International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
Vol. 9, No. 2, 2021, pp. 125-141

EFFECT OF AGRICULTURAL INVESTMENT ON FOOD SECURITY IN SUB-SAHARAN AFRICA: WHAT ROLE DOES INSTITUTION PLAY?

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Abstract:

This study aims to evaluate the effect of agricultural investment and institution on food security in 24 Sub-Saharan African (SSA) countries between 2001 and 2016. Countries are chosen based on data availability. The research employs a two-step system-GMM estimation technique to achieve the study objectives. Findings show that agricultural investment improves food security in the selected SSA countries, whereas internal and external conflicts as measures of governance positively influence food security. The study concludes that investment in agriculture and institutional quality have significant roles to play in ensuring food security in the selected countries. Thus, the study suggests further investment in the agricultural sector to boost agricultural food production, thereby ensuring food security in the selected African countries. Also, internal, and external conflict should be discouraged to ensure food security. Hence, brokering peace among citizens is very crucial to enable improved agricultural productivity, since sustainable peace would promote investment in agriculture, thereby, reducing over-reliance on food importation.
Keywords: *Agricultural investment, food security, institution, Sub-Saharan Africa, System-GMM.*
JEL Codes: *C23, O10, Q.*

1. Introduction

African countries are not immune to food insecurity as one of the issues of development. Arthur (2012) states that food insecurity is a new form of crisis experienced in Africa. Food insecurity means a lack of access to enough food due to a shortage of food production (food availability) or inability to buy food (food accessibility) that will help in meeting the daily energy requirement. Shortage of food production occurs when food demand (population) exceeds food supply (food production), while the inability to buy food results from poverty, that is, lack of access to credit. This implies that food security is achievable if food demand is equal to or less than food supply and if people have access to credit that will enable them to acquire food. Thus, food security is defined as "a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2015a, p. 53). Notably, the study uses food availability and accessibility to define food security following some other studies (Ogunniyi *et al.*, 2020; Twongyirwe *et al.*, 2019; Dithmer & Abdulai, 2018; Applanaidua *et al.*, 2014). According to Haddad (1997), food availability

means adequate production or imports of food to satisfy the food requirements of the population, while food access is the ability of people to get food, either by purchasing it with income from non-farm work or through their production.

Specifically, evidence from sub-Saharan Africa (SSA, henceforth) shows that most of the countries in the region are still far from achieving food security as a result of policy failures, institutional, structural, and health-related challenges, political crisis, growing population, natural disaster, lack of storage facilities, increase in prices (food and general prices inflation), high level of poverty, low levels of education, inadequate income and asymmetric information among others (Ogunniyi *et al.,* 2020; Twongyirwe *et al.,* 2019; Abdullah, *et al.,* 2017; Burchi & Muro, 2016; FAO, 2015b; Arthur, 2012). In other words, countries in SSA are still finding it difficult to meet the food requirements of their citizens. For instance, Ogunniyi *et al.,* (2020, p.1) establish that "153 million individuals, about 26% of the population above 15 years in SSA suffered from severe food insecurity in 2014/15" based on the FAO report in 2016. To add to this. Arthur (2012) asserts that "SSA has the highest proportion of people who are hungry, undernourished or food insecure" (p. 1). To support this fact, Figure 1 shows the relationship between food demand (population) and food supply (food production index) between 2000 and 2014. Countries in the region experienced food security throughout the period even though food exports were greater than food imports in the early period. This hinges on the fact that agriculture was the mainstay of their economies (Arthur, 2012) and the countries were still able to export some of the agricultural products, thus making the food exports to be higher than food imports as depicted in Figure 2. However, the region started importing food items in the latter period as the region was faced with severe food insecurity and this is reflected in the values of food imports greater than food exports (see Figure 2). This is also evident that population is now growing on a geometric rate, people lack access to credit as the level of poverty continues to increase in this region, and natural disaster affects agricultural products negatively causing food inflation in these countries.

