate that the null hypothesis of at most 1 Co integration equations for the model linking was rejected at 5% (1%) significance level. The likelihood ratio statistic for the null hypothesis of the existence of at most 1 Cointegration equations was larger than the z critical vales at 5% and a 1% level. This implies

that more than 1 co integrating equation exists. This further implies that all the variables in the model 4 converge to an equilibrium in the long run (i.e. are co-intergrated).

Table 9: Johansen Cointergration Test

Sample: 1975 2010

Included observations: 34

Test assumption: Linear deterministic trend in the data

Series: LNKAGRICGDP PEV SAP LNKINFRAST LNPRECIPITATION LNTEMP

Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.764176	128.7769	94.15	103.18	None **
0.616676	79.65812	68.52	76.07	At most 1 **
0.507241	47.05634	47.21	54.46	At most 2
0.374489	22.99338	29.68	35.65	At most 3
0.185054	7.041053	15.41	20.04	At most 4
0.002453	0.083510	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP
1.000901	0.580591	0.013504	-0.040255	0.330614	0.874016
0.267514	0.355853	-0.053678	0.017495	-1.158341	-1.083502
0.607787	0.174368	0.176844	0.224223	0.780808	-3.969485
2.069019	0.012988	0.493667	0.025641	-0.298695	-0.078072
-1.239648	-0.081122	0.220575	0.027154	-0.674510	0.324449
-0.040733	-0.095477	0.004480	0.248670	-0.277404	0.473289

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP	C
1.000000	0.580069	0.013492	-0.040218	0.330316	0.873229	-14.71039
	(0.13098)	(0.05257)	(0.03511)	(0.16473)	(0.50167)	
Log likelihood	132.6563					

Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP	C
1.000000	0.000000	0.179084	-0.121889	3.934000	4.680405	-50.34504
		(0.19328)	(0.20413)	(3.90901)	(5.33570)	
0.000000	1.000000	-0.285470	0.140794	-6.212513	-6.563320	61.43178
		(0.31127)	(0.32875)	(6.29535)	(8.59301)	
Log likelihood	148.9571					

Normalized Cointegrating Coefficients: 3 Cointegrating Equation(s)

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP	C
1.000000	0.000000	0.000000	-0.538150	4.735278	13.30158	-79.31758
			(0.78007)	(6.65596)	(18.0341)	
0.000000	1.000000	0.000000	0.804338	-7.489794	-20.30594	107.6156
			(1.23509)	(10.5385)	(28.5536)	
0.000000	0.000000	1.000000	2.324388	-4.474302	-48.14027	161.7815
			(2.12699)	(18.1486)	(49.1731)	
Log likelihood	160.9886					

Normalized Cointegrating Coefficients: 4 Cointegrating Equation(s)

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP	C
1.000000	0.000000	0.000000	0.000000	227.2988	115.3069	-1911.664
				(10685.7)	(5409.72)	
0.000000	1.000000	0.000000	0.000000	-340.1408	-172.7665	2846.303
				(15994.7)	(8097.46)	
0.000000	0.000000	1.000000	0.000000	-965.7742	-488.7231	8076.081
				(45430.5)	(22999.6)	
0.000000	0.000000	0.000000	1.000000	413.5713	189.5479	-3404.897
				(19384.8)	(9813.72)	
Log likelihood	168.9648					

Normalized Cointegrating Coefficients: 5 Cointegrating Equation(s)

LNKAGRICGDP	PEV	SAP	LNKINFRAST	LNPRECIPITATION	LNTEMP	C
1.000000	0.000000	0.000000	0.000000	0.000000	-0.465771	-8.496401

					(1.11710)	
0.000000	1.000000	0.000000	0.000000	0.000000	0.481203	-1.688218
					(1.92387)	
0.000000	0.000000	1.000000	0.000000	0.000000	3.185440	-10.32386
					(4.78872)	
0.000000	0.000000	0.000000	1.000000	0.000000	-21.10094	57.92584
					(5.12545)	
0.000000	0.000000	0.000000	0.000000	1.000000	0.509341	-8.372977
					(0.58698)	
Log likelihood	172.4436					

4.5 Error Correction Modeling

Since the variables in the model the determinants are cointegrated, then an error-correction model can be specified to link the short-run and the long-run relationships.

