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THE EFFECTS OF OFFICIAL DEVELOPMENT AID ON FOOD SECURITY IN KENYA

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Abstract

Food insecurity has been a perennial issue in Kenya. Boosting agricultural output is key to lowering food insecurity and for this to be achieved investment into the sector must be increased; foreign aid into agriculture is one form of investment. The study aimed to evaluate whether foreign aid into Kenya's agriculture sector goes to improve or deteriorate the state of food security. The study was anchored on the modernization and dependency school of thoughts on development of economies. Secondary data was used, the source of the data being Food Agriculture Organization Statistics, World Bank and International Food Policy Research Institute. The data was analysed using STATA computer software and applying Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM) to evaluate the relationship and extent of impact of the independent variables on the dependent variable. The ECM results revealed that Agriculture Official Development Aid had a positive and significant effect at 10 percent on Food Production Index therefore; Agriculture Official Development Aid contributes positively to food security in Kenya. Public spending on agriculture was only significant in the short run at 10 percent and positively boosted productivity hence food security.

The study notes that the agricultural sector in Kenya is in dire need of financial support both in the short run and long run and therefore recommends for increased budgetary allocations to agriculture and proactive management of the received and allocated resources to ensure efficient and effective utilization.

Keywords: Kenya, Food security, Official Development Aid, Agricultural sector, Food production index, Sustainable Development Goals

INTRODUCTION

Food security is a major macro and micro problem in several countries and hence its inclusion as a goal in the Sustainable Development Goals (SDGs) 2030 through the first three goals; ensure no human being suffers from any form of poverty and hunger and attaining good health and wellbeing for all respectively (United Nations, (UN, 2015)). Achieving the SDG 2: Zero hunger, realise worldwide food security and eliminate the different types of malnutrition and fostering sustainable agriculture, (UN, 2015) is very crucial in Africa as it has a positive ripple effect on attainment of SDG 1 and SDG 3 because of the aspect of promoting sustainable agriculture. The most comprehensive definition of food security was coined in 1996 during the UN World Food Summit which redefined and adopted the definition as; "food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life "(Food Agriculture Organization (Food and Agriculture Organizaion, (FAO)), 2010, pg. 10). That broad definition brought out the following dimensions of food security; the availability of food, access, stability and utilization (FAO, 2008).

The global food security situation is deteriorating after several decades of declining food insecurity levels; according to FAO (2017) hunger has been on the rise globally from the year 2016 with total undernourished around the world estimated at 815 million people compared to 777 million people in the year 2015. Moreover, the world ecosystem has been overexploited at the expense of feeding the world and as a result the productive potential of natural resources has declined; soil is degraded with reduced fertility, fish stocks and forest cover have declined and water scarcity has increased (FAO, 2018). In Sub-Saharan Africa (SSA) the Prevalence of undernourishment (PoU), a measure of hunger, has been on an upward trend from 2015; a decrease was experienced from the year 2005 (24.3 percent) to 2010 (21.7 percent), however, a rise from 20.8 percent to 22.7 percent between 2015 and 2017 was observed with the worst hit countries being Eastern and Middle Africa at 30.8 percent and 26.5 percent respectively

(FAO, 2019). This clearly shows that East Africa needs to rethink the issue of food security so as to at least come close to attaining SDG 2 by 2030.

Food security is a human welfare issue and has been taken up by several agencies like FAO, International Fund for Agricultural Development (IFAD) and World Food Programme (WFP) all of which have underscored that underperforming agriculture sector in African countries hinders achievement of food security. The agriculture sector in Africa is poorly invested in resulting in low productivity and a decline in the sector (National Partnership for Africa's Development (NEPAD), 2003). Investing in agricultural productivity has been identified to be crucial for countries aiming to avert food crises in the long run (Timmer, 2010).

The FAO, WFP and IFAD (2012) underscored the major role played by agricultural investment in promoting agricultural growth which leads to poverty and hunger reduction. Islam (2011) also underscored that declining agriculture investment is a major contributing factor for poor agriculture growth and performance in SSA. Kalibata (2010) postulated that agricultural foreign aid can promote agricultural productivity by solving several issues ailing farming through: improved inputs and seeds, infrastructure development to facilitate marketing, agribusiness credit and private sector investments to spur growth and technology advancements in agriculture.

The agriculture sector is a major economic activity in Kenya; directly contributes up to a tune of 30 percent to the country's GDP and indirectly through interdependence within economic sectors up to a tune of 27 percent; moreover, the agriculture sector employs more than 40 percent and about 70 percent of the rural population is dependent on the agriculture sector (FAO, 2015). The agriculture sector was identified as a major sector to help achieve the vision 2030 and particularly a 10 percent economic growth rate (Government of Kenya (GoK), 2007). In Kenya the sector is mostly small-scale on farms averaging 0.2 to 3 hectares and accounts for 75 percent of agriculture output (GoK, 2010).This study will focus on food security in Kenya, the aim being to find out how development resources flow into the agriculture sector directly impacts food security.

REVIEW OF LITERATURE

Development foreign aid has been a subject of discussion from as early as 1944 around the time the International Bank for Reconstruction and Development (World Bank) and the International Monetary Fund (IMF) were set up (OECD, 1994). Discussion and research pertaining to foreign aid can be grouped into two camps; those who support the modernization theory, with a perception that foreign assistance is an impetus for development in countries categorized as developing by focusing on the positive impact of aid. The other camp is for those

who support the dependency theory and argue that foreign aid fosters dependency and propagates underdevelopment in the recipient countries (Kabonga, 2017).

Modernization Theory

"Modernization theory developed as a way of presenting the elements of reform-oriented modernization within democratic Western countries and, therefore, providing a model of the 'correct' way to modernize for other countries" (Bhambra, 2014, p. 20). Early western modernization scholars theorized that modernizing states go through stages of development which relate to how the Western states developed; Lerner (1958), Levy (1965) and Rostow (1960) making the Western nations a yard stick of development. The process of modernization can be assessed by looking at how modernizing states grow focusing on specific characteristics which Lerner (1958) identified as; the state of markets for free trade which was the most efficient way to allocate resources, increasing literacy which enhanced economic participation, growth of mass media which he considered as an enhancer of modernization, rural-urban migration leading to urbanization, growing population density and modern and democratic institutions.

