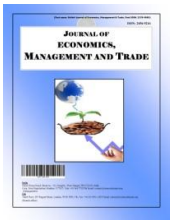

Journal of Economics, Management and Trade

26(5): 11-23, 2020; Article no.JEMT.58403
ISSN: 2456-9216
(Past name: British Journal of Economics, Management & Trade, Past ISSN: 2278-098X)

Agricultural Expenditures and Food Security: Evidence from Sub Saharan African Countries

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Authors' contributions

This work was carried out in collaboration among all authors. Author FDA designed the study with the assistance of author NNL. Author CKT performed the statistical analysis. Author FDA wrote the first draft of the manuscript which was read and corrected by author NNL. All the authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEMT/2020/v26i530252
Editor(s):
(1) Alfredo Jimenez Palmero, University of Burgos, Spain.
(2) Dr. Chen Zhan-Ming, Renmin University of China, China.
Reviewers:
(1) Santosh J. Lagad, Rayat Shikshan Sanstha's Dada Patil Mahavidyalaya, India.
(2) Surendra Singh, ICAR- National Institute of Agricultural Economics and Policy Research, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/58403

Original Research Article

Received 24 April 2020
Accepted 30 June 2020
Published 16 July 2020

ABSTRACT

This paper sets out to investigate the effects of agricultural expenditures on two dimensions of food security in Sub Saharan Africa from 2000-2016. The Feasible Generalized Least Square (FGLS) econometric technique was applied on data from World Development Indicator, Regional Strategic Alliance and Knowledge Support System (ReSAKSS), the World Governing Indicator, the African Development Indicators, the Food and Agricultural Organisation (FAO) data bases. Our results depicted that public agricultural expenditure has negative and significant effects on food availability and utilization while domestic private agricultural expenditure and human capital foster both dimensions of food security. Foreign aid for agriculture has no effects on food availability but promotes food utilization while economic infrastructure promotes food availability but the effects on food utilization are positive and not significant. On the basis of the results, we recommend that SSA African government should increase the size of public agricultural expenditure, increase the level of economic infrastructures so as to crowd in private agricultural investment, lobby for more foreign aid for agriculture, improve the quality of institutions and design different policies to target different dimensions of food security.

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Keywords: Agricultural expenditures; food security; food utilization; availability.

ABBREVIATIONS

CAADP : Comprehensive African Agricultural Development Progamme
GDP : Gross Domestic Product
GHI : Global Hunger Index
LAC : Latin America and the Carribeans
MDG : Millennium Development Goal
MENA : Middle East and North Africa
ODA : Official Development Assistance
PSCE : Panel Corrected Standard Errors
SDG : Sustainable Development Goal
SSA : Sub Saharan Africa
UN : United Nations
UNICEF : United Nations Children Emergency Fund
WDI : World Development Indicators
WFP : World Food Programme
WHO : Wealth Health Organisation

1. INTRODUCTION

The world at large has made enormous efforts to boost agricultural productivity so as to reduce food insecurity over the past decades. These efforts are seen via the United Nations Millennium Development Goals (MDG) number one which intended to reduce extreme poverty and hunger to half by 2015 [1]. At the regional level, in 2003, the Comprehensive African Agricultural Development Program (CAADP) compact was part of the initiative put in place by African heads of states with the targets to increase public spending in agriculture to at least ten percent of total public spending by 2008 as well as increase agricultural GDP growth to 6 percent per annum by 2012 [2]. Information from [3] revealed that despite rising levels of public spending and foreign aid in agriculture, agricultural productivity and food security continued to be dismal in SSA [4,5]. In an attempt to reverse the trends in food insecurity, the Malabo accord was initiated with the aim to re-accelerate efforts towards the fight against hunger in SSA. This lofty agenda was in 2015 supported globally by the SDG number one and two (SDG-2) on eradicating extreme poverty and attaining zero hunger by 2030 respectively.