Table 10: Error Correction Model/Short Run Model

Dependent Variable: DLNKAGRICGDP

Method: Least Squares

Date: 11/16/12 Time: 20:29

Sample(adjusted): 1977 2010

Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLAGLNKAGRICGDP	0.099633	0.165783	0.600984	0.5531
DLNKINFRAST	0.024651	0.024794	0.994213	0.3293
DLNPRECIPITATION	0.056412	0.033349	1.691594	0.1027
DLNTEMP	-0.029292	0.067036	-0.436965	0.6657
PEV	-0.026716	0.016271	-1.641955	0.1126
SAP	-0.013471	0.016047	-0.839479	0.4089
LAGRES_ECT	-0.242583	0.089552	-2.708854	0.0118
C	0.012593	0.012622	0.997706	0.3276

R-squared	0.441453	Mean dependent var	-0.003916
Adjusted R-squared	0.291076	S.D. dependent var	0.044031
S.E. of regression	0.037073	Akaike info criterion	-3.549541
Sum squared resid	0.035734	Schwarz criterion	-3.190397
Log likelihood	68.34220	F-statistic	2.935627
Durbin-Watson stat	2.162940	Prob(F-statistic)	0.020997

Residuals from the co integrating regression are used to generate an error correction term (lagged residuals) which is then inserted into the short-run model. The specific lagged residual term is LAGRES_ECT. The estimates of the error-correction model are given in table 10; Results in table 10 indicated that in the short run, none of the variables except the error correction term is significant. The error correction term measures the speed of adjustment to the long run equilibrium in the dynamic model. The error correction term LAGRES_ECT has the expected sign and is significantly negative (-0.242583, p value =0.0118). This result implies that there is a negative gradual adjustment (convergence) to the long run equilibrium. The coefficient of (-0.242583) indicates that 0.242% of the disequilibria in short run per capita agricultural sector GDP achieved in one period are corrected in the subsequent period. The results also indicate that in the short run, SAPs have the expected negative sign although it is insignificant. All other variables were not short run determinants of per capita GDP.

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary for Findings

Descriptive findings indicated that there has been a consistent decline over time in per capita agricultural sector GDP. This is consistent with expectations as the labour force has risen at a faster rate than the agricultural value GDP. A result also indicates that the per capita capital has been on the rise since 1975. This further indicates that farmers have continued to use more inputs such as fertilizers, seeds, energy despite a downward trend in the per capita agricultural sector GDP. The trend in precipitation has been inconsistent since 1975. This further indicates that the agricultural sector has experienced dramatic swings in rainfall with some years experiencing high rainfall while some years experienced low rainfall. The dramatic changes in precipitation may have been responsible for the decline in per capita agricultural GDP. The trend in temperature has been inconsistent since 1975. This further indicates that the agricultural sector has gradually experienced rising temperatures since 1975. The gradual rise in temperature may have been responsible for the decline in per capita agricultural GDP. The Jarque-Bera test statistic tested the null hypothesis that the distribution of the variables was not significantly different from a normal distribution. The test reveals that KAGRICGD, KCAPITAL, PRECIPITATION and TEMP were normally distributed as the reported p values were more than the critical p value of 0.05. High p values indicate that there is a very high probability that the distribution of the data is normal. The results indicate SAP, PEV and KINFRAST are not normally distributed as the reported p values are less than the critical p values. However, the natural log of KINFRAST is normally distributed.

Bivariate correlation results presented indicate that there is a very strong and significantly positive correlation between SAP and per capita Capital (lncapital) (r=0.828, p value <0.05). This implies that the two variables could be multi correlated. Results from variance Inflation factor (VIF) indicate that lnkcapital introduces serious Multicollinearity and it may be wise to drop it from the regression model. The test results of the unit roots indicated that all variables are non-stationary (i.e. presence of unit roots) at 1%, 5% and 10% levels of significance. This calls for first differencing of the non-stationary variables. It is clear from the results that all the variables become stationary (unit root disappears) on first differencing.

