CSCanada
Canadian Social Science
Vol. 15, No. 8, 2019, pp. 59-73
DOI:10.3968/11227

ISSN 1712-8056[Print]
ISSN 1923-6697[Online]
www.cscanada.net
www.cscanada.org

Role of Public Agriculture Spending on Performance in Sub-Saharan Africa: A Channel-Based Analyses

Saidi Atanda Mustapha[a],*; Oluwafemi Sunday Enilolobo[b]

[a]Lecturer. Department of Economics, Accounting and Finance, Bells University of Technology, Ota, Sango, Nigeria.
[b] Senior Lecturer. Department of Economics, Accounting and Finance, Bells University of Technology, Ota, Sango, Nigeria.
*Corresponding author.

Received 3 July 2019; accepted 8 August 2019
Published online 26 August 2019

Abstract

African heads of state have made several commitments to make the functioning of the agriculture sector sustainable. The two most prominent of these commitments are the Maputo and Malabo declarations. The Maputo declaration stated that country should allocate at least 10 percent of the total fiscal expenditure so as to attain 6 percent agricultural growth. This study investigates the effects of public agriculture spending on agricultural output. This was conducted through the effective quality channels of public agriculture spending such as credit budget channel, research budget channel, fertilizer consumption channel and energy budget channel in sub-Saharan Africa. The study was essential has very limited studies have examined the effects of agriculture public spending to feeding sub-Saharan Africa. The paper adopted the system generalized method of moment to control for endogeneity, simultaneity, and reverse causality. The findings show that public spending enhances agriculture performance to feed SSA without considering the effects of identified channels, however this relationship is weak. The paper concludes that private subsidization of fertilizer should not be the major priority of the SSA governments; but the more essential agricultural sector policies should focus on: providing infrastructures such as energy railing, connecting road networks; and research and development.

Key words: Public agriculture spending; Agriculture performance; System GMM; Maputo declaration

Mustapha, S. A., & Enilolobo, O. S. (2019). Role of Public Agriculture Spending on Performance in Sub-Saharan Africa: A Channel-Based Analyses. *Canadian Social Science, 15*(8), 59-73. Available from: http://www.cscanada.net/index.php/css/article/view/11227
DOI: http://dx.doi.org/10.3968/11227

INTRODUCTION

Extreme hunger is one of the major challenges facing the African continent. In 2018, all stakeholders presence at the World Food Congress held at Cairo refutes the persistence of hunger in Africa and avowed it to be unacceptable. Agriculture is the only way to reduce the pressing harmful effect of hunger. African governments had decreased investment in agriculture between 1980 and 2003, this is own to the fact that the World Bank led Structural Adjustment Programs (SAPs) advocates for investment in agriculture to be scaled down (Akroyd, 2004). This had made investments and donors support to agriculture declined by 72% between 1988 and 2003 (see One, 2013); and low levels of investments in African agriculture are reflected in the dearth of infrastructure and extension services such as irrigation and farmers inputs. Meanwhile, Gadin (2018) stated that the situation Africa is experiencing requires massive public investment in agriculture and research and development.

One of the conscious efforts of the African governments to end hunger and promote agriculture sector growth is the Maputo declaration. The declaration is the commitments of African heads of States to allocate at least 10% of the total public spending to the agriculture sector so as to achieve a 6 percent agricultural growth rate. The declaration was committed to ending hunger and halving poverty in the continent through inclusive agricultural growth by 2025 (African Union, 2014). Seventeen years since Maputo commitment, many SSA countries have significantly increased their public spending on agricultural sector, yet, strong evidence on the increasing importance of agricultural sector performance are

decidedly mixed. While the work of Adofiu *et al* (2012), Wangusi & Muturi (2015), Charlotte & Mughal (2018) among others, lent credence to the importance of increased public spending on agricultural sector performances and food production, Mogues (2011), Anríquez*et al*(2016) and Kumar and Dkhar (2018) were significant turning point. Kumar and Dkhar (2018) for instance argued that decades of public spending had not significantly contributed to agricultural sector performance. Meanwhile, Akroyd (2004), Mogues *et al* (2012) and Newettie (2017) asserted that, the extent to which increased public spending contributed to agriculture sector performance depend on the quality and channels of the spending.

An increasingly common argument in favour of public spending-agricultural sector growth channels is that, it may determine the return on agriculture investment and lead to an increase in the sector capacity to improve food production and food security in SSA especially where more than 223 million people are under-nourished and the population under extreme poverty may rise from the 2015 figure of 420 million to 550 million by 2025 (African Development Bank 2018). A curiosity into the aggregate spending in the sector is more likely to reduce the quality effects of spending such that a relatively large share of resources is being allocated to the lower impact activities.

The paper is essential, as it does not concentrate on the aggregate impact alone, but examines the quality and channel of public agriculture spending on agriculture. Studies have established that examining the quality and channels of spending are more important than the overall level of spending (see Akroyd, 2004; and Benin and Mogues, 2012). In the work of Benin and Mogues (2012), public spending is perhaps considered as an important policy instrument available to governments of most developing countries for promoting growth. It further suggests that studies that concentrated on the effects of aggregate public expenditure on agricultural performance without considering the potential threat of heterogeneity impact across the different types of agricultural expenditures, such as input subsidies, research, extension, irrigation, among others, is incomplete. . It seems therefore risky, without a serious empirical study, to conclude definitively on the impact of public spending on agriculture sector performance and food production without detail analysis of the issue of quality spending in SSA, even though the overall opinion tends, a priori, to suggest a positive impact on quantity spending.

The quality and channels of spending will eventually depends on quality spending especially based on the financial binding constraints and looking at alternative results of spending through agricultural development. This therefore, raises a concern on what could be dominant public spending channel that ensures the successful achievement of the Maputo commitment? The paper assumes that, improved food production should not be mistakenly interpreted as a result of increased public spending on agriculture without monitoring agriculture spending that goes into different priority areas since agricultural growth also depends upon non-agriculture expenditures such as in rural infrastructure, subsidies, irrigations, technology, research and development, among others. The paper is imperative as it provides an assessment of the progress made in Sustainable Development Goals (SDGs), which is to end hunger and achieving sustainable agriculture in Africa by 2025.

The paper is arranged into five sections as follows. Section one consists of the introductory part of the paper. Section two provides review of related empirical literature. Section three presents the theoretical framework and methodology that explains the empirical strategy adopted by the paper. Section four discusses the empirical estimations. Section 5 concludes the paper and highlighted some policy implications.