Despite all these efforts at global and regional levels, the level of hunger has been gradually on the rise since 2014. Globally, hunger rose by 11% rendering about 821 million people hungry in 2017. Among all the regions in the world, SSA and South Asia stand tall in terms of hunger. Information from [6] revealed that after Asia which recorded the highest level of hunger of about 31% in 2018, SSA came second with 29.9%. In terms of undernourishment, SSA had the highest level which stood record high at 21.35% against 15.3% for South Asia, 6.4% for Latin America and the Caribbean (LAC), 9.5% for Middle East and North Africa (MENA) and a global average of 10.8%. The situation in Central and Eastern Africa remains very worrisome because these sub regions continue to record the highest levels of undernourishment in SSA (Central Africa 24.7% & East Africa (28.6% in 2018) against 4.8% for North Africa, 14.1% for Western Africa and 18.8% for Africa as a whole. In term of wasting and stunting, these two sub regions are still worst with high prevalence of stunting and wasting of 34.9%, 39.5% and 9.0 and 8.8% respectively in 2018 [3].

Many debates are put forth with regards to the causes of the unabating levels of food insecurity in SSA. Following the theoretical construct of Chenery and Strout in 1966 [7], aid can propel development and take out developing countries from the doldrums of poverty by closing the saving gap and complementing domestic investment which promotes capital accumulation in the agricultural sector [8]. It implies that the looming level of food insecurity in SSA can also be blamed on the international community in terms of low and volatile external funding to agriculture [9]. Despite this argument, many other writers hold that food insecurity in SSA can be blamed on poor or failed public policy such as limited, volatile and inefficient public expenditures in the food sector [10], limited trade liberalisation, limited credit to the agricultural sector, poor governance that promote civil strife

and wars, adverse and deteriorating terms of trade in international product and capital markets. Thus, to [9] the blame lies on both governments in SSA and donors. Another school of thought think that such looming levels of hunger be blamed on nature in terms of climate change but other think that this ideology is baseless since aid and public expenditures can be used to reduce the negative effects of climate change[10,11].

Despite the call for increased spending from governments in SSA and donors, there are theoretical and empirical controversies on the effectiveness of such agricultural investments in Africa. Theoretically, the Keynesians, Classical and development economists have varied opinions on the effectiveness of foreign aid and public spending on the economy. To begin with, the Keynesians [12] think that increasing public expenditures can lead to greater growth via multiplier and the crowding in effects on private investment and hence, more food production. This simple equation has been refuted by the classical economists who propose minimal state intervention in the economy on the grounds of market distortions via taxes, subsidies and the well known crowding out effects [13]. Taking the case of aid for agriculture, there have been a lot of controversies on its effectiveness in promoting food security with inconclusive findings announced in literature from the public choice and public interest schools of thoughts [14,15, 16,17].

The effects of agricultural aid on food security are inconsistent and inconclusive [18,19,20]. Held that aid may generate no effects on food security While [21,22,23,24,11,8] concluded in their own studies that aid has negative effects on food security.

Going to public agricultural expenditures, the empirical results are also inconsistent and inconclusive [25]. While authors like [5,26,27]. Point to positive effects of public spending on agricultural performance and food security but [28,29] hold that such expenditures have no effects. On the other hand Jambo [13,30,31] insinuated that the effects depend on the composition of public spending. To these empirical controversies, some authors hold that excessive public spending and aid are deleterious to agricultural development and food security [32,26].

In the midst of these theoretical and empirical contradictions on the effects of these expenditures on food security, given limited studies in SSA, we post the following main research question: What are the direct effects of agricultural expenditures on food security in SSA. More specifically, we intend to respond to the following research questions:

i. What are the direct effects of agricultural expenditures on food availability in SSA countries?
ii. What are the direct effects of agricultural expenditures on food utilisation in SSA countries?

This study is relevant because hunger has enormous socio-economic and political costs. Hunger has long terms negative effects on health, cognitive ability and consequently long term productivity as well as development effects [18,19]. Finally, there is a paradox of food security in SSA. SSA has abundant arable land [3], vibrant youthful and agricultural population but the region continues to suffer from low agricultural productivity and high levels of food insecurity.