Notwithstanding, the countries in the region have put more effort into reducing hunger in the region (Ogunniyi *et al.* 2020) as one of the ways to achieve the Sustainable Development Goals (SDGs) before 2030. This is also reflected in the reduction of the prevalence of hunger in the region by 31% between the base (1990-92) and 2015 according to FAO (2015b; 2016) in Ogunniyi *et al.* (2020). Alternatively, the FAO (2015b) reports show that one person out of four in the region is undernourished compared to a ratio of one out of three in 1990-92. One of the measures put in place is to increase government expenditure on agriculture in this region. This is also stressed by Djokoto (2012) that the provision of food for the populace is a macro-level responsibility for the government and this can be achieved by increasing agricultural spending.

According to Mengoub (2018), agricultural investment is a requirement to develop and organize the agricultural sector. This investment can come from the public, private and foreign sectors. This suggests that investing in agriculture becomes essential because it promotes agricultural productivity, thereby increasing the sector's capacity to spur food production and food security in SSA especially where under-nourished people are over 223 million and the number of people living under extreme poverty may increase from 420 million in 2015 to 550 million by 2015. From the public sector, African heads of state in 2003 decided to allocate at least 10% of the national budget on agriculture to ensure 6% agricultural growth based on the Maputo Declaration on Agriculture and Food Security that was later reconfirmed in the Malabo declaration (Mink, 2016; Mustapha & Enilolobo, 2019). So far, it is observed that SSA governments have been able to increase their expenditure on agriculture since the inception of the Maputo declaration 17 years ago. The question that comes to mind is that has increased public agricultural spending translated into increased agricultural performance in form of increased food production and food security. There are restricted sector-level data on private sector investment, most of which concentrate on foreign direct investment (FDI). With relation

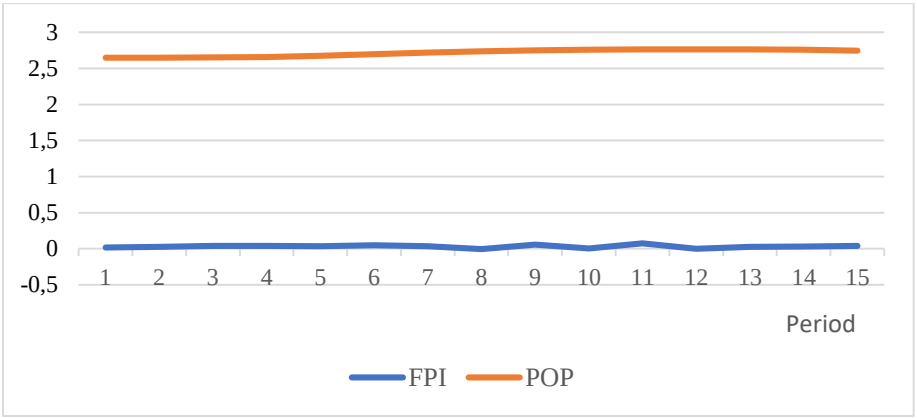
to FDI in agriculture in Africa, Fiedler and Iafrate (2016) report that FDI in the African food and agriculture sector remained low relative to other regions, accounting for just 10.5% of the world's FDI in the food and agriculture sector (see also Mengoub, 2018).

However, several studies have shown that agricultural investment, be it a public or private investment, can have a substantial effect on food security. For instance, Ben Slimane *et al.* (2015) point out that FDI in the agricultural sector improves food security, while Djokoto (2012) observes that agricultural FDI does not provide food security. On public investment, studies have shown that increasing government expenditure (public investment) on agriculture could either increase (Charlotte & Mughal, 2018; Wangusi & Muturi, 2015) or decrease (Kumar & Dkhar, 2018; Anriquez *et al.*, 2016) food production and food security. Those studies that confirm a negative relationship between public agricultural spending and food production (food security) believe that increasing government expenditure on agriculture would adversely affect food security if the spending is not channeled in the right direction and not properly monitored. This implies for public spending on agriculture to reduce food insecurity, a strong institution must be put in place to checkmate the excesses of public officials (see also Newettie, 2017). Therefore, to examine the role of the institution as a determinant of food security in SSA, this study uses six indicators to measure the role of the institution. These include government stability, socio-economic conditions, internal conflict, external conflict, religious tension, and ethnicity. It is discovered that most countries in SSA since 2000 are witnessing weak institutions believing to be adversely affecting agricultural investment. This implies that a strong institution is necessary to achieve the proper functioning of agricultural investment that would help in improving food production and food security.