1. REVIEW OF EMPIRICAL LITERATURE

In the eras of the 1980s and the 90s, agriculture remained a low-priority item in the policy agenda of most African countries, as focus was mainly on economic reforms and liberalization of the industrial, finance and other service sectors (Yu *et al*., 2015). Policy rhetoric shifted in 2000 with realization of agriculture's potential for leading economic growth and poverty alleviation in Africa. The renewed interest was based on the African government endorsement of expending 10 percent of their budget on agriculture. While several empirical studies has contributed to the role of public spending on agriculture, results in the literature appeared controversial covering the full gamut from positive effects, to negative effects ant to conditional effects. Evidence provided by Itodo *et al* (2012) and Olomola *et al* (2014) for instance, shows that public spending has a positive impact on agricultural sector performance growth of rural areas of Nigeria. Wangusi and Muturi (2015) finds similar results on the impacts of agricultural public spending on agricultural productivity in Kenya over the period 1973 to 2012. The result of Adofiu *et al* (2012) show similar results with that of Itodo *et al*(2012) and Wangusi and Muturi (2015) but rather laid emphasis on how the share of the budget allocated to agricultural sector should be monitored so as to be able to guarantee food security, employment and overall economic growth and development in Nigeria.

The argument that increased public expenditure leads to increased GDP up to a certain point in which economic growth attains its maximum value prompted Faruk & Aydınb (2013) to focus on understanding the optimal level of public spending on agriculture growth. When economic growth has attained its peak, the marginal productivity of public expenditure is equal to the marginal productivity of private sector expenditure. The economic contribution of increased public expenditure becomes zero. After this point, the influence of the law of diminishing returns

will lead to a situation in which increasing the share of public expenditure any further will decrease the rate of economic growth. As a result, it will be necessary to downsize the state in order to increase output. Additional increase in public expenditure will only mean economic stagnation and shrinkage. According to Friedman (1997), the government has an important role in a free and open society. It is emphasized that, average contribution of the public sector in the economy is positive, but as the public share of national income increases from 15% to 50% the marginal contribution of the public sector will be negative. Therefore, Friedman advocates that based on development level of countries, the optimal level of public spending should be between 15% and 50%. Accordingly**,** Faruk & Aydınb (2013) test the applicability of an "inverted U" shape relationship between public spending and economic growth and determine the optimal level of public spending based on Armey curve hypothesis for Turkey, Romania and Bulgaria economies. Based on ARDL bound testing approach developed by Paseran *et al* (2001), Faruk & Aydınb (2013) findings show that the share of present public expenditure in GDP exceeds optimal public expenditure for the three countries.

Based on Maputo 2003 endorsement of allocating at least 10% of the national budget to agriculture, and to achieve at least 6% annual agricultural growth, Ebi & Amaraihu (2018) raised the question by how much would changes in agricultural expenditure improves agricultural output in Nigeria? The author conclude that increasing agricultural expenditure to 10% of the total expenditure in line with Maputo Declaration would increase agricultural output by 11-times greater than the impact of what is actually spent on agriculture. Selvara (1993) assess the impact of agricultural government expenditure and instability on agricultural output growth using time-series data over the 1951-52 to 1988-89 periods. The results indicate that the government expenditure policies are of vital importance for the growth of agricultural sector and any instability in agricultural government expenditure is inversely related to the growth of the sector.

All these studies above emphasized the impact of aggregate spending impact on agricultural sector performance rather than considering returns on public expenditure on related agriculture areas, such as R&D, energy, or other functions, with high bearing on agricultural growth and poverty reduction. This might have suggests that policy should ultimately target blanket recommendation of increasing agricultural spending without giving attention to heterogeneous impacts of different types of agricultural investments may bring.

Some of the studies that considers the component of public spending are Armas, Osorio, Blanca, and Abriningrum (2012),Benin (2015), Anríquez, Foster, Ortega, Falconi, and Salvo (2016) and Newettie (2017). Armas, Osorio, Blanca, & Abriningrum (2012) found that, public spending on agriculture and irrigation during the period 1976-2006 had a positive impact on agricultural growth, while public spending on fertilizer subsidies had the opposite effect in Indonesia. Józimo & Ortega (2006) in related study show how the share of the budget allocated to subsidizing private inputs has a negative and significant impact on the efficiency of public spending. Newettie (2017) examine the component of public expenditure that is more growth enhancing for the agricultural sector in Zambia, Malawi, South Africa and Tanzania between 2000 and 2014. Vector Error Correction Model (VECM) was used to test the impact of public expenditure, private investment and net trade on agricultural GDP growth. The result from the analysis reveals that agricultural growth responds differently to the agricultural spending types across the chosen countries. The implication of Newettie (2017) findings was that more efficient targeting of public investments by the governments stimulates growth in the agricultural sector. Using data on 34 countries in Africa south of the Sahara (SSA) from 1980 to 2012, Benin (2015) assesses the returns to public spending in the agricultural sector, considering expenditures on agriculture as a whole versus expenditures on agricultural research. Based on instrumental variables estimator the study found the elasticity of land productivity with respect to total agricultural expenditure per hectare to be 0.04, (low) and elasticity with respect to agricultural research expenditure per hectare to be 0.09 (higher). The aggregate returns to total agricultural expenditure and agricultural research expenditure in SSA are estimated at 11 percent and 93 percent, respectively. Anríquez, Foster, Ortega, Falconi, and Salvo (2016) support the evidence that the displacement of government expenditures on public goods by subsidies to private goods inhibits the performance of the farm sector. The authors present an analysis of the influence of the mix of expenditures related to agriculture on net income generation, using data for 19 Latin American and Caribbean countries during 1985-2012. Their results demonstrate that total government spending on the farm sector positively impacts agriculture's performance. More importantly, and of greater practical economic significance, increasing the share of expenditures committed to public goods, ceteris paribus, would significantly raise rural income as measured by sector value added per capita of the rural population. Their result is in line with that of Kumar and Dkhar (2018) based on a time series data of 30 years from 1984-85 to 2013-14. Kumar and Dkhar (2018) recently examined the short and long run relationship between government expenditure on agriculture and its allied sector and agricultural output of Meghalaya, India. They study found that the effect of public expenditure on agriculture is negative and significant, expenditures on education and transport on agricultural output are significantly positive and public expenditure in agriculture through healthcare however does not significantly affect agricultural output in the long run.