On the bases of these empirical studies, we observe a gap to fill in literature in terms of empirical methodology by adopting FGLS and PCSE estimators which none the above cited authors in literature have used in the analysis of determinants of food security in SSA. Secondly, we note that most studies on food security are at micro and meso levels. They evaluate the effects of agricultural expenditures on mostly agricultural production and productivity while less attention is paid to various dimensions of food security. This study takes a macro approach by using most recent panel data up to 2016 implying that there is new evidence the effects of public expenditures on food security captured by food availability per capita per day, which is a complete rather than a partial measure of food availability like in the studies of [21,8]. We also make use of the novel composite index(the global hunger index) developed by FAO which tracts hunger and captures more than one dimension of food security. This is very relevant since agricultural expenditures can have different effects on the different dimensions and requires the use of different interventions to enhance them.

After this introduction, the rest of the paper is organized as follows: Section 2 literature review. Section 3 deals with the methodology. Results and discussion are presented section 4 and lastly

the section 5 centers on the conclusion and recommendations.

2. METHODOLOGY

The econometric strategies used in this paper span from unit root test, correlation analysis and descriptive statistics. We used the FGLS to estimate the parameters of the model and the Panel Corrected Standard Errors (PCSE) for robustness test.

2.1 Model Specifications: UNICEF 1991 Framework on Malnutrition

The empirical model in this work is based on the [18] framework on the determinants of child malnutrition. In this set up, we assume only two levels of food security namely; food availability and utilization or adequacy for simplification. We insinuate that agricultural expenditures, institutions, economic liberalisation and climatic change are the basic determinants of food availability [19]. This food availability comprises of food production, food imports, stock variations, exports and food waste. Following [33], this food availability depends on agricultural expenditures; agricultural and rural infrastructure, technical assistance, production subsidies to producers, input subsidies, payments to value chain users (traders, processors, transporters), food stocks, land ownership regularization, import subsidies, food, market infrastructures, extension services and research [25]. These direct and supportive agricultural expenditures also impact on food utilisation indirectly via food availability or directly by way of direct government and donor spending on education, health, expenditures on safety and regulations, food controls and standards, clean water and sanitation, micro nutrient and de-worming interventions, complementary and therapeutic feeding [33,34,35,36,37,38]. Based on the above conception, the general model or the determinant of food security based on the UNICEF framework can be stated as:

$$M_{it} = f(X_{it}, B_f) \quad (1)$$

Where M_{it}= the food security indicator for country i at the time t, f = is a function of, X_{it}= the basic and immediate determinants of food security such as agricultural expenditures and institutional variables, Bf = other environmental factors that impact food security. Based on the works of [8, 21], we adopted two econometric models per the specific objectives of this work. They are stated as;

$$apc_{it} = \propto_0 + \propto_1 paetge_{it} + \propto_2 odaa_{it} + \propto_3 dompia_{it} + \propto_4 hk_{it} + \propto_5 infraindex_{it} + \propto_6 cc_{it} + \propto_7 lspr_{it} + \propto_8 ecolib_{it} + \propto_9 clvar_{it} + \propto_i + \epsilon_{it} \quad (2)$$

$$ghi_{it} = \beta_0 + \beta_1 pae_{it} + \beta_2 odaa_{it} + \beta_3 dompia_{it} + \beta_4 hk_{it} + \beta_5 infraindex_{it} + \beta_6 cc_{it} + \beta_7 lspr_{it} + \beta_8 + \beta_8 ecolib_{it} + \beta_9 clvar_{it} + V_i + \epsilon_{it} \quad (3)$$

Where *fapc* = the food availability per capita per day for country i, at the time t (a measure of food availability), *ghi*= is the global hunger index of country i at the time t (a measure of food utilization or adequacy), *paetge* = is the public agriculturalexpenditure asa percentage of the public sector expenditure, *Odaa* = the agricultural development assistance measured in millions of Dollars, *dompia* = is the domestic private agricultural expenditures captured by the capital stock in the agricultural sector, *hk* = the human capital index built on the basis of principal component analysis (PCA) on primary completion rate and life expectancy at birth, *infraindex* = is the African infrastructural development, cc is control of corruption, cc = is the control of corruption index (-2.5 islowand +2.5 is high), *lspr* = the legal system and property rights, *ecolib* = is the economic liberalisation index built on the basis of PCA based on credit to the private sector as a percentage of GDP and trade openness and *clvar* = the climate change variable of country i at the time t in degree celsus. We assume that the countries have individual intercepts given by $\propto_0$ and β_0 which are assumed to vary across countries or time and $\propto_1$ to $\propto_9$; β_1 to β_9 are the coefficients to be determined, $\propto_i$ and v_i reflect individual countries unobservable time invariant characteristics correlated with other regressors and e_{it} are the stochastic disturbances which are assumed to be uncorrelated with other covariates, are independently and identically distributed (e_{it} ~IID (0, σ_v^2). The expected signs of the regressors and sources are given in Table 1.