From the foregoing, it is important to examine whether institution plays any role in reducing food insecurity. This becomes necessary because food insecurity can adversely affect human health, human capital development, and productivity, thereby affecting the growth and socio-economic development of any country, SSA inclusive. This narration is confirmed by Drimie and Casale (2009, p. 31) where food insecurity causes "poor physical, psychological, socio-emotional and cognitive development of people, and especially children's school attendance and adults' long-term income-earning ability". Also, it appears that when people have no access to food in a country, it affects them in living and maintaining normal lives and in becoming socially and economically productive (Jenkins & Scanlan, 2001), thereby adversely affecting the overall development of the country.

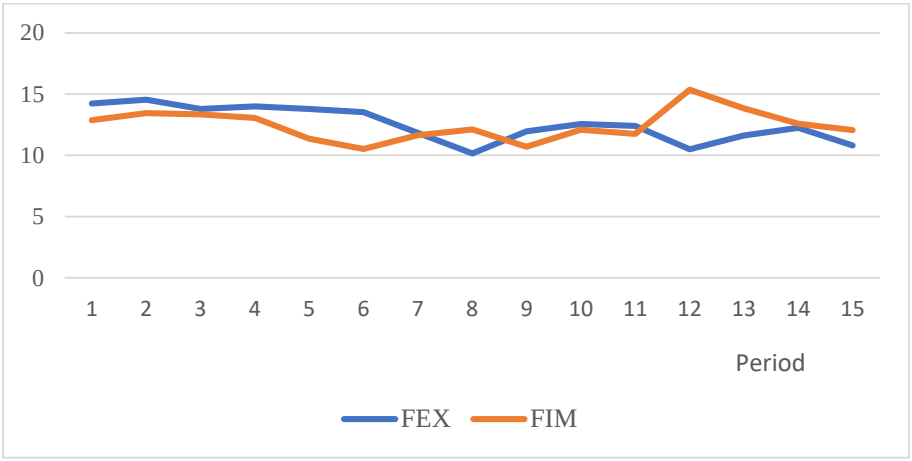
Contrary to most of the extant studies that focused primarily on microeconomic determinants of food security, this present study investigates the macroeconomic and institutional determinants of food security in some selected countries in SSA. The reason being that (i) most of the studies used a household survey that might not be a true representation of the happenings in the countries surveyed, (ii) some of the macroeconomic variables that are believed to be affecting food security might not be captured properly on a micro-level using a household survey, and (iii) the literature on the role institution plays in determining food security in SSA is scanty. Institution plays a significant role in achieving food security and it is included because almost all the countries in SSA are faced with a weak institution (Bello-Schunemann & Moyer, 2018; Mink, 2016) and this can affect agricultural investment, hence leading to a shortage of food production as well as preventing people from having access to food production. Also, a strong institution can positively affect farmers and negatively affect poverty, thus ensuring food security (Ogunniyi *et al.*, 2020). This study, then, adds to the existing literature by examining institutions as a determinant of food security.

The paper is planned as follows. Section two focuses on the literature review, while section three details the methodology. Section four presents the empirical results and discusses the findings, while section five provides the study's conclusion with some recommendations.



Source: Authors' Compilation (WDI, 2019).

Figure 1. Food Production Index and Population Growth Rates in SSA (2000-2014)



Source: Authors' Compilation (WDI, 2019).

Figure 2. Food Exports and Imports in SSA (2000-2014)

2. Literature Review

Most of the studies on the determinants of food security did not account for its macroeconomic and institutional determinants; rather they examined the microeconomic determinants of food security using a household survey. This study is among those few studies that investigate the macroeconomic and institutional effects of food security.