Mogues (2011) performed a country-level analysis on Ethiopia. The author found that public expenditures on agriculture as a whole do not have comparatively high rural income returns and are surpassed by public investments in road infrastructure and education. Mogues (2011) traced the effects of agricultural performance on rural welfare, as well as the effects of public agricultural spending on agricultural performance. This multistage analysis makes clear that the weak link is the latter effect, whereas the role of agricultural productivity for increasing rural incomes is strong and robust. This finding suggests that the technical efficiency of agriculture outlays, as well as its allocative efficiency, needs to be examined.

The modest or disappointing results regarding the effects of aggregate agricultural expenditures are worth further exploration. Some of the aforementioned studies that found a statistically insignificant effect of aggregate agricultural spending considered economic growth as the outcome of interest. As shown above, there is great heterogeneity in impacts across the different types of agricultural expenditures, such as input subsidies, research and development, energy, and other areas. An examination of aggregate spending in the sector is likely to wash out these effects, especially if the expenditure composition in the country or countries studied is such that a relatively large share of resources is being allocated to the lower-impact activities. Besides the issue of different effects of public spending on agriculture, more may be learned from an examination of the effects of corruption impact on public spending on agricultural sector performance. We are not aware of any work undertaking such analysis, and it thus constitutes an important area for achieving sustainable goal of feeding Africa.

2. THEORETICAL FRAMEWORK AND METHODOLOGY

2.1 The Quality Theory of Public Expenditure on Agriculture

The rationale for increasing public spending in boosting agriculture sector performance to feed SSA is originated from Keynesian argument which postulates that, the state can increase public spending to enhance the capacity of the economy to grow. Keynes posited that there exist a fundamental relationship between public expenditure and economic growth through government fiscal operations. Accordingly, the existence of any form of declining growth was due to lack of adequate public spending. Government expenditure can help improve the level of productive investment, hence economic growth and development can be secured (Ram 1986). Benin and Mogues (2012) consider public spending as perhaps the single most important policy instrument available to governments of most developing countries for promoting agriculture sector growth and sustainable food production. Consequently, increased government investment on agriculture can raise the productivity of all factors in agricultural sector and lead to higher agricultural growth which can play important role in alleviating poverty and hunger (Anderson *et al*. 2006).

Meanwhile, Akroyd (2004) argues that quality spending to agriculture is more important than the overall level of spending; a fact often alluded to by Keynesian theory of effective spending but often neglected by prescriptive approaches to spending. Quality public spending may eventually depends on optimal allocation especially based on the financial binding constraints and looking at alternative results of spending through agricultural development and thus, bringing about the question of dominant public spending channel that ensures the successful achievement of Maputo/Malabo Protocol. It is logical that governments would spend on public goods and services or spend in areas where the impacts of the spending are likely to be greatest based on the notion of program placement effects (Maddala 1983). For example, public spending on research, extension and education leading to improvements in the stock of modern technologies, knowledge and human capital would be expected to raise agricultural productivity of all factors of production. Public spending on agricultural input subsidies, on the other hand, would be expected to directly increase the use and amount of the subsidized inputs and increase agriculture sector perforce. Recipients of a subsidy may alter their labor supply or spending and savings choices, which would in turn affect their farm and non-farm production and consumption decisions in a manner that may undermine the expected outcomes of the subsidy program (van de Walle 2003). Public spending on infrastructure (e.g. railroads, energy) may be expected to greater factor accumulation as well as higher value of agriculture production.

Agricultural productivity through increased public spending can offer people greater access to food through at least three pathways: (1) by increasing production for self-consumption, in the case of subsistence farmers; (2) by reducing prices for net buyers of food (IFPRI 2011); and (3) by increasing marketable output for agricultural producers who sell all or part of their output, thus increasing their incomes. The income gains of the third pathway can translate into better nutrition through greater calorie consumption and gains in dietary diversity, as well as improved health through a better ability to purchase medicine and access health services. However, not all agricultural investments will be equally successful in bringing about such gains in productivity, consumption and income. The first striking features of this theory are, increasing public spending is imperative in the quest for agricultural productivity to feeding Africa goal. Again, if policymakers were to focus on agricultural productivity growth in undertaking their public spending decisions,

they should prioritize much different kinds of investments within SSA. This is based on the argument that not only the quantity of spending affects economic growth but also its composition and effectiveness.

2.2 Model Specification

In order to have a comprehensive perspective of the concept, the paper provides three separate specifications. The first model specified examines the impact of public spending on food production and agricultural sector performance. This is followed by examining the impact of macroeconomic mishap and dependence on environmental resources affect public spending influence on agriculture to feeding sub-Saharan Africa. Lastly, the aggregate effect was considered to clearly show the impact of public spending on agriculture sector performance.

2.2.1 Examining the Effect of Public Spending on Food Production and Agriculture Sector Performance

Following the argument of Benin et al. (2012) that, public spending affect agricultural growth through different channels, the question of which area of agriculture spending is most rudimental to agricultural growth remains ambiguous for Africa and specifically, sub-Saharan Africa. The paper resolved these by providing optimal allocation especially allocations that are based on the financial binding constraints; and looking at alternative results of spending through agricultural development, hence the question on what is the dominant public spending channel that ensures the successful achievement of Maputo protocol raised is answered.

The model to show the relationship between the public agriculture spending channels and food production and agricultural sector performance is specified in equation (1).

$$\begin{aligned} Avg_{i,t} &= \alpha_1 Avg_{i,t(1,2)} + \alpha_2 ggdp_{i,t} + \alpha_3 ggdp_{i,t}^2 + \alpha_4 budg_{i,t} + \alpha_5 acre_{i,t} + \alpha_6 [acre.budg]_{i,t} \\ &+ \alpha_7 agri_{i,t} + \alpha_8 [agri.budg]_{i,t} + \alpha_9 rail_{i,t} + \alpha_{10} fercons_{i,t} + \alpha_{11} [fercons.budg]_{i,t} \\ &+ \alpha_{12} energ_{i,t} + \alpha_{13} [energ.budg]_{i,t} + \sum_h \eta^h X_{i,t}^h + \phi_i(v_{i,t}) + \varepsilon_{i,t}^* \end{aligned} \quad (1)$$

Where all errors are independent of each other and among other variables in the model. i represents the indexes for countries, t represents time period, and Avg is the measure of agriculture value added annual percentage growth, α_1 is the elasticity of agriculture value added annual percentage growth lagged for the most two periods. This is an approach that brought into the model some level of dynamics (see Baltagi and Levin, 1986). Other $\alpha's$ represent elasticities of various regressors included in the model, respectively. The study is mainly interested in the level of significance of the interactive coefficients since it would present evidence of substitutability between public spending and agriculture financial channels.