2.2 Techniques of Estimation

The strategy followed to estimate the parameters in the model follow that used by [39,40,41]. We make sure that the model is well specified so as to avoid model specification bias. We based our conclusion on model specification bias on intuition [42] on the grounds of careful selection of variables of interest as in the works of [21,8, 11]. When we performed the Breusch Pagan/ Cook Weisberg test of heteroskedasticity, the results showed that there is heteroskedsatic (the

outcome of the tests in presented in the appendix). Given the presence of heteroskedasticity, we used the Feasible Generalized Least Square (FGLS) estimator to estimate the parameters in the models and the Panel Corrected Standard Error Estimator for robustness tests. This is because in the presence of panel, the FGLS provides consistent and asymptotically more efficient estimates of the parameters and is also robust in the presence of autocorrelation [40,41]. The regressions are carried out with the aid of stata 14 software.

2.3 Data and Sources

We make use of panel data with time series property. The data used in this work comes from a number of secondary sources namely: The World Development Indicator (2018) of the World Bank, the ReSAKSS (2018) of the International Food Research Institute (IFPRI) of the FAO, FAOSTAT (2018) data base of FAO, the World Governing Indicators (2018) of the World Bank, African Development Indicators (2018) of the African Union (AU) and the Freedom House and Wall Street Journal (2018).

2.4 Sample

We used 21 countries from SSA on the basis of data availability (Names of countries are in the appendix). Out of the 48 countries in SSA, we were able to obtain complete data for 21 countries. The study ranges from 2000- 2016. This is guided by data availability.

2.5 Preliminary Tests

2.5.1 Descriptive analysis

The Fig. 1 provides a description of the evolution of key variables. A close look at foreign aid for agriculture (ODA), starting from 2002, and one observes a fall in agricultural foreign aid in 2006. From 2008 to 2016, agricultural foreign aid took an upward trend. This follows the 2007 global food crisis which attracted more interest on the need to boost agricultural production by providing assistance to developing countries so as to curb food insecurity [4]. Global hunger index (GHI) has been falling over time from a high level of about 55% in 1980 to 29.2% in 2016.it correlates with ODA for agriculture. In 2002, when ODA for agriculture was 3.845% of total ODA, GHI was 39.174%. When ODA for agriculture rose to 6.7% in 2016, GHI fell to 28.65%. Intituively, ODA for agriculture can explain the movements in GHI or food insecurity in SSA. Public agriculture research expenditure (PARE) is near stagnant and below 1% of the agricultural GDP. Public agricultural expenditure as a percentage of total public expenditure takes a declining trend from 1980 when it was about 10.1% but fell to a low level of about 3.5% in 2016 [5]. Food availability given by agricultural value added (AGVA) has been the most volatile of all the variables indicating the unstable nature of food production in SSA [3]. It does not correlate with agricultural expenditure. In 1983, 1984, 1990 and 1992 public agricultural expenditure stood at 8.5%, 7.12%, 5.6% and 4.9% but agricultural GDP growth rates were negative at -2.6%, -1.10%, -0.7% and -1.9 % respectively. The greatest anomally occurred in 2002 when public agricultural expenditures fell to 3.4% but agricultural GDP growth rate rapidly increased to 16.6, the highest growth rate from 1980 to 2018.