Rostow (1960) identified and explained five economic and social stages of development which all societies go through in their modernization pursuit. The stages are:

a) The traditional society; it is a society characterized by limited productivity due to lack of or and limited utilization of modern science and technology in production
b) The pre-condition for take-off; this stage called for fundamental and substantive changes on the social structure, political system and production techniques of a well-established traditional system. This stage is characterized by; capital mobilization through banks and other institutions; increased investment in the transport, communication and manufacturing; growth in commerce both internally and externally and utilization of modern technology in the manufacturing sector.
c) The take-off: the stage when the old blocks and resistance to steady growth are overcome. A surge in technological development is experienced in industry and agriculture
d) The drive to maturity: The economy's make-up changes continuously with improved production techniques. The state's economy enters the international economy with production of a wide variety of goods such that goods formerly imported are produced locally and there new import requirements.
e) High mass-consumption; mass production of goods and the economies begin to move to production of durable consumer goods and services.

Modernization school of thought believe that developing countries go through development on provision of much needed capital for investment and technological advancement (Shallal,1994); this is in agreement with Harrod-Dormar growth model which places a lot of importance on capital stock for investment as a stimulus for growth. Capital stock has two main sources; domestic savings and foreign capital inflows. The Marshall plan of the post-world war II was used to further the idea that underdeveloped states can go through modernization with the help of developmental aid (Matunhu, 2011). Most African countries have a savings deficit therefore foreign aid is seen as an essential source of funding. Government spending on agriculture is another source of investment to the sector, however, African governments spending on the sector is low; a focus on four East Africa countries (Kenya, Uganda, Tanzania and Ethiopia) reveals that only Ethiopia spent above 10 percent on the sector between 2002 and 2008 (Salami et.al, 2010).

Modernization of the agriculture sector is adoption of new and improved production methods including use of new methods of production, cultivation of new and wider variety of crops and employing different marketing skills (Ellis and Biggs, 2001). These activities that entail modernization of agriculture require capital investment hence the belief that modernization goes hand in hand with development aid from developed nations into underdeveloped nations (Matunhu, 2011).

Modernization theory has been criticized for failing to achieve modernization in some of the third world states. Matunhu (2011) underscores the characteristic of modernization theory as a linear model which is deterministic hence changes leading to development are initiated externally which explains the continuous interference of the western nations into the economic and political conditions of third world nations. Matunhu argues that this interference is a disguise to exploit their resources.

Dependency Theory

The dependency theory has its origin in the Third World countries, Latin America being its source. The theory came about from the unequal economic situation that Third World countries were in and scholars trying to explain the reason these countries were not developing like the western developed nations and the persisting inequality, and by extension to find a way forward for development of these countries. Prebich, an Argentina is credited to have given the theory its roots through his ideas on unequal trade relations between the core-periphery nations (Love, 1980). This theory places a lot of emphasis on the relationship that exists between the core and periphery countries and rejects the theory of comparative advantage as the path for less developed nations to develop.

Unlike the modernization theory which prescribed to the underdeveloped nations the same path that developed nations followed to develop, Prebich (1944) argued that periphery states cannot use the same monetary tools used by the United States to pursue full employment because of unequal exchange and its side effects on foreign exchange on peripheral countries. Prebich (1948) postulated that terms of traded were favourable to exporters of industrial goods and worsened for exporters of raw material, his arguments were backed by later findings of Singer through the United Nations (U.N) in 1949 on relative prices of imports and exports of underdeveloped countries. Singer's scholarly writing on technical progress was in line with Prebich's (1944) core-periphery ideas. According to Singer, technical progress in developed nations was experienced in their manufacturing industries leading to incomes increasing, while in underdeveloped nations technical progress was witnessed in their agricultural sector consequently food production raw materials productivity increased causing prices to fall (Love, 1980). Singer explained the differentials in technical progress using different income elasticity of demand for primary and manufactured goods. Since developed nations imported raw materials and undeveloped nations imported manufactured goods the core-periphery trade relations benefited the core leaving the periphery worse-off. Frank (1966) argued that third world countries were undeveloped but their under-development was as a result of the nature of their relationship with developed capitalist nations which dominated and exploited them.

Rodney (1972) and Samir et al (1987) also make use of the core-periphery relationship to illustrate how Europe (the core) exploited Africa (the periphery) during colonization; Europe grew and developed by exploiting Africa's resources and expatriating profits from Africa produced by Africans leaving the African people worse-off. The idea that aid is a tool used by developed states to grow and improve their economies at the expense of third world countries is also shared by Matunhu (2011) who argues that Africa's impoverished condition is not one of natural occurrence but is as a result of an orchestrated capitalist dominance by the metropolis whose aim is extraction and repatriation of surplus value from Africa to the metropolis. Kabonga contributes to this body of knowledge and claims that, "Aid has become a tool for the development of underdevelopment; for it is creating more employment and demand for services and goods in the core countries than in the periphery" (Kabonga, 2017, p. 10).

Dependency school of thought argues that foreign aid causes international economic dependency slowing growth of developing countries (Shallal, 1994). Slow and no growth of the agricultural sector coupled with high population growth in poor countries has often been cited as a main cause of food insecurity (Grigg, 1985, Paddock and Paddock, 1975 and Yates, 1986). Supporters of dependency school of thought postulate that food aid can lead to neglect of the agriculture sector by recipient governments because effects of food shortage are not felt hence

not politically considered for reforms and because food aid is a solution though temporary, there are no early warning signs that would evoke the need for action (Stevens, 1978). Trade and emergency food aid has been cited as one of the reasons political leaders in Africa fail to priorities the issue of food shortage in their countries (FAO, 2006). Mellor (1988) faulted under-investment of the agriculture sector in developing countries for its poor performance as these countries instead focus on urban capital-intensive industries in their development strategies. Janvry (1976-1977) argued that developed countries produce food crops in surplus which are directed to developing countries cheaply, the long-term effect is the collapse of agriculture in developing countries, causing a hunger crisis.