2.2.2 Do Level of Corruption and Dependence on Mineral Oil Resources Affect Public Spending Effect on Agriculture to Feeding SSA?

In an attempt to have a better understanding of the role of public spending on agriculture in SSA, this study considers the possible effects of corruption and dependence on oil on the effects of public spending on agriculture to feed in SSA based on equation (2).

$$\begin{aligned} Agp_{i,t} &= \lambda_1 Agp_{i,t(1,2)} + \lambda_2 ggdp_{i,t} + \lambda_3 ggdp_{i,t}^2 + \lambda_4 budg_{i,t} + \lambda_5 maputo_{i,t} \\ &+ \lambda_6 oildisease_{i,t} + \lambda_7 corrup_{i,t} + \lambda_8 [corrup.budg]_{i,t} + \sum_h \eta^h X_{i,t}^h + \mu_{i,t} \end{aligned} \quad (2)$$

Note: all the explanatory variables in the model were extracted from equation (1) except Maputo, oil-disease, corruption and interaction of corruption and budget that are included as explanatory variables in the model. The matrix of X refers to a set of variables that the literature has found to affect agricultural production in Africa (Mauro, 1995; Svensson, 1995; World Bank report, 1999; G20 summit report, 2016; Africa Agriculture Status report, 2016; and OECD, 2017). The paper considered these variables to be important determinants for feeding SSA model.

2.2.3 Aggregate Model on the Impact of Public Spending on Agriculture Sector Performance

After seventeen years of the meeting held by the African heads of State committed to achieving the Maputo targets, this study adopted the model specification of Kumar & Dkhar (2018) to examine the relationship between public expenditure and agricultural production in SSA. The model to capture this representation is specified in equation (3) as follows:

$$Avg_{i,t} = \theta_1 Avg_{i,t(1,2)} + \theta_2 ggdp_{i,t} + \theta_3 ggdp_{i,t}^2 + \theta_4 budg_{i,t} + \sum_h \eta^h X_{i,t}^h + \upsilon_{i,t} \quad (3)$$

Note: all errors are independent of each other and among other variables included in the model. X is the other control variables, which include arable land (as percentage of total land area), domestic investment (proxy by gross fixed capital formation), government consumption expenditure as percentage of GDP, growth rate of population and agriculture export. The paper is concentrated on the significance of the estimator of government budget in the agriculture performance model.

Direct estimation of equation (1) will result in general biasedness of the estimators (Arellano and Bond, 1991). The biasedness will occur through the endogeneity issues arising from the system of equations. The study controls for the endogeneity issue by introducing lagged dependent variable as independent variables and a set of instruments based on system Generalized Method of Moments (system-GMM) regressions, following Arellano and Bond (1995). There are several reasons for adopting the GMM technique. First, the number of cross sectional observation is substantially higher than the time period (n>t). Second, the system of estimation corrects for biases in the difference estimator. Third, the estimation approach has some little endogeneity issues as it accounts for simultaneity. Moreover, the use of time-invariant omitted variables also increases the control for endogeneity. This is consistent with Bond *et al*. (2001) and the system GMM estimator proposed by Arellano & Bond (1995) and Blundell & Bond (1998) has better estimation properties when compared with the difference estimator proposed by Arellano & Bond (1991).

This paper follows the approach of Roodman (2009a) extension of Arellano & Bover (1995) because it restricts over-identification and instrument proliferation and also accounts for cross-sectional dependence (Baltagi, 1998; Boateng *et al*., 2016). This method also allow for more instruments and leads to improved efficiency. The Arellano-Bover/Blundell-Bond has one and two step variants, the paper makes use of the two-step because it is more robust and asymptotically more efficient than the one step (Nickel, 1981).

3. PRESENTATION AND DISCUSSION OF EMPIRICAL ESTIMATES

3.1 Examining the Effect of Public Spending on Food Production and Agriculture Sector Performance

The inconclusiveness in the effect of public spending on agriculture may likely be as a result of aggregate agricultural spending. Empirical conclusion based on aggregate agricultural spending may be too risky as it might likely wash out the quality spending effects and ultimately obscured World Bank (2002) fundamental question, which area of agriculture public spending is most fundamental for sustainable agricultural sector growth. To surmount this aggregate spending argument, Table 1 shows the result of quality channel public spending of agriculture. The second column is the public spending agriculture credit channel model. The third column is the public spending agriculture research channel model. The fourth column is the public spending agriculture rail line channel model. The fifth and the sixth columns are public spending agriculture fertilizer and energy channel models. The Hansen J statistics of over identifying restrictions of the entire model confirm that the instruments used are uncorrelated with the residuals, hence acceptable and healthy. As expected, this study finds that initial two periods of agriculture sector performance measures of past realizations of agriculture sector growth has positive impact on its current levels.

This is consistent with the argument of Ugwuanyi & Abula (2015) and Owolabi *et al* (2017) that provide evidence that economic growth lead to agriculture in Nigeria. The coefficient associated with the real level of real GDP growth is found to be positive and statistically significant in all the channels. The quadratic coefficient also becomes negative in sign and significant in all the models. The results also provide evidence of a humped-shaped relationship between real GDP growth and agriculture value added growth implying higher level of real GDP growth are positively associated with agriculture value added growth in SSA but with a non-constant effects. This suggests that the marginal effects of real GDP growth shows decreasing returns for agriculture value added growth as before. Agricultural land area is positively and significantly associated with a higher agriculture value added growth as before in the entire models. Domestic investment rate proxied by gross fixed capital formation all have positive signs but are not all statistically significant effect on agriculture value added growth. The models that are significant are rail line-budget and energy-budget channels.

As seen in Table 1, our estimates suggest that, on average, a percentage increase in the share of gross fixed capital formation will lead to about 4.18 percent, 5.06 percent and 5.84 percent increase in agriculture value added growth in rail line-budget and energy budget channels, respectively in SSA. However, its effects are not significant in the credit-agric budget, research-agric budget and fercon-budget channels. Population is negatively and significantly related with agriculture value added growth but has a strong positive relationship with food production in SSA. The relationship between exportation of agricultural good and agriculture value added growth is consistently positive and statistically significant. The results show that coefficients for log of government expenditure on Agric (BUDGET) have correct positive signs with 5% level of significance for all the models except that of fertilizer channel that lost its significance at 5% level.