Table 2 presents the descriptive statistics. We observe that the mean value of food availability per person per day was about 191.9916 calories. This fell below the minimum caloric intake recommended by FAO which is between 1600 to 2400 for adult women and 2000-3000 calories for adult men per day [33]. The standard deviation portrays that food availability is very volatile so as to say. This reflects the inconsistency in domestic food production associated to weather variations and the unpredictability of food aid inflows in SSA. The mean level of hunger is at about 31.8475 percent indicating that hunger is still serious in SSA [43]. The mean value of public agricultural expenditures as a percentage of total public spending was 5.8% just about half of the CAADP 10% threshold. The standard deviation is high indicating the volatile nature of public expenditure in the sector [5]. The low mean value of ODA for agriculture, is confirmatory to the fact that the amount of aid to the agricultural sector in SSA in proportion to total aid to the SSA economies is very low [4]. We observe that there is marked widening the min-max ranges meaning that some countries have increased domestic food production and public spending in agriculture disproportionately.

Table 1. Variables, expected signs, authors and sources of data

Variables	Expected Signs & Authors on fapc ghi		Sources of data
Paetge	-[13]	+[8]	ReSAKSS (2018)
Dompia	+ [8]	- [8]	FAO (2018)
Odaa	+ [21]	- [21,11]	ReSAKSS (2018)
Hk	+[15]	- [15]	WDI (2018) and PCA
Infraindex	+[46]	-[46]	African Infrastructural Development Index (2018)
Cc	+[5]	- [8]	WGI (2018)
Lspr	+ [25]	-[25]	Freedom House (2018)
Ecolib	+[19]	-[19]	WDI (2018) and PCA
Clvar	-[11]	-[11]	FAO (2018)

Source: Authors reviews (2020)

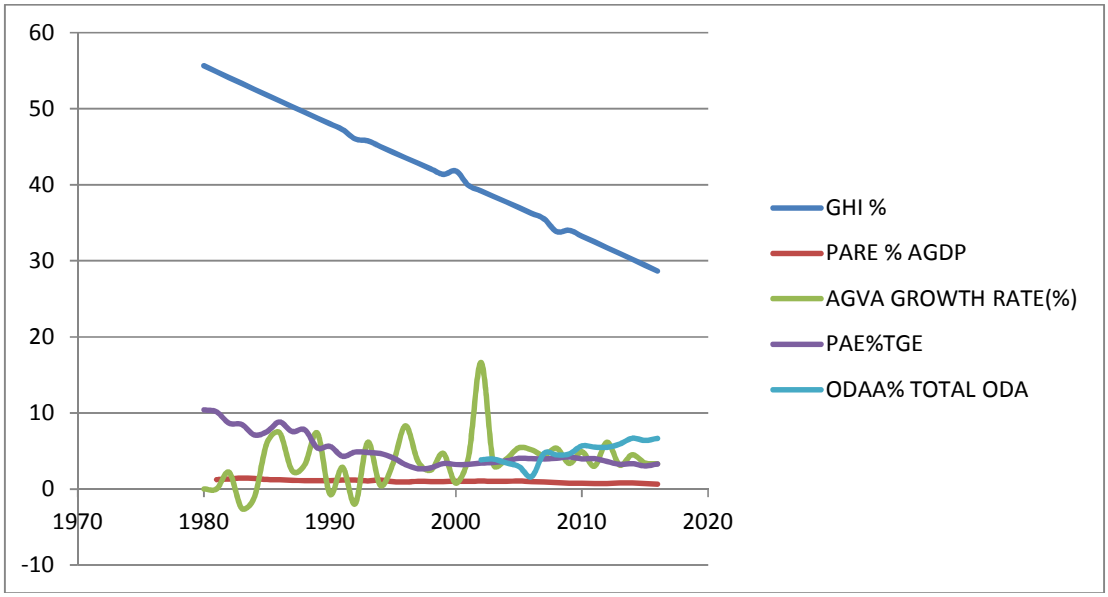

Fig. 1. The dynamics of agricultural expenditures and food security in SSA

Source: Authors (2018)

NB: ODA is agricultural foreign aid, PARE is public agricultural research expenditures, AGVA is agricultural value added, GHI is global hunger index and paetge is public agricultural expenditure