The two step Engle granger test results indicated that the lagged residuals were stationary at 5% and 10% levels. This implies that the lagged residuals were stationary. This further implies that

there is cointergration among the long run variables. This also implies that the variable converge to a long run equilibrium. The Johansen Cointegration test indicated that the null hypothesis of at most 1 Co integration equations for the model linking was rejected at 5% (1%) significance level. The likelihood ratio statistic for the null hypothesis of the existence of at most 1 Cointegration equations was larger than the z critical vales at 5% and a 1% level. This implies that more than 1 co integrating equation exists. This further implies that all the variables in the model 4 converge to an equilibrium in the long run (i.e. are co intergrated).

Results in indicated that the R squared of the regression between LNKAGRICGDP and PEV had an R squared of 16.1%. The Rsquared improved to 44.2% once the SAP dummy was introduced. The r squared increased marginally from 44.2% to 47.2% upon the introduction of LNKINFRAST. There was no observed change in R squared when LNPRECIPITATATION and LNTEMP were introduced. The introduction of the LAGLNAGRICGDP significantly improved the R squared from 47.2% to 89.09%. In all models, the f statistic indicated that the independent variables were good joint predictors of LNKAGRICGDP.

Results in model 1 and Model 5 indicated that PEV had a negative and significant relationship with LNKAGRICGDP (-0.106, p value 0.015; -0.0321, p value= 0.0838). This implies that an increase in PEV by one unit leads to a decrease in LNKAGRICGDP by 0.106 and 0.0838 units respectively. Results in model 2, 3, 4 and 5) indicated that SAP had a negative and significant relationship with LNKAGRICGDP (-0.136, p value=0.0003; -0.135, p value=0.0002; -0.135, p value= 0.0005; -0.036, p value=0.0768). This implies that the introduction in sap by one unit leads to a decrease in LNKAGRICGDP by 0.136, 0.135, 0.135, 0.036 units respectively. Results in model 5 indicated that the lagged per capita income had a positive and significant relationship with LNKAGRICGDP (0.829, p value = 0.0000). This implies that an increase in the previous year per capita agricultural GDP by one unit leads to an increase in the current year per capital agricultural GDP by 0.829 units. Results in indicate that the other variables (LNKINFRAST; LNPRECIPITATION and LNTEMP) had insignificant causal relationships with LNKAGRICGDP.

Error correction modeling results indicated that in the short run, none of the variables except the error correction term is significant. The error correction term measures the speed of adjustment to the long run equilibrium in the dynamic model. The error correction term LAGRES_ECT has the expected sign and is significantly negative (-0.242583, p value =0.0118). This result implies that there is a negative gradual adjustment (convergence) to the long run equilibrium. The coefficient of (-0.242583) indicates that 0.242% of the disequilibria in short run per capita agricultural sector GDP achieved in one period are corrected in the subsequent period. The results also indicate that in the short run, SAPs have the expected negative sign although it is insignificant. All other variables were not short run determinants of per capita GDP.

5.2 Conclusions

It was possible to conclude from the study that structural adjustment programme (SAPs) had a negative and significant long run effect on per capita agriculture GDP. The results are in line with the school of thought that advocates against structural adjustments programs. According to this school of thought, SAPs will be harmful to economies. This school of thought is centred on the new Keynesian economics. The new Keynesian economics were originated by Stanley Fischer, Edmund Phelps, and John Taylor. Their focus was on demonstrating the micro