Based on a household survey, that is, using primary data, a number of factors have been identified to influence household food security which include natural disaster such as drought and flood (Twongyirwe *et al.*, 2019; Pacetti *et al.*, 2017; FAO *et al.*, 2015; Berhane *et al.*, 2013); access to credit (Twongyirwe *et al.*, 2019; Gundersen & Gruber, 2001; Ribar & Hamrick, 2003); land security (Keovilignavong & Suhardiman, 2020); women's empowerment (Galie *et al.*, 2019); education (Kidane *et al.*, 2005); ownership of livestock (Ali

& Khan, 2013); jobs loss and low level of income (Loopstra & Tarasuk, 2013); non-farm work (Owusu *et al.,* 2011); gender of the household head (Kassie *et al.,* 2014); size of the family (Bogale, 2012); remittances and access to market information, and age of the household head (Mango *et al.,* 2014); dependency ratio, electricity connection, irrigation availability (Asghar & Muhammad, 2013); monthly income, structure of the family (Bashir *et al.,* 2013); and infrastructural availability (Gill & Khan, 2010); education, government expenditure on health, remittances, inflation assets, unemployment, gender of the household head, age (Abdullah *et al.;* 2017); cash transfer and labour constraints (Bhalla *et al.,* 2018); formal and informal employment (Blekking *et al.,* 2020); culture, gender, family, and decision-making power policy (Alonso *et al.,* 2018); cultivate land size, gender of the household head, livestock holding, improved seed, and non-farm income (Abdulla, 2015); soil biodiversity (El Mujtar *et al.,* 2019), rainfall variability and remittances (Generoso, 2015); land tenure reforms and tenure security (Holden & Ghebru, 2016); farming experience, cassava output, education, number of dependants, age, access to credit, access to extension agent, distance to farm and farm size (Ajayi & Olutumise, 2017); family size, livestock ownership, mothers' time constraint, and sex (Kahsay *et al.,* 2019); dietary diversity and food expenditure (Lo *et al.,* 2012); cash transfer (Tiwari *et al.,* 2016)**;** poverty, household consumption, gender, and education (Maitra & Rao, 2015); land access and land rental (Muraoka *et al.,* 2017); agricultural and nutrition information (Ragassa *et al.,* 2019); and air pollution and food production (Sun *et al.,* 2017),

While using secondary data, the following are the few studies that investigate the macroeconomic and institutional effects on food security. In terms of a panel framework, Ogunniyi *et al.* (2020) study the effect of governance quality and remittances on food security in SSA using a system generalized method of moments (GMM) between 1996 and 2014. The findings show that governance quality and remittances independently increase food security and also, the interactive term of the two variables shows a significant positive relationship with food security. Besides, the authors argue that population growth and inflation, as expected, reduce food security in the selected countries, while human capital leads to food security.

Furthermore, Ben Slimane *et al.* (2015) investigate the nexus between foreign direct investments (FDI) and food security in 55 developing countries employing random and fixed effect methods. The panel results indicate that FDI in agriculture, secondary, and tertiary sectors increase food security in these countries. While examining the FDI's spillover through the agricultural production to food security, it is observed that FDI in secondary and tertiary sectors increases and decreases food security, respectively. Similarly, a study by Mihalache-O'Keef and Li (2011) reveals that FDI in the tertiary sector has a significant negative effect on food security. Using conditional mixed process (CMP) estimation, Santangelo (2018) explores the effect of agricultural FDI in land on host country food security in 65 developing countries between 2000 and 2011, arguing that agricultural FDI in land by developed-and developing-country investors have a positive and negative impact on food security, respectively. In addition to the findings of the author, cropland, economic development, food imports, and population exert a significant positive effect on food security, while government consumption and political instability have an insignificant negative impact on food security. However, Djokoto (2012) in Ghana affirms that FDI in the agricultural sector fails to ensure food security. In examining the effect of trade openness on food security, Dithmer and Abdulai (2017), using a dynamic panel analysis for several countries between 1980 and 2017, reveal that trade openness and economic growth have a significant positive effect on food security.