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Fapc	357	191.9916	178.8728	10	897
Paetge	357	5.877915	4.063744	.5125648	25.14348
Odaa	357	5.344631	3.602082	1	19
Dompia	357	318.4822	491.0719	4.209728	4349.469
Hk	357	61.80697	12.5698	24.9445	87.73179
infra_index	357	19.77106	15.85208	1.808	82.15234
Cc	357	-.4522565	.6486526	-2.094025	2.307741
Lspr	357	4.38423	1.435727	1.47	7.63
Clvar	357	.764065	.3641124	-.26	1.818
Ecolib	357	43.00132	20.87104	16.5363	107.2222
Ghi	357	31.84745	8.74266	11.8	58.7

Source: Authors (2020)

Table 3. Correlation matrix

	Fapc	Paetge	Odaa	Dompia	hk	Infraindex	Cc	Lspr	clvar	ecolib	Ghi
Fape	1.0000										
Paetge	-0.3361*	1.0000									
Odaa	-0.2088	0.2417*	10000								
Dompia	0.0823*	-035227*	-0.1607*	10000							
Hk	0.5677*	-0.3238*	-0.0570	0.2113*	1000						
infraindex	0.6166*	-02293*	-0.2262*	0.2752*	0.2870*	10000					
Cc	0.4806*	-0.2188*	-0.0207	0.0178	0.2583*	0.3575*	10000				
Lspr	0.4956*	-0.2979*	-0.0911	0.1638*	0.4733*	0.4052*	0.6686*	10000			
Clvar	0.0037	0.1156*	0.1189*	0.1428*	0.1487*	-0.0937	-0.1736**	-0.1610*	10000		
Ecolib	0.5285*	-0.2497*	-0.1191*	0.2187*	0.4963*	0.5836*	0.5073*	0.4466*	0.0024	10000	
Ghi	0.7029*	0.4118*	-0.1239*	-0.4213*	-0.6574*	-0.3967*	-0.3576*	-0.4225**	- 0.2312*	0.6936*	10000

Source: Authors (2020)

Table 4. Panel unit root test

	At level		At first difference		Order of integration
	Statistic	p-value	Statistics	p-value	
Fapc	-3.9344	0.6258	-14.6965	0.0000	I(1)
Paetge	-6.9599	0.0371	-	-	I(0)
Paeva	-8.1097	0.0001	-	-	I(0)
Paet	0.3368	0.9999	-14.0398	0.0000	I(1)
Odaa	-6.5021	0.0180			I(0)
dompia	-0.3084	0.9965	-16.0122	0.0000	I(1)
Hk	-3.2374	0.2481	-11.8944	0.0000	I(1)
infra-index	-6.0107	0.0090			I(0)
Cc	-18.3210	0.0000			I(0)
Lspr	-6.2186	0.0173			I(0)
geffect	-23.4291	0.0000			I(0)
Clvar	-17.0020	0.0000			I(0)
Ecolib	-4.4691	0.0889	-17.4944	0.0000	I(0)
Ws	-1.8870	0.3440	-10.9381	0.0001	I(1)
Ghi	-0.1274	0,7926	-18.8084	0.0003	I(1)

2.5.2 Correlation analysis

The outcome of the correlation matrix shows in Table 3. That there are significant positive and negative correlations between the regressors used in the models. Even though the correlation between hunger and economic liberalization index is greater than 0.5, it is not up to 0.8 to eliminate any of the variables from the estimation of the models.

2.5.3 Unit root test results

We use the LLC test because the panel is balanced. On the basis of the results in Table 4, public agricultural expenditures, aid for agriculture, infrastructural index, control of corruption, legal system and political rights, climate change and economic liberalization index are stationary at level while food availability per capita per day, domestic private agricultural expenditures, human capital and hunger are stationary at first difference.

3. RESULTS AND DISCUSSION

Table 5 shows of the estimations of the econometric models based on the FGLS and the PCSE estimator used for robustness tests. The dependent variables are food availability per capita and food utilization.

3.1 The Direct Effects of Agricultural Expenditures on Food Availability

The results of the effects of agricultural expenditures on food security are given by column 1 in Table 5. The first column shows the base line results on the effects of agricultural expenditures on food availability. The second column shows the results of the effects of agricultural expenditures on food utilization (adequacy). The outcome of the robustness test based on the PCSE shows almost direction and level of significant of the explanatory variables indicating that our results are robust.