foundations of price and wage stickiness. According to Gordon (1990), sticky prices imply that real GDP is a residual, and is not determined by agents in the economy. Therefore, the firms optimize by setting prices, and accept quantities (production levels) as given. This runs contrary to the neoclassical and new classical theories, which asserts that the firms are price takers and optimize by setting quantities (production levels). This school of thought also argues that structural rigidities are dominant characteristics of less developed economies, and therefore, price mechanisms are less capable of inducing significant response among economic agents. Therefore, liberation of markets and leaving the market forces to function alone will lead to market failure especially in the area of unresponsive prices and the lack of smooth and free transference of resources from one productive activity to another (Killick, 1990a/b; Yagci et al., 1985). For instance, leaving market forces to determine the price of maize in developing economies may lead to farmers abandoning the activity all together due to poor market prices and high cost of production. The government therefore needs to provide subsidies (which run contrary to SAP). In addition, the assumption that farmers are rational is of course subject to critique. Furthermore, farmers do not have perfect information, and the assumption of perfect competition does not hold. Proponents of this school of thought argue that external factors that make developing countries unique include dependence on a few primary exports and on capital goods imports, low income elasticities for primary products, competing synthetics, terms of trade deterioration, weak infrastructure of international trade, and so on. The internal factors unique to developing economies include policies, climatic vagaries, population growth, political instability, wars. This further implies that policies (SAPs) which are ideal for developing countries may not necessary work for developing economies.

The study also concluded that Post Election Violence has a negative and significant long run effect on the per capital agriculture GDP. This further implies that the political environment may significantly influence the performance of the agricultural sector. Therefore, it may be necessary to enhance political stability as a way to encourage productivity in the agricultural sector. The study also concluded that the lagged per capital agricultural performance has a positive and significant effect on the per capita agricultural performance. Hence, above average per capita performance in year t-1 leads to better per capita agricultural performance in the current year. The results also led to the conclusion that the long run per capita agricultural growth may be linked to the short run growth by an error correction term of -0.242583 which indicates that 0.242% of the disequilibria in short run per capita agricultural sector GDP achieved in one period are corrected in the subsequent period. The results also concludes that weather indicators (temperature and precipitation), and per capita infrastructure did not have a significant effect on the short run and long run per capita Agricultural GDP.

5.3 Policy Recommendations

The study recommends that policy response should be encouraged to reduce or counteract the effect of Structural adjustment programmes on the per capita agriculture. Various policy options are available; For instance, some harmful policies need to be eliminated such as the removal of subsidies. Subsidies are important in lowering the cost of production and also encouraging economies of scale. Specific subsidies that need to be re-introduced include; subsidies on fertilizers, seeds and other agricultural inputs.

Another suggested policy option would be to enhance the adaption of privatized agricultural institutions. The government should put in place structures that facilitate the resilience of

privatized enterprises in the wake of highly competitive environments. The government can do this by ensuring that qualified leaders who are transformational in nature is appointed to top positions of privatized institutions. A good example is the NEW KCC, the Agricultural Finance Bank and the Kenya Meat Commission. Transformational leaders would be able to guide the privatized institutions during turbulent and competitive economic times.

Another measure is the encouragement of value addition in primary agricultural products. This will ensure that they will be competitive in the world market. In addition, the value added products will be more responsive to price related structural adjustment programmes.

The government should address the terms of trade. The government may do so through encouraging exports and discouraging imports. This would protect infant industries, would reverse the balance of payments trend, and improve the terms of trade. This would finally improve agricultural GDP as agricultural exports would fetch better prices in the international market.

Non price mechanisms such as Infrastructure should be encouraged especially in the rural areas. This will ensure that transportation of agricultural inputs and outputs are easily transported into and out of the farms. This may also have a bearing on the overall cost of production.

Policy options for the government of Kenya would be to enhance the political stability of the country especially during electioneering years. The government may do so by creating awareness to the citizens on the importance of peace, unity and tolerance and their impact on the incomes of the citizens. Other measures of creating stability in the country would be to have national cohesion initiatives, zero tolerance to corruption, devolution of resources and governance, good conduct of politicians in public and the institutionalization of a strong judiciary and police force.

5.4 Areas of further research

The study recommends that future studies should focus on specific crops. For instance, studies may be done on the effect of structural adjustment program's on the maize production, rice production, cash crop production such as tea, coffee and Miraa. Another area of study would be to investigate the impact of SAPs on the livestock productivity in Kenya. In addition, the studies may also concentrate on specific livestock products such as milk, beef and poultry products. It is also important to find out if the geographical sectors were affected differently by SAPs. For instance, was the impact of SAPS more pronounced in Arid and semi-arid areas compared to high agriculture potential areas?

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