The credit variable and its interaction with government spending have positive but statistically insignificant effect on agriculture sector performance. However, it has an insignificant positive effect in the sub-Saharan Africa estimation. Our result is not surprising given the problems of low percentage of commercial bank lending to agriculture and high interest rates in many African countries. For instance, commercial bank lending to agriculture is only 4.8 percent lending (AFDB, 2016) or USD 660 million per year, out of a total of USD 14

billion per year. This low value is an indication that the phenomenon may not significantly reach smallholder farmers and small and medium agro-enterprises. Smallholder farmers in particular continue to experience inadequate access to seasonal credit and practically no access to investment credit. The result of this is a significantly unmet demand for credit in the agricultural sector, although such credit is crucial to addressing the growing demand for agricultural commodities and shifting preferences towards higher value food sources.

Table 1
Effect of Public Spending Channel on Agricultural Sector Performance in SSA

Variable	Credit agric-budget channel	Research agric-budget channel	Rail line-budget channel	Fercons-budget channel	Energ-budget channel
Avg(-1)	0.086*(0.0012)	0.110*(0.000)	0.124*(0.000)	0.102*(0.0036)	0.101*(0.000)
Avg(-2)	-0.070*(0.0057)	-0.075*(0.000)	-0.070*(0.000)	-0.079**(0.015)	-0.076*(0.006)
Lggdp	3.669*(0.000)	3.847*(0.000)	3.870*(0.000)	3.780*(0.000)	3.099*(0.000)
Lggdp-Squared	-6.401*(0.000)	-6.534*(0.000)	-6.812*(0.000)	-6.422(0.000)	-6.159*(0.000)
Larland	1.725**(0.088)	0.808(0.354))	0.059(0.946)	1.603**(0.0714)	1.081(0.186)
Lgfcf	1.774(0.2504)	2.278(0.156)	4.185*(0.006)	0.907(0.627)	2.820**(0.075)
Lggcon	-1.401(0.57)	-1.678(0.315)	-2.349(0.1681))	-2.063(0.548)	-1.231(0.5526)
Pg	-2.262(0.133)	-2.947**(0.016)	-1.946(0.113)	-2.349(0.299)	-3.230*(0.021)
Lagexp	-3.209*(0.000	-2.3429*(0.000)	-3.617*(0.000)	-3.084*(0.000)	-2.900*(0.000)
Budget	0.639*(0.000)	0.471*(0.001)	0.654*(0.000)	0.623**(0.068)	0.807*(0.000)
Credit agric	0.0042(0.8265)				
Lcreditagric-budget	0.020(0.9363)				
Lresearchagric		2.259*(0.000)			
Lbudget-research-agric		2.440*(0.0286)			
Lrailline			0.0075(0.3222)		
Lrailline-budget			0.399*(0.0000)		
Lfercons				0.944(0.312)	
Lfercons-budget				-0.420(0.696)	
Lenerg					0.846*(0.0370)
Lenerg-budget					0.065*(0.0000)
Obse(panel)	154	154	154	154	154
Std error	8.29	8.19	2.1	8.09	2.0
Instr-rank	115	115	115	115	115
J Stat	99.23(0.54)	99.03(0.52)	98.35(0.58)	97.03(0.51)	95.35(0.58)

Notes: * denote 5 percent levels and * * denote 10 percent levels of significance. When performing the Hansen test for over-identification, the "collapse" option in Eviews was used to reduce the lag range and avoid instrument proliferation, in conjunction with the Windmeijer (2005) correction for robust standard errors.

The proportion of spending on agriculture research and development is positively and significantly associated with higher agriculture productivity in SSA in line with Benin (2015). One unit increase in number of people researching into agricultural would bring about 2.26 percent increase agriculture productivity and the interactive coefficient is also 2.4 percent positively significant. The results indicate that the more proportion of budget expended on agricultural research is a predictor of agricultural productivity in Sub-Saharan Africa countries on average. In other words, public fund expended on agricultural have contributed to promote agricultural sector growth where high proportion of the public spending goes to agriculture research. The results favour the research - knowledge generation argument that research in agricultural development is central to any meaningful transformation of the sector. Investment in R&D is key to ensuring the generation of agricultural technologies and technical knowledge about products. The result is very similar to that of Benin (2015) who assesses the returns to public spending in the agricultural sector in 34 countries in Africa south of the Sahara (SSA) from 1980 to 2012. This is the reason for SSA countries should continue to invest in agricultural R&D, while making long-term commitments through regional R&D initiatives and creating supportive policy environments for agricultural R&D .

Our results show that the coefficient of the fertilizer subsidies variable positive but insignificant in SSA. The

interaction coefficient also has negative and insignificant relationship with agriculture value added. These results are not too far from that of Armas *et al* (2012) that found public spending on fertilizer subsidies to be negative in Indonesia. It also closely related to the study of Józimo & Ortega (2006) that argue that budget allocated to subsidizing private inputs has a negative and significant impact on the efficiency of public spending. Studies like Svensson (1995) have positive relationship between level of corruption and fertilizer consumption. Since fertilizer consumption is private oriented, the result then supports the World Bank and Transparency International that corruption being the misuse of public office for private gain may be inimical to public spending effects on fertilizer.

On average, a unit increase in energy suggests around a 0.84 percent point increase in agricultural growth. It should be noted that this coefficient is sensitive to agriculture at 5% level of significance. With respect to interactive coefficient of energy and public spending, the results reveal positive impact on to agriculture value added in SSA countries. The elasticity of agriculture value added with respect to energy- public spending interaction is about 0.07, suggesting that if energy- public spending channel improve by a unit on average, agriculture value added would improve by 0.07 percent. This implies that agriculture value added is responsive to energy-public spending channel. These findings suggest that the marginal impact of public spending on agriculture sector growth is increasing with more spending on energy in SSA. This provides information regarding the complementarities nature of public spending and energy in enhancing agriculture sector growth in SSA countries. The results favour the argument that energy has important applications in agriculture that are central to fostering investment in the sector and promoting performance and growth. The state of energy especially rural power in Africa has implications for the extent of farmland irrigated, value addition to farm produce in support of industrialization, and post-harvest loss reduction, etc. Access to modern forms of energy is important for the rural poor, as it enables them to enhance their production and improve their household incomes, expenditure, educational outcomes, and standards of living.