Developed countries dominate and structure the world trade systems and foreign aid with the aim of sustaining and securing the stability of their economic, social and political systems (Toton, 1988). The study further posited that hunger is a consequence of policies structured to protect and promote economic systems of developed nations.

Empirical Literature Review

This is a review of empirical studies and results undertaken relating to ODA and how it impacts agricultural productivity and by extension food security. The earliest research focused on determining how ODA affected the economic growth of developing countries while recent research has been sectoral empirical studies.

Burnside and Dollar (1997) investigated the relation between aid, policies and growth in 56 developing countries using 2 stages least squares (2SLS) method; they estimated simultaneous equations on aid, policies and growth. Instrumental variables and over-identifying of the system of equations was applied to test the inter-relationship of aid and policies and their effect on growth. The study concluded that aid had positive effects only when there were good policies and in particular; fiscal, monetary and trade policies, however, on average the impact was minimal.

Dalgaard, Hansen and Tarp (2004) looked into the link between aid and growth by critiquing the Country Policy and Institutional Assessment Index (CPIA) by Collier and Dollar (2001, 2002). They used Over-lapping Generations model (OLG) and the Grande Causality whose results led to the conclusion that aid does have a favourable effect on productivity and hence growth and development, they however, cautioned that aid is only a stimulant to the process and not a solution in itself. The empirical analysis of the study also found a weak link between policy and aid which was a contradiction of Collier and Dollar (2001, 2002) and further revealed a robust pattern of the ineffectiveness of aid in tropical areas.

Research that has been conducted on food security and foreign aid has majorly focused on food aid. Effects of food-aid flows into India, Bangladesh, Zambia and Ethiopia which are major aid recipients were analysed and the conclusion reached was that if food aid is targeted toward food insecure households and timed such that producers do not suffer adverse price changes then food aid enhances food security (Ninno, Dorosh and Subbarao, 2005). Abdulai, Barrett and Hoddinott (2004) used the GMM to estimate a vector auto- regression model on panel data of 42 Sub-Saharan countries from 1970 to 2000 and found that food aid stimulated food production once country specific unobservable were controlled. Their study concluded that food production and food aid have an inverse relationship; increase in food productivity in current years implies a reduction in food aid in the future years and vice-versa.

Gelan (2007) employed computable general equilibrium modelling to analyse the effects of food aid on food production in Ethiopia. The simulation modelling found that removing food aid had a positive and significant effect on agriculture through raising employment by 4 percent and 2 percent in the agriculture and non-agriculture sectors respectively. Moreover, there was an increase in the use of agriculture land by 1.4 percent and GDP rose by 0.45 percent.

There exist a good number of studies on the effect of non-food foreign aid on agriculture growth and productivity. Norton, Ortiz and Pardey (1992) analysis on the effects of aid on agricultural growth for 98 less developed countries from 1970 to 1985 using Ordinary Least Squares method (OLS) concluded that over the period under study foreign aid had a significant effect on the productivity of the agriculture sector in Asia and sub-Saharan Africa. Petrikova (2015) analysed panel data of 85 developing countries to investigate the impact of development aid on food security; the analysis used the General Method of Moments (GMM) and the 2 stage least squares (2SLS) estimators and arrived at the conclusion that general aid played a significant role in fostering food security over the period of 1994-2011.

Studies on non-food foreign aid to the agriculture sector generally agree there exist a positive and significant impact on agriculture productivity in African countries. Alabai's study made use of data from 47 SSA countries for the period of 2000-2010 and applied a Generalised Method of Moments (GMM) model. The analysis revealed that foreign agricultural aid was not only beneficial but also significant on agricultural GDP and agricultural productivity at 10 percent significance. The study disaggregated foreign aid into bilateral and multilateral which revealed that bilateral agriculture aid contributed greatly to agriculture productivity while multilateral agriculture foreign aid contributed more to GDP hence economic growth was greater, this led to the conclusion that the type, nature and origin of aid could have a different impact on the recipient economy. Ssozi, Asongu and Amavilah (2017) went further to analyse the effect of ODA on food crop and

industrial crop production. They used the system two-step GMM on data from 36 SSA for the period of 2002-2015, their results and conclusion were that ODA improved industrial crop productivity but a negative relationship existed between ODA and food crop production. The study underpinned the importance of good public institutions and economic freedom as enablers of agricultural productivity growth and increased ODA effectiveness.

Akpokodje and Omojimite (2008) looked into the effects of development assistance on Nigeria's agriculture growth through simultaneous equations with control variables and found that foreign aid positively and significantly impacted agriculture growth. Their results and conclusion were however contradicted by a subsequent similar study in Nigeria; Ighodaro and Nwaogwugwu (2013) use autoregressive distributed lag (ARDL) method and the Error Correction Models concluded that domestic savings and not foreign aid produces a positive impact on agriculture growth in the short and long run in Nigeria.

The target of literature on foreign aid in Kenya is the nexus between foreign aid and economic growth and development and is on the economy as a whole. Oduor and Khainga (2009) analysed effectiveness of aid on poverty reduction; they concluded that ODA has been impactful in eradicating poverty in the districts that had ODA funded projects. Njeru (2003) analysis showed that foreign aid flows and project aid positively and significantly influence development expenditures which imply a significant effect on the public financial planning process. He further postulated that the government switches overseas aid from the intended development activities to recurrent expenditures; this concurs with Devarajan et al., (1998) conclusions on aid fungibility.

The focus of this research paper is on agriculture foreign aid; its impact on productivity and eventual food security in Kenya. Investment is vital for agriculture productivity to be realized, however, Kenya's public expenditure into the sector is below the recommended 10 percent Maputo agreement and hence foreign aid can supplement the deficit. In this respect, I have not come across existing research study of this nature conducted in Kenya; those conducted in Sub-Saharan Africa and developing countries have led to differing conclusions as earlier discussed and propose opposing policies to be adopted on issues of foreign aid. The study findings would be of importance to economic policy formulaion in Kenya and donors as it will inform as to whether foreign agriculture aid is beneficial and promotes food security. The study will further try to establish the relationship between agriculture foreign aid and government spending into the agriculture sector; this would help in reforming the sector through the much-needed investment

RESEARCH METHOD

Research Design

The main study objective of this study aimed to answer how ODA affect food security in Kenya, hence the research design for the study is descriptive. Descriptive research design allows for inferential analysis, the use of this design enabled inferences pertaining the relationships that exist between the study variables to be made from the data. The use of annual time series data spanning from 1980 to 2017 provided robust data for analysis, moreover, data on all the variables under consideration was available over the period.