On a country-specific analysis, Applanaidua *et al.* (2014) employ a Vector Autoregressive (VAR) approach to analyse the dynamic relationship between macroeconomic variables and food security in Malaysia over the period 1980-2012. The results show that food prices and population increase food security significantly, while other macroeconomic variables (biodiesel production, government expenditure on rural development, exchange rate, and gross

domestic product) follow the a priori expectation in influencing food security insignificantly. Likewise, Akpan (2009) in Nigeria studies the nexus between oil production and food insecurity between 1970 and 2007 using a VAR approach and the study shows that oil revenue does not significantly translate to food security. The reason being that over-reliance on oil has led to the neglect of the agricultural sector. Also coming from the findings is that agricultural output is the important determinant of food insecurity, while per capita income is unable to explain food insecurity in Nigeria. In China, Wang (2010) study the effects of food prices and climate change on food security in 27 provinces between 1985 and 2007. The dynamic system GMM reveals that climate change significantly reduces food security in the current year, while food price has no significant impact on food security in the current year.

Several studies reveal that improving agricultural output would ensure food security. Among those factors that can influence agricultural productivity are government expenditure, oil price, capital, labour, and exchange rate. Specifically, Mustapha and Enilolobo (2019) in sub-Saharan Africa assert that GDP (gross domestic product) growth rate, agricultural land area, agricultural exports, domestic savings, and public agricultural spending positively affect agricultural productivity (food production), while corruption negatively reduces agricultural productivity (food production). Other studies that support increasing government agricultural expenditure to increase agricultural productivity are Okon and Christopher (2018), Charlotte and Mughal (2018), Wangusi and Muturi (2015), Adofu *et al.* (2012), and Olomola *et al.* (2014), while Kumar and Dkhar (2018), Anriquez *et al.* (2016;), and Mogues *et al.*, (2012; 2015) maintained otherwise. Binumote and Odeniyi (2013) study the effect of crude oil price on agricultural productivity in Nigeria with the evidence that oil price and labour reduce agricultural productivity, while exchange rate and capital increase agricultural productivity in Nigeria.

Unlike other micro studies, this present study uses the macro-level of all the variables involved. Following other macro studies, the study specifically examines the effect of agricultural investment on food security bringing in the role of the institution.

3. Methodology

To examine whether institutions play any role in determining food security in the sub-region, equation 3.1 is developed. The model comprises food security as the dependent variable with macroeconomic variables, measures of institutional quality, and lag of the dependent variable as the independent variables. Equation 3.1 is given as:

$$Index_{it} = \beta_1 Index_{it-1} + \beta_2 Invetsment_{it} + \beta_3 Inflation_{it} + \beta_4 GDP_{it} + \beta_5 Capital_{it} + \beta_6 Institution_{it} + \beta_7 Poverty_{it} + \varepsilon_{it} \quad (1)$$

where
Index: Agriculture production Index
Investment : Agricultural Investment
Inflation: Consumer Price Index
GDP: Gross Domestic Product
Capital: Human Capital
Institution: Institutional Quality
Poverty: Poverty Level

The food production index measures the level of productivity of each country in the region as regards food supply. It is generated by World Bank and we use the index to proxy food security. Also, agricultural investment measures the level of investment of each country in agriculture which is expected to have a positive effect on food security. The value of the

agricultural investment is in logarithm form. Inflation is used to capture the value of money in the region within the study period. It is measured by the consumer price index. Gross Domestic Product (GDP) is the monetary value of goods and services produced in the region by each country. It is measured at constant prices. Human capital measures the quality of workers in the agricultural sector in the region. It is captured by the net primary school enrollment. Poverty, on the other hand, captures the number of poor people in each country in the region. This variable is included to examine its impact on food security. It is measured as the number of people that are living below $2 per day in the region.