These latter set of results give tentative support to channel effect of the agriculture spending as higher amounts spent on only agriculture research and energy are found to be associated with higher agricultural sector performance, given suspension to a conditioning spending effects in SSA. One of the innovative aspects of this paper is the inclusion of the credit to agriculture and its interaction with public spending. Our results show that both higher agriculture credit and its public spending interaction are not significantly associated with higher agricultural sector performance in all estimates. The coefficient fertilizer consumption and its interaction with public spending are also positively signed but not significant as expected. We find evidence of a positive coefficient for rail line as well as its interaction between public spending and rail line construction in SSA. According to the result, the elasticity of Agric Value added growth with respect to public spending-rail line construction interaction is about 0.399, suggesting that if public spending-rail line channel improve by 10%, on average, Agric Value added growth would improve by 0.399%. IFPRI studies in other countries, including Ethiopia, Ghana and Zambia, emphasize the importance of rail line and rural roads for increasing smallholder access to agricultural inputs and product markets. Rail line and rural roads enable farmers to participate in higher value-added market chains, thereby contributing significantly to poverty reduction (Benin, *et al* 2008).For the last two years, the Government of Uganda has dramatically increased its spending on roads, with special focus on national roads. Research by Fan, *et al* (2004) shows that investment in rail line and rural road infrastructure in SSA, particularly feeder roads, has a high return and can have large effects on agricultural growth and poverty reduction. The marginal returns to public spending on rail line and rural roads on agriculture output and poverty reduction is three to four times larger than the returns to public spending on fertilizer subsidy.

Expectedly, our result shows that energy is positively and significantly associated with Agric Value added growth. While the coefficient for Agric Value added growth is 0.84 at 5% level of significance, its interaction with public spending- energy is 0.065 at 1 % level of significance. These findings suggest that the marginal impact of energy on Agric Value added growth is increasing with more public spending on the supply of energy. In other words, public spending has contributed to agriculture sector growth in countries with constant supply of energy.

Also instructive is the positive results for the coefficient of public spending on agriculture research and its interactive coefficient. Specifically, the coefficient for Agric Value added growth is 2.25 at with (0.0000) probability while the interaction coefficient of agriculture research-public spending is 2.44 with (0.0000) probability. These results which suggest that public spending on agriculture research increase Agric Value added growth positively and that the effect of public spending on Agric Value added on agriculture research growth becomes even stronger when this indicator of agriculture research is included, are novel, and in our view extremely interesting results especially given the strongest complementarities nature regarding public spending and agriculture research in enhancing agriculture sector growth in SSA countries.

The results imply that knowledge generation for agricultural development is central to any meaningful transformation of the sector growth (Africa Agriculture Status Report 2016). Aside agricultural research that

indicated the strongest level of coefficient, the other results that provided the next positive and significant result to agriculture growth is energy supply and followed by rail line provision. Although this may not necessarily be strongly indicative of how different investments compare in other developing countries, it does indicate that the impact of public spending on agriculture-supportive investments may, at times, greatly surpass the impacts of direct agriculture-related spending. A comparison of the effects of public spending on agricultural related channels on agricultural sector performance immediately shows that the optimal shift in spending prioritization is not the same when increasing agricultural growth is the paramount policy objective. The role of corruption and overdependence on oil in achieving Maputo/Malabo commitments may worth looked into given the unexpected negative result between public spending and fertilizer consumption and its interaction coefficients.

3.2 Do Level of Corruption and Dependence on Mineral Oil Resources Affect Public Spending Effect on Agriculture to Feeding SSA?

The United Nations (1999) warned that corruption distorts resources allocation and government performance. The leaders of the G20 reiterated the detrimental effects of corruption on equitable allocation of public resources, sustainable economic growth, and the integrity of global financial system and the rule of law (G20, 2016). Accordingly, Table 2 contains the empirical results of the effects of corruption and oil resource dependence on the performance of agricultural sector in achieving Maputo goals.

Table 2
Effects of Corruption and Oil Resources Dependence on Achieving Maputo Commitments in Sub-Saharan Africa

Variable	Oil-disease model	Corrup-budget model
Lagricprod(-1)	0.945*(0.000)	0.914*(0.000)
Lagricprod(-2)	-0.158*(0.000)	-0.151*(0.0001)
Lggdp	-0.045*(0.000)	-0.044*(0.0000)
Lggdp-Squared	0.016*(0.007)	0.030*(0.0008)
Larland	0.0430(2167)	0.078(0.1236)
Lgfcf	-0.143*(0.000)	-0.165*(0.0001)
Lggcon	-0.119*(0.000)	-0.0517(0.2193)
Pg	0.086*(0.000)	0.0282(0.3739)
Lagexp	0.024*(0.0046)	0.030*(0.0249)
Budget	0.018*(0.000)	0.010*(0.0207)
Maputo	0.0245(0.0238)	
Oildisease	0.0068(0.4229)	
Corrup		-0.089**(0.0669)
Corrup-budget		-0.028*(0.0015)
Obse(panel)	126	126
Std error	0.09	0.08
Instr-rank	78	78
J Stat	68.29(0.32)	66.99(0.30)

Notes: * denote 5 percent levels and * * denote 10 percent levels of significance. When performing the Hansen test for over-identification, the "collapse" option in Eviews was used to reduce the lag range and avoid instrument proliferation, in conjunction with the Windmeijer (2005) correction for robust standard errors.

Our results show that increasing government expenditure on agriculture by Ethiopia, Niger, Mali Burkina Faso to the tune of 10 percent from 2003 as prescribed by Maputo declaration have greatly impacted on the performance agriculture sector performance. The result shows that coefficients for log of government expenditure on agriculture (BUDGET) have the correct sign and is significant at both 5% with a probability value of 0.0238for Agriculture value added growth. This result is different from the earlier one that was significant at 10 percent. The reason for the weak effect which was argued to be as a result of the low number of countries (four out of the eighteen SSA and eleven African countries) that have managed to allocate 10% of their budgets to agriculture. This difference in significance based on the number of countries that adhere to Maputo commitment justifies the importance of increasing public funds to agriculture sector. This is in tandem with studies likes, Ebi*et al* (2009), Abula and Ben (2016) in developing countries spending to agriculture is one of the most important government instruments for promoting agricultural growth.