Theoretical Framework

Data was analysed in the form of a multiple linear regression model through selection of determinants of food security and incorporating agricultural ODA into the factors. Aker and Lemtouni (1999) put forward eight determinants of food security for their function and a similar approach was adopted with slight modifications on the variables. The general form of the multiple linear regression equation that was applied is as below:

$$FPI = f(AODA, GAE, GHG, ER, POPL, GDPGR) \cdots\cdots\cdots\cdots\cdots\cdots \; eqn\ 2$$

FPI being Gross Food Production Index Number (2004-2006 = 100) for Kenya

AODA being agricultural official development aid to Kenya in US dollars

GAE being government expenditure directed to agricultural in Kenya in Kenya shillings

GHG is Greenhouse gas emission in Kenya

Exchange Rate (ER) for Kenya

Popl is the Kenyan population

GDPGR is Kenya's growth domestic product growth rate

The explanatory variables chosen are factors that affect agricultural productivity. Annual greenhouse house (GHG) emission is a representative of climatic change. GHG emissions affect the ozone layer causing global warming. The effects of global warming; changes in temperature and precipitation, natural disasters like floods, droughts and heat waves all adversely affect agricultural activities and make the country more food insecure (GOK, 2018). Studies by Verter (2017) and Hanif, Nisa and Yaseen (2019) used Carbon dioxide (Co2) emission to represent climate change and from econometric analysis Co2 emission appeared to depress agricultural productivity. Exchange rate affects agricultural productivity though import of inputs and machinery used in agricultural activities; prices of these imports vary with fluctuations of the exchange rate. Uremadu et al (2018) empirical analysis revealed a positive significant effect of government agriculture expenditure in Nigeria's agricultural productivity while real exchange rate produced a negative effect on

agricultural output though insignificant. Population growth affects agricultural productivity through increased occupation of land suitable for agriculture, high altitude and humid areas have high crop productivity however due to population density land subdivision is rendering farming an uneconomical activity (GOK, 2010). Population growth also provides cheap labour for agriculture which reduces reliance on and adaptation of improved, mechanized and efficient ways of carrying out agricultural activities. Ighodaro and Nwaogwugwu (2013) and Uremadu et al (2018) studies showed that population affected agriculture and the empirical results revealed an inverse relationship.

Gross domestic product growth rate (GDPGR) was a control variable. Growth rate of GDP is associated with business cycles and hence influences an economy's productivity.

The variables under consideration that are not in percentage form; FPI, GAE, GHG and POPL will be transformed using natural logarithms such that the coefficients yielded from the analysis will be percentages which are more informative in regards to the impact of the variables.

Model Specification

To measure the impact of the independent variables on the dependent variable and to establish their interaction the study used the Autoregressive Distributed Lag (ARDL) and the Error Correction Model (ECM). The ARDL and ECM models allows for testing of existence of both the short run and long relationship of the variables being studied. When the F-statistics from ARDL model is less than the lower bound only the short run model equivalent to equation 3 is estimated. The long run relationship is estimated when the F-statistic obtained is greater than the lower and upper bound, which leads to estimation of the ECM. The short run and long run relationship that was estimated is as below;

$$\Delta lnFPI = \alpha_0 + lnFPI_{t-1} + \alpha_1\, lnAODA_{t-1} + \alpha_2 lnGAE_{t-1} + \alpha_3 lnGHG_{t-1} + \alpha_4 ER_{t-1} + \alpha_5 lnPOPL_{t-1} + \alpha_6 GDPGR_{t-1} + \sum_{i=1}^{n} \Delta\beta_1 FPI_{t-i} + \sum_{i=0}^{n} \Delta\beta_2 lnAODA_{t-i} + \sum_{i=0}^{n} \Delta\beta_3 ER_{t-i} + \sum_{i=1}^{n} \Delta\beta_4 lnGAE_{t-i} + \sum_{i=1}^{n} \Delta\beta_5 lnPOPL_{t-i} + \sum_{i=1}^{n} \Delta\beta_6 GDPGR_{t-i} + \sum_{i=1}^{n} \Delta\beta_7 lnGHG_{t-i} + \varepsilon_t \cdots\cdots\cdots eqn\ 4$$

Where,

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\ and\ \alpha_6$ are the long run coefficients and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\ and\ \beta_6$are the model dynamics over a short run period and n is representative of the number of optimal lags.

Data Type, Sources and Analysis

This study used annual time series data spanning 1980 to 2017 at the National level and data was obtained from; FAO Statistics, World Bank and International food policy research institute (IFPRI). Data analysis and evaluation was done using Stata Statistical software.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 is a summary of descriptive statistics of the variables for the period of 1980 to 2018. Descriptive statistics give an insight of the data being used. Exchange rate (ER) has the highest mean and the largest maximum while its minimum is the second smallest, this shows high volatility of the exchange rates within the period under consideration which is further underscored by its large standard deviation. The other variables have considerably low standard deviations.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LnFPI	39	4.147127	.3361399	3.553918	4.624679
ER	39	56.87998	31.01424	7.420187	103.4109
lnPOPL	39	17.23081	.3377955	16.61384	17.755
LnGHG	39	10.70797	.3154537	10.2543	11.28414
LnGAE	39	22.84216	1.087886	20.84371	24.78547
lnAODA	39	18.43463	.8376586	16.37429	19.96225
GDPGR	39	4.934677	2.3026	.200506	9.405699

Pre-estimation Diagnostic Tests

Time series data is tested before regression modeling to determine its characteristics and align it to statistical modelling. Tests carried out were unit root test for stationarity using the ADF test, multicollinearity test to test for residuals correlation through the variance inflation factor test and cointegration to test for existence of long run equilibrium of the variables.