We begin our interpretation with the global significance of the model and latter pay keen attention to the levels of significance, the signs of the coefficients and then relate to results obtained to other empirical works. With the general statistical significance based on the probability of 0.0000 in the different models, we conclude that the models are globally good.

To begin with, the results reveal that public agricultural expenditure has significant negative effects on food availability. One unit increase in public agricultural expenditure leads to 1.405997 points fall in food availability per capita. This is due to deficiencies in the management of public agricultural expenditures. Excessive current spending with its deleterious effects on production [5,8]. [20,17] in his study based in SSA revealed that high public input subsidy programs and price support programs have negative effects on agricultural output.

While domestic private agricultural expenditure has positive and significant effects on food availability per capita per day, foreign aid for agriculture has no effects. A unit increase in domestic private investment in agriculture leads

to a 0.2972 unit increase in food availability. The result is in line with the results of [8] which revealed that private agricultural capital has positive effects on agricultural productivity in developing countries due to its efficiency [44] and crowding in effects of public investment [45].

Human capital has significant positive effects on food availability. A one unit increase in human capital leads to a 2.237624 points increase in food availability. This is certainly due to human capital productivity enhancing effects [46]. Education also promotes the adoption and use of new technology in agriculture [47]. This is in line with other studies of [48,49,50,51].

Economic infrastructure has positive and significant effects on food availability at the one percent level of significance. A unit increase in infrastructural development leads to a 0.4810 point increase in food availability. This is because of the transaction cost reducing effects of roads on private agents in this sector [46]. This result is in line with that of [45]. The use of telephone promotes agricultural businesses practices.

The institutional and policy variables namely control of corruption, legal system and property rights and economic liberalization have significant positive effects on food availability. A unit improvement in control of corruption, legal system and property rights lead to 10.0515, 10.0145 and 1.9384 points increase in food availability respectively. This can be via their positive effects on agricultural output growth [8, 52]. This is corroborated by the results of [8].

Trade openness improves food availability via import of food from the rest of the world. [25] held that good policies like monetary, better institutions, land reforms, tax reforms and trade improve crop yields. This contradicts the empirical results of [53].

3.2 The Direct Effects of Agricultural Expenditures on Food Utilization (Adequacy)

The results are presented in Table 5 in column under the 2 regression.

Foreign aid for agriculture promotes food utilization significantly. A unit rise in foreign aid for agriculture leads to a 0.1246 improvement in food utilization [54]. This result is in line with that of [11] which revealed that agricultural aid has improves food security via climate change mitigative effects. The results of [21] revealed that both multilateral and bilateral agricultural ODA promotes agricultural growth and food security in SSA.

Domestic private agricultural investment promotes food utilization. A one unit increase in domestic private investment in agriculture leads to a 0.0033 point improvement in food utilization. This result is in line with that of [8] to whom private agricultural capital stock positively affects food security in developing countries.

Human capital enhances food utilization. A unit increase in human capital leads to a 0.2649 points improvement in food utilisation. Human capital improves food security first by improving production and access via poverty reduction. Secondly, it improves food utilization via improved nutritional education and better health which ameliorates food absorption [2018]. This is in line with the result of [18,19] which concluded that the health environment and women educational status affect child malnutrition positively.

Legal system and property rights enhance food utilisation. A unit improvement in the legal system and property rights lead to a 0.3315 point improvement in food utilisation. This result is corroborated by that of [8,55]. Property rights that promote access to land titles promote access to productive assets, land markets and long term investment in agriculture [55]

Climate variation rather enhances food adequacy. This is possible via the mitigation of the negative effects of climate change by the use of public agricultural expenditures and foreign aid for agriculture [11]. This can also result from household adaptation to climate change.

Economic liberalisation ameliorates food utilization significantly**.** A unit improvement in economic liberalisation leads to a 0.1726 point improvement in food utilisation. This is because financial deepening can help to boost production, reduce poverty and smooth consumption [56, 57]. Trade allows for poverty reduction and increases food availability, varieties and dietary diversity to the households [19].