The result for oil disease shows positive but insignificant relationship. This is an indication that, dependence on oil resources may not be detrimental to agriculture sector development if more funds are allocated to the sector. This result confirms the Africa Agriculture Status (2016) Report that Mineral-rich countries had the lowest average annual agriculture expenditure share, at 3.2 percent. The result also suggests that, there is negative and significant relationship between level of corruption and agricultural sector performance in SSA. A percentage increase in level of corruption reduces agriculture sector performance by 0.089 percent. This result is in line with the finding of Mauro (1995) and Svensson (1995) and World Bank (1999) that found corruption to be growth retarding. It also in line with the argument of World Bank and Transparency International that corruption being the misuse of public office for private gain. As such it involves the improper and unlawful behavior of public fund whose positions create opportunities for the diversion of money and assets from government to themselves and their accomplices. Corruption distorts resources allocation and government performance (United Nations, 1999). The leaders of the G20 reiterated the detrimental effects of corruption on equitable allocation of public resources, sustainable economic growth, the integrity of global financial system and the rule of law (G20 2016). The results favour the growth-enhancing/retarding view of non-financial institutional quality pioneered by Adam Smith, reasoned by North 1990, World bank 2002 and more recently by the empirical works of (Keefer & Knack 1997, Hall & Jones 1999, Bruinshoofd 2016, Glaeser *et al* 2004) and supports the idea in growth literature that non-financial institutions define the 'rules of the game'

and the conditions under which economic agents operate in an economy (Acemoglu & Robinson 2013, Bruinshoofd 2016). With respect to interactive coefficient of corruption and public spending, the results reveal negative impact on agricultural sector growth. The elasticity of agricultural sector growth with respect to corruption-public spending interaction is about -0.02, suggesting that high corruption affect public spending negatively. This implies that agricultural sector growth is responsive to corruption-public spending channel. These findings suggest that the marginal impact of public spending on agricultural sector growth is decreasing with the level of corruption. This is the part the government of the world's newest country, Kosovo, seems to be toeing when it say, its priority is to improve the rule of law in order to reduce corruption and build up the state. Moreover, given the poor performance of rule of law that exists for African economies, it is not impossible that the poor performances of the rule of law determine the lack of control of corruption (OECD 2017), and the reason for lack of sustainable growth in SSA (bearing on fantastically corrupt euphemism). The poor institutional qualities especially high level of corruption seems to be undermining all efforts to growth SSA. Also As opined by Rodrik (2002), if the rules of the game were a mess, corruption would strive (OECD 2017) and no amount of tinkering with macroeconomic policy would produce the desired results.

3.3 Aggregate Model on the Impact of Public Spending on Agriculture Sector Performance

Table 3 presents the results based on the effect of public spending on agricultural sector performance to feed SSA. The table presents result on the effects of public spending on agricultural sector performance in terms of Maputo model and on food production in terms of Malabo model. The results are based on 18 SSA countries over the period 2001-2017. The results pass a battery of diagnostic tests. The Hansen J for Maputo (93.90 with 0.59) and Malabo (96.36 with 0.25) statistics of over identifying restrictions confirm that the instruments employed are acceptable and healthy i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Across all estimations, this study finds that initial agriculture sector performance and food production as measures of past realizations of agriculture sector growth has positive impact on its current levels. This implies that, the coefficient associated with real agriculture sector growth is found to be positive and statistically significant in both the agriculture performance (Maputo) and food production (Malabo) samples. To test the hypothesis that real GDP growth has a non-monotonic relationship with Agriculture value added growth, the squared real GDP growth is added to the explanatory variables. The quadratic coefficient becomes negative in sign and significant in the two models. The results therefore provide evidence of a humped-shaped relationship between real GDP growth and agriculture value added growth which signifies that higher level of real GDP growth are positively associated with agriculture value added growth and food production in SSA but with a non-constant effects.

Table 3
Effect of Public Spending on Agricultural Sector Performance and Food Production in SSA

Variable	Maputo model	Std. error	Malabo model	Std. error
Avg(-1)	0.105*(0.000)	0.0177	0.945*(0.000)	0.0157
Avg(-2)	-0.071*(0.002)	0.0233	-0.158*(0.000)	0.0235
Lggdp	-3.478*(0.000)	0.8026	-0.045*(0.000)	0.0051
Lggdpg-squared	6.146*(0.000)	0.5590	0.016*(0.0073)	0.0060
Larland	-0.883(0.2205)	0.7176	0.043(0.216)	0.0346
Lgfcf	2.920*(0.039)	1.4036	0.143*(0.000)	0.0283
Lggcon	-0.5507(0.7768)	1.9391	-0.119*(0.000)	0.0243
Pg	-3.542*(0.032)	1.6434	0.086*(0.000)	0.0208
Lagexp	3.246*(0.000)	0.4818	0.024*(0.005)	0.0086
Budget	0.0125**(0.062)	0.0066	-0.018*(0.000)	0.0023
Observation	154		140	
Std error		5.67		0.15
Instr rank	115		96	
J Stat	93.90(0.59)		96.36(0.25)	

Notes: * denote 5 percent levels and * * denote 10 percent levels of significance. When performing the Hansen test for over-identification, the "collapse" option in Eview was used to reduce the lag range and avoid instrument proliferation, in conjunction with the Windmeijer (2005) correction for robust standard errors.

This suggests that the marginal effects of real GDP growth shows decreasing returns for agriculture value added growth and food production in SSA. Thus, this finding supports Chenery (1960), Kuznets (1971), and Haraguchi & Rezonja (2011) assertion of a U-shaped relationship between economic development and food

manufacturing output. Agricultural land area is positively and significantly associated with a higher agriculture value added growth and food production in SSA. This result is in line with Haraguchi & Rezonja (2011). Domestic investment rate proxied by gross fixed capital formation has positive and highly statistical significant effect on agriculture value added growth and food production in SSA. As seen in Table 1, our estimates suggest that, on average, a percent increase in the share of gross fixed capital formation will lead to about 2.92 percent and 0.14 percent increase in agriculture value added growth and food production, respectively in SSA. Population is negatively and significantly related with agriculture value added growth but has a strong positive relationship with food production in SSA. Exportation of agricultural good has positive and highly statistical significant effect on agriculture value added growth but not on food production in SSA.