Unit Root Test

Complied study data set was subjected to a unit roots test to determine the order of integration for stationarity of the data. The order of integration was particularly useful when performing the ARDL bounds test as it limits to order one of integration, if variables are stationary at higher orders of integration the test becomes invalid (Ouattara, 2004). The null hypothesis being tested: $H_O = Stationary$

The Augmented Dickey Fuller (ADF) test was used to determine unit roots. Table 2 presents a summary of the ADF test for the variables. First, entire data set was tested at level, zero lags. Variables not stationary at percent levels of 1, 5 and 10 were differenced and retested for unit roots.

Table 2: Augmented Dickey Fuller Test

	At level		First difference	
Variable	**P-Value**	**Test Statistic (t)**	**P-Value**	**Test Statistic (t)**
lnFPI	0.275	-1.109 ***	0	-7.190
lnGHG	0.978	0.028 ***	0	-6.072
ER	0.442	-0.777 ***	0	-5.711
lnPOPL	0	-20.68	-	
lnGAE	0.042	-2.105 ***	0	-4.882
lnAODA	0.004	-3.045 *	0	-7.807
GDPGR	0.01	-3.442*	0	-6.763

*The values with the subscripts *, ** and *** shows failure to reject the Ho at the 1 percent, 5 percent and 10 percent critical levels respectively*

The absolute values of the t statistic for; lnPOPL is greater than the critical values at all levels of significance therefore the null hypothesis was rejected hence stationary at value. The absolute values of lnFPI, lnGHG, ER, lnGAE, GDPGR and lnAODA are not less than the absolute critical values at various levels of significance therefore the null hypothesis was not rejected hence their time series was non-stationary at level. In order to make the series stationary, the first difference for lnFPI, lnGHG, ER, lnGAE, GDPGR and lnAODA was obtained and the unit root test performed which yielded stationary series as shown in table 2.

Multicollinearity

A test for multicollinearity was conducted using the variance inflation factor. Table 3 shows the variance inflation factor and its inverse for each variable in its stationary form.

Table 3: VIF with Differenced Variable

Variable	**VIF**	**1/VIF**
dlnGHG	1.16	0.861465
dER	1.08	0.926719
lnPOPL	1.08	0.924396
dlnGAE	1.09	0.916621
dlnAODA	1.12	0.892337
dGDPGR	1.05	0.948483
Mean VIF	1.10	

The test results revealed that there was no multicollinearity among the independent variables since the VIF values for all the six variables are less than 10.

Autocorrelation

The data was tested for serial correlation of the residuals using the Breusch-Godfrey LM test. The null hypothesis tested was that the residuals are not serially correlated and it is rejected when the p-value is greater than 5 percent. Table 4 shows the test results obtained with a p-value of 0.1603.

Table 4: Breusch-Godfrey LM test for Autocorrelation

Lags (p)	chi2	Df	Prob > chi2
1	1.971	1	0.1603

H_O: No serial correlation1

The p-value obtained is greater than 5 percent which is an indication that the data was not adversely affected by serial correlation.

Lag Length Selection Criterion

A test for lag selection was conducted using varsoc. Table 5 shows the results for lag length selection; Final prediction error (FPE), Akaike information criterion (AIC), Hannan-Quinn information criterion (HQIC) and Schwarz information criterion (SBIC) were minimized at lag 2. SBIC had the lowest value and was chosen for this study.

Table 5: Lag Length Selection Criteria

Lag	**LL**	**LR**	**Df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	-138.003				6.0e-06	7.83799	7.94544	8.14276
1	168.604	613.21	49	0.000	5.6e-12	-6.08668	-5.22712	-3.64853
2	270.428	203.65*	49	0.000	4.4e-13*	-8.94204*	-7.33037*	-4.37052*

Cointegration

The ARDL bound test for cointegration was conducted instead of the Johansen Test for cointegration as earlier proposed because the variables are stationary at different levels. The Johansen test for cointegration is best suited when the variables are stationary at first difference however since the unit root test conducted revealed that the variables under consideration are stationary at different levels the ARDL bound test was applied. The hypothesis tested under ARDL bound test is that there is no cointegrating equation ($H_0 = no\ cointegration$). The null

hypothesis is rejected at the 10percent, 5percent or 1percent level under two instances: if the F-statistic obtained is greater than the critical value for the upper bound $\langle I(1) \rangle$ and also greater than the critical values for the lower bound $\langle I(0) \rangle$.

Table 6 is a presentation of the ARDL bounds test for cointegration carried out. The results indicate that the F-statistic is greater than the critical values of the lower bound and upper bound. Therefore, we reject the null hypothesis and conclude that there is cointegration. This implies that the variables have a long run relationship and hence the error correction model was estimated to establish the long run relationship of the variables.

Table 6: Cointegration Diagnostic Test Results of
FPI, GAE, AODA, ER, POPL, GHG and GDPGR

F = 5.193

	10 percent level		5 percent level		2.5 percent level		1 percent level	
	(1_0)	(1_1)	(1_0)	(1_1)	(1_0)	(1_1)	(1_0)	(1_1)
K_6	2.12	3.23	2.45	3.61	2.75	3.99	3.15	4.43

Error Correction Estimates of the ARDL Model

Table 7 gives the summary results for the ECM ARDL model run; it shows that 38 data sets were used. The R-squared of 63.06 percent indicates the extent which the independent variables elucidates movement in the dependent variable by 63.06 percent which is an indication that the model is a good fit.

Table 7: Model summary

Description	Value
Number of observations	38
R-squared	0.6306
Adj R-squared	0.4743
Log likelihood	82.200637
Root MSE	0.0336

The results of the ECM ARDL model are as represented in table 8 and table9. Table 8 shows the long run relationship of the variables. From the long run empirical results population has a significant effect on gross production index at 1 percent level. A one percentage increase in population causes FPI to increase by 2 percent. The results for population are contrary to the expectations of this study but are in agreement with economic theory where greater population implies more labour force which impacts productivity favourably. Exchange rate and greenhouse gas emission are significant at 5 percent level and both have an inverse relationship with FPI

which is in agreement with the study's expectations and economic theory. A one per centum increment in exchange rate causes FPI to decline by 0.0037 per centum on the other hand if GHG rises by one per centum FPI declines by 0.244 percent, this observation concurs with economic theory that increase in greenhouse gas emissions negatively impacts on productivity. AODA is significant at 10 percent level and has a positive impact on FPI where a percentage increase in AODA causes FPI to increase by 0.022 percent. GAE and GDPGR have a positive impact on FPI however; they are insignificant at the three levels of significance (1 percent, 5 percent and 10 percent).