Institutional quality, which is our variable of interest, is measured using six variables. The variables are political stability, socio-economic conditions of the countries, internal conflict, external conflict, religious tension, and ethnic tension. As a result of this variation, six different models are estimated to examine the significance of each of the institutional quality variables. We specify a dynamic model, as presented in equation 3.1, to avoid the problem of endogeneity that may arise from agricultural investment and GDP being correlated with the error term. To estimate equation 3.1, we use System-GMM proposed by Arellano and Bover (1995). Its estimator is said to be more precise and efficient than the Arellano and Bond first-differenced GMM estimator (Blundell & Bond, 1998; Blundell *et al.*, 2000; Ahmed & Suardi, 2009; Apanisile & Olayiwola, 2019). For robustness check, we employ both one-step and two-step estimators of Arellano and Bover (1995) system-GMM.

Furthermore, the paper employs panel data of 24 SSA countries, between the period 2001 and 2016. Countries are selected based on data availability. The selected countries are Angola, Botswana Burkinafaso, Cameroon, Congo, Ivory Coast, Ethiopia, Ghana, Guinea, Kenya, Liberia Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Sierra Leone, South Africa, Sudan, Togo, Zambia, and Zimbabwe. Data are collected from three different sources. Data on agriculture investment is collected from the Food and Agriculture Organization data set, institutional quality variables are collected from the International Country Risk Guide, and data on macroeconomic variables and agriculture production index are collected from World Development Indicator (online version).

4. Empirical Results and Discussion of Findings

We begin our analysis by examining the descriptive statistics and correlation matrix of all the variables. The results are presented in Tables 1 and 2, respectively. The descriptive statistics, as presented in Table 1, provides information on the variability and distribution of the variables. Values of Statistic such as mean, median, minimum and maximum values, standard deviation, skewness, kurtosis, and Jarque-Bera are provided. It can be deduced that the mean and median values of all the variables fall within their minimum and maximum values. This implies that they display a high level of consistency. Besides, the low values of standard deviation show that the variables do not deviate from their mean. About the shape of the distribution, the skewness results show that agricultural investment, GDP, poverty, agriculture production index, and socio-economic conditions are positively skewed, while all other variables are negatively skewed. In terms of the height of each distribution, results of kurtosis show that poverty has the highest and ethnic tension has the lowest. Lastly, the null hypothesis of the normal distribution for the series is rejected at a 5% level of significance given the probability values of the Jarque-Bera. The absence of normal distribution may be attributed to the heterogeneous nature of the data used which is usually corrected during estimation.

International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
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Table 1. Descriptive Statistics

	Agric. Investment	Inflation	GDP	Human Capital	Govt Stability	Poverty	Agriculture Production Index	Socio-Economic Conditions	Internal Conflict	External Conflict	Religious Tension	Ethnic Tension
Mean	5.1431	1.7195	23.509	4.2751	2.1030	10.846	4.7287	3.0624	8.5126	9.8121	4.0974	3.2033
Median	5.0900	1.9350	23.250	4.3500	2.1100	6.0000	4.6900	2.8800	8.5000	10.000	4.1250	3.0000
Maximum	8.4900	4.5900	26.860	4.5900	2.4000	89.400	5.3300	6.0000	11.920	12.000	6.0000	5.0000
Minimum	0.8400	-3.2100	20.980	3.4100	1.4900	0.3000	3.8900	0.5000	2.9600	3.9600	0.5000	0.6700
Standard Deviation	1.4355	1.1261	1.2878	0.2592	0.1872	16.393	0.2229	1.2819	1.4358	1.3814	1.3619	1.0041
Skewness	0.2313	-0.9083	0.7583	-0.9883	-0.3073	3.6431	0.2785	0.5876	-0.3282	-1.0671	-0.4806	-0.1246
Kurtosis	2.5785	4.8607	3.5274	3.3169	2.3375	16.44629	2.9635	2.7184	2.9836	4.7460	2.1853	1.9580
J-Bera	6.2677	108.20	41.260	64.128	13.067	3742.29	4.9886	23.369	6.9018	121.66	25.405	18.364
Prob	0.0435	0.0000	0.0000	0.0000	0.0014	0.0000	0.0825	0.0000	0.0317	0.0000	0.0000	0.0001
Sum	1974.96	660.32	9027.57	1641.64	807.57	4165.20	1815.850	1175.99	3268.85	3767.86	1573.42	1230.07
Sum Sq Dev	789.31	485.71	635.26	25.745	13.431	102931.7	19.035	629.43	789.60	730.94	710.42	386.17
Obs.	384	384	384	384	384	384	384	384	384	384	384	384
Cross Sections	24	24	24	24	24	24	24	24	24	24	24	24