The results show that coefficients for log of government expenditure on Agriculture (BUDGET) have the correct sign but lost its significance at both 1% and 5% for Agriculture value added growth. Although the coefficient gained its significance at 10%, the reason for the weak effect could be as a result of the low number of countries (four out of the eighteen SSA and eleven African countries) that have managed to allocate 10% of their budgets to agriculture (Charlotte & Mughal 2018). Again weak effect may be due to the less than 4% average amount spent per year for Africa as a whole as a share of total public expenditure far short of the Maputo target of 10 percent. The result is a pointer to the unexpectedly negative and significant relationship between public spending and food production and modeled by Malabo declaration. The weak result is also a pointer to the US$12 billion actual spending on agriculture in 2014 (AFDB 2016) instead of US$40 billion required if meeting the Maputo/Malabo commitments to feeding Africa is still desired (Africa Agriculture Report 2016). Another possible fundamental reason for the weak relationship between government expenditure and Agriculture value added growth could be as a result of lack of ultimately target for productive components of agricultural expenditures, accompanied with a blanket recommendation in the literature. An agriculture public expenditure is expected to be a tool meant to provide guidance on ways to improve the both the quantity and the quality of the expenditure program. Improving the quantity implies increasing the size of the sector budget, in cases where the size is too small, through additional budget resources or reallocation from other sectors. In other cases, where the spending level is sufficiently high, it implies raising the efficiency of the resources allocated to the sector, to improve outcomes within a given level of resources, whether the desired outcome is rural poverty alleviation, higher sector growth rates, or increased sustainability of programs (World Bank and United Kingdom Department for International Development 2011). Even if the result has come as expected, should improve growth in agriculture and food security be interpreted to mean equal public spending especially as pointed out that the 10% spending target may be a blunt instrument without efficient allocation to different factor that can exert different impact on sustainable agricultural growth.

Mogues *et al* (2015), for instance, argue that (1) different types of public agriculture expenditure have different effects on different outcomes, and that some types of expenditures may not be productive at all; (2) different effects take different times to materialize; and (3) effects are different in different locations, reflecting the influence of conditioning factors. Specifically for Africa, evidence from different studies on the relationship between different types of agriculture expenditure (research, irrigation, marketing, infrastructure, farm support subsidies) and growth and other development outcomes show that different types of agriculture expenditure are positively and significantly related to agricultural growth and many other development outcomes. Increasing agricultural spending without giving attention to heterogeneous impacts of different types of agricultural investments as well as prioritizing the spending may not bring about desired positive impacts. Accordingly, it seems therefore risky, to base empirical conclusion of agricultural performance and feeding SSA on aggregate agricultural spending as it might likely wash out the quality spending effects and ultimately obscured World Bank (2002) fundamental question, which area of agriculture public spending is most fundamental for sustainable agricultural sector growth? The next discussion focuses of the important issue of quality channel of agricultural spending with the Maddala (1983) program placement effects argument that all agricultural investments are not equally important.

4. CONCLUSION AND POLICY RECOMMENDATIONS

Conclusion

The venomous impact of the decades-long downward spiral of public investments in agriculture, which contrasted painfully with the sustained successes of Asia's Green Revolution, led to the July 2003 Maputo declaration, where African leaders made a bold commitment to reverse the underinvestment that had held the agriculture sector back for so long and allocate 10 percent of national budgets in promoting agricultural growth and end hunger in the continent. After Seventeen years of Maputo declaration, this paper investigates the impact of public agriculture spending on agriculture performance in SSA. In particular, the paper focused on the quality and channel of public agriculture spending

on agriculture to feed SSA. This is more important than the overall level of spending; a fact often neglected by prescriptive approaches to spending. This paper provided support for the notion that public spending is key to agriculture sector performance to feed SSA. The study therefore concluded that achieving Maputo target of feeding Africa through agriculture depends on spending nothing less than 10 percent on agriculture. The study examined one specific link between public spending and agriculture sector performance to feed SSA. Our assumption is that agricultural sector growth and food production improvement should not be mistakenly interpreted as a result of increased public spending on agriculture without monitoring agriculture spending that goes into different priority areas such as in road and rail infrastructures, research and development, education and enlightenment, fertilizer subsidies, credit, irrigations, technology among others.

Based on this notation, the paper studied the quality channel effects of agriculture public spending; the public spending agriculture credit channel effects; and the public spending agriculture research channel effects; the public spending agriculture rail line channel effects; the public spending agriculture fertilizer consumption channel and the energy channel effects. The paper found that public spending for agricultural development through research and development is the most central to feeding Africa. Public spending on energy supply followed by rail line provision is essential to agriculture sector performance to feeding SSA. While the study found that agricultural growth gains from a public money invested in credit given and fertilizer subsidy are not significant, it concluded that agricultural growth gained the most from a public money invested in R&D in agricultural, followed by public fund expended in energy and lastly on rail line.

This paper concludes that supporting research and development and other public infrastructures like energy, rail line are more agriculture and food production enhancing than supporting private subsidization of fertilizer. The paper concluded more investment in agriculture is necessary, as well as channel-based spending to increase agricultural production and food supplies to feed SSA citizens.

Policy Recommendations

i. It is important to emphasize that the policy implications from the findings show that more resources should be dedicated to the high-return activity than has been allocated so far.

ii. Feeding SSA through public spending on agriculture sector in Sub-Sahara African may have a considerable bearing on effective control of corruption entrenched in a vigorous judicial reforms. Government should pay close attention to fighting systemically especially when it comes to issues of budget.

iii. Better targeting of public spending is therefore as important as focusing on increasing existing expenditures. Here, a caveat must be mentioned: the transparency of public spending is sacrosanct since findings suggest that the marginal impact of public spending on agricultural sector growth is decreasing with the level of corruption.

iv. More so, diversification is paramount for SSA countries with oil resources that want to feed its people by 2025. Government should set to invest more financial resources from oil revenues. Such resources should not be utilized to support the bloated public and political jamborees, but should be invested in unlocking the binding constraints to agricultural transformation through investing in public infrastructures like rails and energy that are catalyst for sustainable agricultural growth.

v. One ought to be cautious to extrapolate too strongly from effects of public spending limited to federal government fund since state and local governments in many sub-Sahara African countries account for nothing less than 50 percent of all public expenditure. Hence, all tiers of government should be encouraged and enlightened in this crusade.

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