The error correction term is negative (-0.95) and highly significant and indicates the rate at which the short run model adjust to the long run equilibrium. A coefficient of -0.95 is an indication that the short runs adjust to long run equilibrium at a high pace.

Table 8: The Long Run Relationship

dlnFPI	Coef.	Std. Err.	T	P>T	[95 percent Conf. Interval]	
ADJ lnFPI L1	-.9534245	.1762491	-5.41	0.000	-1.31571	-.5911393
lnAODA	.0223601	.0128699	1.74	0.094	-.0040944	.0488145
lnGHG	-.2444149	.114119	-2.14	0.042	-.47899	-.0098399
ER	-.0036515	.0012113	-3.01	0.006	-.0061413	-.0011616
lnGAE	.0272354	.0250509	-1.09	0.287	-.0787283	.0242575
lnPOPL	2.000483	.2516124	7.95	0.000	1.483286	2.51768
GDPGR	.0032886	.0033742	0.97	0.339	-.0036472	.0102244

Table 9 is the output for the short run relationship of the variables. In the short run only lagged population and government expenditure have positive and significant impact on future productivity. A one per centum population growth causes FPI to increase by 31 percent while an increment of GAE by a per centum causes FPI to increase by 0.035 percent. AODA is insignificant and negative in the short run which implies that a 1 percent increase in AODA leads to reduced productivity which is the inverse of its impact in the long run. GAE positively impacts FPI which is the inverse of the long run effect, this is likely to be caused by the meager allocations to the sector, its positive impact in both the long run and short run is an indication of its positive feedback effects into agriculture and hence the need to increase the allocations.

Table 9: The Short Run Relationship

dlnFPI	Coef.	Std. Err.	T	P>T	[95 percent Conf. Interval]	
ΔAODA	-.0156621	.0103577	-1.51	0.143	-.0369526	.0056285
ΔlnGHG	.1210586	.118282	1.02	0.316	-.1220734	.3641907
ΔER	.0013661	.0013581	1.01	0.324	-.0014255	.0041576
ΔlnGAE	.0354431	.0214289	1.65	0.100	-.0086047	.0794909
ΔlnPOPL	31.02843	9.8231	3.16	0.004	10.83676	51.2201
_cons	-27.4754	5.170438	-5.31	0.000	-38.10338	-16.84741

The overall ECM ARDL model equation is:

$$\Delta lnFPI = -27.475 - 0.95[lnFPI_{t-1} - 0.022lnAODA - (-0.322)lnGHG - (-0.0037)ER - (-0.027)lnGAE - 2lnPOPL - 0.003GDPGR] - \Delta 0.016lnAODA + \Delta 0.001ER + \Delta 0.035lnGAE + \Delta 31.028lnPOPL$$

Granger causality test to determine relatioship between AODA and GAE

The granger causality null hypothesis tested was there is no causality between variables under consideration. The point of rejection is a p-values less than or equal to 0.005. Table 10 shows the granger causality tests obtained for lagged and differenced AODA and GAE. The P-values obtained (0.474 and 0.423) are greater than 5 percent which is an indication that the two variables do not granger cause each other. These results agree with the Granger causality Wald tests in Appendix 2. Therefore, no significant relationship exists between AODA and GAE.

Table 10: Granger causality test results for AODA and GAE

	dlnFPI	dlnGHG	dlnAODA	dlnGAE	lnPOPL	dGDPGR	dER
dlnAODA L1.							
Coef.	4.283497	-1.668883	-.3650305	-.1309597	49.06834	-.0221124	.0071646
Std. Err.	2.015088	1.652992	.1294317	.3469264	68.56558	.0455045	.0167903
Z	2.13	-1.01	-2.82	-0.38	0.72	-0.49	0.43
P>z	0.034	0.313	0.005	0.706	0.474	0.627	0.670
dlnGAE L1.	dlnFPI	dlnGHG	dlnAODA	dlnGAE	lnPOPL	dGDPGR	dER
Coef.	1.753763	2.892179	-.1750618	-.9703391	.0135495	.0534932	21.61005
Std. Err.	2.028186	1.663736	.130273	.3491814	.0168995	.0458003	69.01125
Z	0.86	1.74	-1.34	-2.78	0.80	1.17	0.31
P>z	0.387	0.082	0.179	0.005	0.423	0.243	0.754

Postestimation diagnostics

These are statistical tests to determine suitability, reliability and stability of estimated coefficients. The tests will check for autocorrelation and homoscedasticity of residuals and stability of the model of the parameters.

Autocorrelation

The Durbin-Watson d-statistic of 2.17 indicates no autocorrelation which is in agreement with the Breusch-Godfrey LM test whose P-value is greater than 5 percent indicating absence of serial correlation.