Table 5. Results of FGLS and PCSE estimates

Variables	FGLS estimates		Robustness Test: PCSE estimates	
	(1) fapc	(2) ghi	(3) fapc	4) ghi
paetge	1.405997***	0.1233**	-2.0884***	0.2107***
	(0.4641)	(0.0519)	(0.7701)	(0.0625)
odaa	-0.5905211	-0.1346***	0.3555	-0.2569***
	(0.3762387)	(0.0399)	(1.0960)	(0.0546)
dompia	0.2972**	-0.0033**	0.0139**	0.0037***
	(0.0068)	(0.0003)	(0.0068)	(0.0004)
hk	2.237624***	-0.2649***	2.2277***	-0.2645***
	(0.3067)	(0.0759)	(0.3066)	(0.0228)
infraindex	0.4810***	0.0101	1.4629***	0.0152
	(0.1180)	(0.0125)	(0.3179)	(0.0190)
cc	10.0515**	0.00659	13.433	-0.3475
	(4.9551)	(0.3317)	(8.8277)	(0.4803)
lspr	10.0145***	-0.3315*	1.7299***	-0.1813
	(2.4775)	(0.18142)	(4.0443)	(0.2398)
clvar	-0.9006	-0.6214**	-3.23132	-1.2112***
	(3.0581)	(0.3371)	(5.5359)	(0.4957)
ecolib	1.9384***	-0.1726**	3.1082***	-0.1669***
	(0.2638023)	(0.0129)	(0.4231)	(0.0165)
cons	-95.4878***	58.4371***	-1.845000**	58.0258***
	(20.3072)	(1.4383)	(0.3449)	(1.7657)
R-square			0.5570	0.8117
Wald chi2 (9)	70.66	80.63	38.97	59.92
Prob > chi2	0.0000	0.0000	0.0000	0.0000
No of observation	357	357	357	357
No of countries	21	21	21	21

*Standard errors are in parentheses. ***; ** and * are the levels of significance at 1%, 5% and 10% respectively*
Source: Authors (2020)

4. CONCLUSIONS AND POLICY IMPLICATIONS

In this paper, we investigated the direct effects of agricultural expenditures on two dimensions of food security in a sample of 21 countries in SSA from 2000-2016. Our results from the static panel models reveal that agricultural expenditures have mixed effects on the food security dimensions.

Briefly, public agricultural expenditure deteriorates both dimensions of food security. Domestic private agricultural spending, human capital, infrastructural development index, legal system and property rights and economic liberalization significantly promotes the two dimensions of food security while economic infrastructure and control of corruption promotes food availability but have no effects on food utilization. Equally, aid and climate change enhance food utilization but have no effects on food availability.

On the basis of our results, we recommend that SSA African government should increase the size of public agricultural expenditure, promote private investment in the sector, increase the level of infrastructural facilities so as to crowd in private agricultural investments, lobby for more foreign aid for agriculture but needs to improve on their institutional and policy environment (trade and financial development) so as to attract more private investment that would drive food security in SSA. Different public interventions should be designed for different aspects of food security as one policy cannot fit all the dimensions.

One vital weakness of our study is that the conclusion and policy recommendations apply only at the regional level as it does not take into consideration countries specificities. In reality, heterogeneity exists in agricultural expenditures and food security in SSA African countries. On this note we suggest that future studies could be

based on country specific studies so as the gain more insight on the effects of agricultural expenditures on food security, an account might also be taken on the components of aid for agriculture while at the same time more transmission channels can be investigated.

ACKNOWLEDGEMENT

We deeply gratify the editorial team and the review bench for the valuable efforts in upgrading the quality of this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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THE APPENDIX

Table 6. Breusch Pagan/cook Weisberg test of hetroskedasicity

Chi-2	65.05
Probability	0.00146
Conclusion	There is heteroskedasticity

List of countries in the sample

Cameroon, South Africa, Ghana, Nigeria, Togo, Mali, Kenya, Zambia, Zimbabwe, Ivory Coast, Botswana, Burkina Faso, Uganda, Tanzania Senegal, Niger, Mozambique, Mauritius, Namibia, Madagascar, Kenya

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/58403