Source: Authors' Computations

Table 2. Correlation Matrix

	Agric. Invest.	**Human Capital**	**Ethnic Tension**	**External Conflict**	**GDP**	**Agric. Prod. Index**	**Inflation**	**Internal Conflict**	**Poverty**	**Relig. Tension**	**Socio-Economic Condition**	**Govt Stab**
Agricultural Investment	1.00											
Human Capital	0.05	1.00										
Ethnic Tension	-0.37	0.29	1.00									
External conflict	-0.17	0.31	0.35	1.00								
GDP	0.84	0.15	-0.20	0.02	1.00							
Agriculture Production Index	0.15	0.21	0.15	0.04	0.07	1.00						
Inflation	0.11	0.09	-0.10	-0.05	0.12	-0.05	1.00					
Internal Conflict	-0.45	0.19	0.57	0.53	-0.28	-0.01	-0.08	1.00				
Poverty	0.50	-0.08	-0.32	-0.09	0.53	-0.02	0.16	-0.37	1.00			
Religious Tension	-0.20	0.39	0.53	0.31	-0.16	0.01	0.01	0.59	-0.34	1.00		
Socio-Economic Condition	-0.15	0.11	0.27	0.43	-0.01	-0.10	0.002	0.47	-0.25	0.45	1.00	
Government Stability	-0.29	-0.04	0.09	0.20	-0.19	-0.29	-0.05	0.32	-0.18	0.20	0.36	1.00

Source: Authors' Computations

The correlation matrix shows the degree of association among the variables. The result also shows the correlation coefficient and the direction of relationships among variables. We concentrate on the relationship between the dependent variable and all independent variables. It can be deduced that a positive relationship exists between agriculture production index (dependent variable) and agricultural investment, human capital, ethnic tension, external conflict, GDP, and religious tension. However, there exists a negative relationship between the dependent variable and inflation, internal conflict, poverty, socio-economic condition, and government stability. It is worthy of note that a weak relationship exists among all variables except in the relationship between agriculture investment and GDP where the coefficient (0.84) is above 0.50. The inclusion of the two variables in the same model will cause multi-collinearity. This problem is resolved during estimation.

Table 3. Panel Unit Root Test Results

Variable	Level	LLC	Prob	IPS	Prob	ADF	Prob	Remarks
Agricultural Investment	0	0.37	0.64	2.63	0.99	41.24	0.74	I(1)
	1	-6.03	0.00*	-4.36	0.00*	102.00	0.00*	
Human Capital	0	-0.55	0.28	-6.60	0.00*	30.49	0.97	I(1)
	1	-5.61	0.00*	-4.44	0.00*	97.67	0.00*	
Ethnic	0	-4196	0.00*	-1300	0.00*	65.49	0.00*	I(0)
External Conflict	0	-13.58	0.00*	-7400	0.00*	117.90	0.00*	I(0)
GDP	0	3.99	0.00*	-0.709	0.23	72.91	0.00*	I(0)
Agriculture Production Index	0	0.66	0.74	1.74	0.95	36.10	0.89	I(1)
	1	-4.58	0.00*	-4.63	0.00*	103.45	0.00*	
Inflation	0	-5.34	0.00*	-2.79	0.00*	81.94	0.00*	I(0)
Internal Conflict	0	-6.31	0.00*	-3.54	0.00*	97.91	0.00*	I(0)
Poverty	0	0.70	0.75	1.62	0.94	21.13	0.99	I(1)
	1	-6.30	0.00*	-2.08	0.01*	57.31	0.05**	
Religious Tensions	0	-11.53	0.00*	1200	0.00*	57.39	0.00*	I(0)
Socio-economicconditions	0	-1.97	0.02**	-1.239	0.10	61.32	0.04**	I(0)
Government Stability	0	-3.90	0.00*	-1.60	0.05**	66.90	0.03**	I(0)