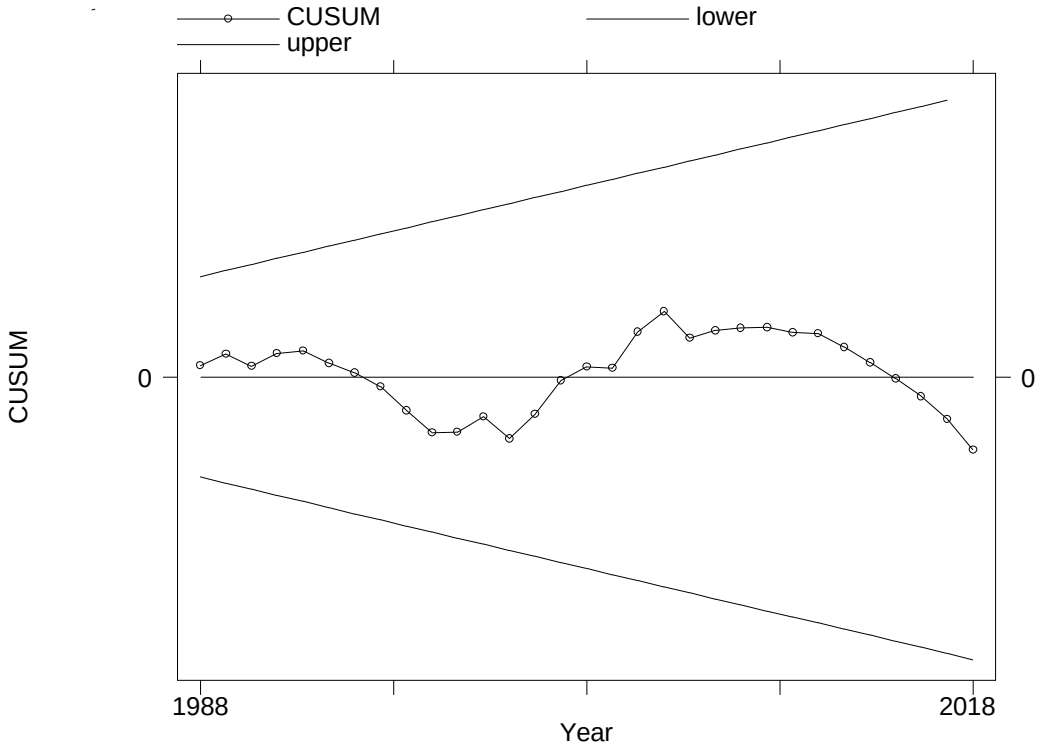
Heteroskedasticity

The White's test for heteroskedasticity yielded a P-value of 0.4236 which means that the null hypothesis of presence of homoskedasticity was not rejected.

Model stability

To establish stability of the model; the equation obtained was subjected to a recursive estimate test was by running the CUSUM tests and CUSUM of squares tests. The CUSUM test is a cumulative sum of the recursive residuals which are plotted with the 5 percent critical lines. Parameter stability occurs when the cumulative sum falls between the areas of two critical lines. 5 percent level of significance. The results from figures 1 show that the model is stable at 5 percent level of significance.

Figure 1: Cusum6 Test



CONCLUSIONS

This study aimed to assess the effect of two major sources of investment into the agriculture sector in Kenya; agricultural foreign aid on agriculture and government expenditure into the sector with the study results aimed at formulating policy recommendations that would help improve agriculture productivity and by extension improve food security in Kenya.

The empirical analysis done on data for the period of 1980 to 2018 revealed that foreign aid in the form of official development flows to agriculture is significant in the long run with a positive impact implying that an increase in aid to agriculture increases productivity in the long run. However, it was insignificant and negative in the short run. That inverse effect can be attributed to the volatile nature of aid coupled with lengthy procedures for committed aid to be disbursed, the lags between commitment and disbursements delay implementation of projects and eventual benefits to the agriculture sector. Government expenditure into agriculture was positive both in the short run and long run but was only significant in the short run. The positive effect aligns with economic theory and research undertaken. For example, Kipruto and Nzai (2018) in their analysis on agricultural expenditure in agriculture in Kenya concluded that public expenditure has a positive and significant effect on agriculture output. Two studies in Nigeria conducted by Adofu (2012) and Ewubare and Eyitope (2015) analysis on public spending into agriculture revealed a significant and positive contribution of public spending into agricultural productivity.

The ECM results show that AODA positively impacts on agriculture productivity and is significant in the long run. Government expenditure into agriculture though insignificant does have a positive effect on agriculture productivity in the long run and significant in the short run at 10 percent with a positive effect. Food security is therefore boosted as productivity increase. The granger causality results indicated no relationship between AODA and GAE, that is, one cannot be used to predict the future of the other therefore they do not influence each other.

Greenhouse gas emissions was significant and negatively affects agricultural productivity hence lowers food security. The government should implement and enforce policies that will lower emissions and increase absorption of gasses through increased forest coverage.

RECOMMENDATIONS

Great concern has been raised on the declining food security in the last decade. Kenya being an agriculture dependent economy needs to focus attention on how to boost productivity in the sector and one such way to do it is increase funding to the sector. From this study's findings AODA is positively and significantly influences agriculture productivity in the long run while government agriculture expenditure though insignificant in the long run does positively

influence productivity. In the short run government expenditure significantly and positively impacts productivity. Therefore, the following recommendations would go a long way to boost productivity.

i. The government through the ministry of treasury should allocate more resources to the agriculture sector to improve productivity.
ii. The study recommends for the government to align its agricultural policies with aid donors so as to boost aid received in the sector. Aid disbursed should also be followed up to ensure management of the aid by ensuring it is directed to improve the areas and factors limiting agricultural productivity like improving infrastructure to promote ease of movement of inputs and outputs and accessibility of markets and mechanization of agriculture activities.
iii. The government should take conscious efforts to monitor finances meant for agriculture are utilized in the sector and for the purpose intended. This will ensure that budgetary allocations and foreign aid are not mismanaged.
iv. Policies should be put in place to reduce emission of greenhouse gasses since they have detrimental long-term effects on agriculture productivity and hence food security.
v. The government through the central bank should purpose to implement monetary policies with an aim to stabilize the exchange rate. This will help to stabilize prices of imported agriculture inputs.

AREAS FOR FURTHER RESEARCH

This study found inverse results on the impact of aid to agriculture in the short and long run. Therefore, further studies need to be done, first on the effect and extent of impact of disaggregated sources of aid; that is bilateral and multilateral aid on agricultural productivity in Kenya. Second, there is need to analyse the effect of utilization of agricultural foreign aid received on agricultural productivity in Kenya: the study would analyse the different uses agricultural foreign aid is put into in the agricultural sector that is; administrative, research and technology, training and information dissemination, land development, extension services, inputs, water resources and irrigation developments, agricultural cooperatives and post-harvest activities.

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APPENDICES

Appendix 1: Raw Data for the Period 1980 to 2018

Year	FPI	POPL	ER	GHG	GDPGR	AODA	GAE
1980	34.95	16,417,197.00	7.420187	28,468.69	5.591976207	84,970,000.00	1,128,000,020.98
1981	35.1	17,063,876.00	9.047498	28,404.28	3.773544197	79,250,000.00	1,868,000,030.52
1982	39.12	17,736,326.00	10.92232	29,812.38	1.506478254	101,070,000.00	1,745,000,004.77
1983	40.32	18,431,761.00	13.31152	31,668.24	1.309050242	92,410,000.00	2,023,999,929.43
1984	37.5	19,146,400.00	14.41387	33,170.18	1.755216977	48,150,000.00	1,659,999,966.62
1985	42.11	19,877,083.00	16.43212	33,349.26	4.30056182	43,550,000.00	2,674,000,024.80
1986	46.02	20,622,560.00	16.22574	34,675.61	7.177555391	38,130,000.00	2,773,999,929.43
1987	46.1	21,382,112.00	16.45449	34,921.40	5.937107446	240,100,000.00	4,184,999,942.78
1988	50.15	22,153,676.00	17.7471	36,807.31	6.20318382	258,810,000.00	2,855,999,946.59
1989	52.44	22,935,092.00	20.57247	38,381.07	4.690348768	87,650,000.00	7,559,000,015.26
1990	51.42	23,724,579.00	22.91477	38,490.00	4.192050974	183,920,000.00	5,374,499,797.82
1991	53.67	24,521,703.00	27.50787	37,250.00	1.438346791	286,410,000.00	3,190,000,057.22
1992	54.95	25,326,078.00	32.21683	37,250.00	-0.79949396	137,810,000.00	3,883,000,135.42
1993	53.19	26,136,216.00	58.00133	37,050.00	0.353197256	106,290,000.00	4,184,000,015.26
1994	54.68	26,950,513.00	56.05058	37,310.00	2.632784519	95,320,000.00	6,115,999,698.64
1995	55.5	27,768,296.00	51.42983	37,650.00	4.406216526	42,670,000.00	9,068,999,290.47
1996	52.71	28,589,451.00	57.11487	37,190.00	4.146839267	32,300,000.00	7,304,999,828.34
1997	53.87	29,415,659.00	58.73184	37,110.00	0.47490192	79,190,000.00	7,647,999,763.49
1998	56.99	30,250,488.00	60.3667	38,560.00	3.290213723	36,620,000.00	8,294,199,943.54
1999	61.15	31,098,757.00	70.32622	40,730.00	2.305388596	18,700,000.00	10,317,999,839.78
2000	57.66	31,964,557.00	76.17554	39,680.00	0.599695392	60,860,000.00	9,408,220,291.14
2001	63.51	32,848,564.00	78.5632	39,200.00	3.779906496	40,380,000.00	9,536,165,237.43
2002	66.06	33,751,739.00	78.74914	40,100.00	0.54685953	12,920,000.00	10,670,681,953.43
2003	67.93	34,678,779.00	75.93557	41,070.00	2.932475546	67,930,000.00	10,487,529,754.64
2004	70.05	35,635,271.00	79.17388	43,690.00	5.104299776	75,570,000.00	12,206,629,753.11
2005	79.64	36,624,895.00	75.55411	44,060.00	5.906666082	112,300,000.00	10,850,476,264.95
2006	82.71	37,649,033.00	72.10084	44,530.00	6.472494299	173,650,000.00	9,920,269,966.13
2007	85.02	38,705,932.00	67.31764	61,330.00	6.850729771	136,440,000.00	14,141,613,960.27
2008	86.82	39,791,981.00	69.17532	62,660.00	0.232282746	57,520,000.00	16,791,904,449.46
2009	90.41	40,901,792.00	77.35201	63,080.00	3.306939815	219,990,000.00	23,876,750,946.04
2010	95.67	42,030,676.00	79.23315	64,700.00	8.405699224	357,490,000.00	31,809,448,242.19
2011	91.49	43,178,274.00	88.81077	67,080.00	6.10826372	87,090,000.00	39,793,964,385.99
2012	95.22	44,343,467.00	84.5296	66,430.00	4.563209131	167,720,000.00	56,380,786,895.75
2013	98.06	45,519,981.00	86.12288	68,440.00	5.878680567	322,850,000.00	43,508,396,148.68
2014	98.39	46,700,055.00	87.92216	71,370.00	5.357125644	191,630,000.00	53,094,184,875.49
2015	100.62	47,878,336.00	98.17845	73,990.00	5.718507131	295,900,000.00	33,202,262,878.42
2016	100.99	49,051,534.00	101.5044	79,550.00	5.8789493	223,600,000.00	41,449,066,162.11
2017	100.25	50,221,142.00	103.4109	76,750.00	4.805696525	467,190,000.00	58,102,519,989.01
2018	101.97	51,392,565.00	101.3016	78,830.00	6.318450702	208,850,000.00	2,752,503,962.48
Source	FAOSTAT	World Bank	World Bank	IFPRI	World Bank	FAOSTAT	IFPRI

Appendix 2: Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
dlnGAE	dlnFPI	.87413	2	0.646
dlnGAE	dlnGHG	3.2552	2	0.196
dlnGAE	dlnAODA	1.926	2	0.382
dlnGAE	dER	2.1197	2	0.347
dlnGAE	dGDPGR1	1.5964	2	0.450
dlnGAE	lnPOPL	2.2792	2	0.320
dlnGAE	ALL	13.66	12	0.323
dlnAODA	dlnFPI	10.877	2	0.004
dlnAODA	dlnGHG	1.5733	2	0.455
dlnAODA	dlnAODA	.14839	2	0.928
dlnAODA	dER	1.4524	2	0.484
dlnAODA	dGDPGR1	2.1718	2	0.338
dlnAODA	lnPOPL	3.61	2	0.164
dlnAODA	ALL	27.514	12	0.007

Appendix 3: Post-estimation test results

1. Durbin-Watson d-statistic (12, 38) = 2.170154
2. Breusch-Godfrey LM test for autocorrelation

Lags (p)	chi2	df	Prob > chi2
1	1.314	1	0.2516

3. Breusch-Godfrey White test of Heteroskedasticity

   Ho: homoscedasticity Against Ha: unrestricted heteroskedasticity

   chi2 (37) = 38.00

   Prob > chi2 = 0.4236