Note: ***, ** and * denote 1%, 5% and 10% levels of significance, respectively.
Source: Authors' Computations

The next step is to test the stationarity properties of the data. This is important because if non-stationarity is not corrected, the results of the analysis may be spurious with serious negative implications on policymaking. To achieve this, we employ three-panel unit root tests to confirm the stationarity level of all the variables, and the test is carried out with intercept and trend options. The results are presented in Table 3. It can be deduced that there are mixed results of I(1) and I(0). The I(0) implies the variables are stationary at level while I(1) implies the variables are stationary after the first difference. Variables such as agricultural investment, human capital, agriculture production index, and poverty are stationary after the first difference. All other variables are stationary at their original state.

One could have suggested Panel Autoregressive Distributed Lag (PARDL) as the estimation technique given the mixed result of the unit root test. However, given the likely problem of endogeneity, multi-collinearity, and simultaneity that may ensue in the analysis, of which panel ARDL might not be able to correct, we specify dynamic model and use system-

GMM as the technique of estimation. We estimate a two-step system-GMM and for robustness check, a one-step system-GMM is employed to validate our results. Table 4 presents the combined two-step and one-step system-GMM results. The two-step system-GMM is our main result and the one-step system-GMM is presented for comparison.

The dependent variable, as presented in Table 4, is the agriculture production index. The index is used to proxy food production which stands for food security. For the independent variables, we have GDP and inflation as measures of macroeconomic variables, six institutional quality variables, and lag of the dependent variable. Most notably, we unbundle the institutional variables to assess their effect on food security individually.

To start with, the diagnostic tests reveal that the estimates are consistent and the instruments are valid, provided that the p-values of the AR(2) are insignificant and the instrumental ranks are greater than the number of parameters estimated, respectively. Besides, the insignificant J-statistics imply that the instruments are valid.

The previous value of food security, as anticipated, has a significant and positive effect on its current values in all models. This suggests that the food production index is a reliable index of food security over time. Following the a priori expectation, agricultural investment exhibits a positive and significant relationship with food security. This is unsurprising because investment in agriculture in terms of the use of mechanized machinery in African countries would spur agricultural productivity, thereby enhancing food security and this is in line with the study of Ben Slimane *et al.* (2015) who establish that FDI in agriculture ensures food security. To support this fact, there is an innovative public-private partnership, called Africa Agriculture and Trade Investment Fund (AATIF) aims at ensuring food security and providing additional income to farmers, entrepreneurs, and labourers alike by investing patiently and wisely in productive local chains. In the same way, food production rises as the general price level (inflation) increases in all models except model 4. This relationship can be clarified from the supply side (food availability) in that any increase in the prices of goods and services will encourage suppliers to increase supply since it will lead to a rise in overall sales, all things being equal. This finding is contradictory to the work of Wang (2010) who argues that food prices (inflation) have no substantial effect on food security.

Furthermore, the rise in economic activities (GDP) contributes to a decrease in food production, negatively affecting the achievement of food security as seen in all models in Table 4. This is against the study by Dithmer and Abdulai (2017) who opine that economic growth ensures food security. The explanation for this may be that increasing economic growth stems from the fact that most of the farmlands are being used for industrial purposes. Also, as the African economy develops, there is a shift from an agricultural economy to an industrialized economy. Another reason for this finding is rural-urban migration due to the high level of unemployment in African countries. A high level of unemployment in Africa leads people to abandon rural areas for urban areas in search of greener pasture, and this could harm agricultural activities in the rural area. Human capital, as measured by school enrolment, leads to an increase in food production that can help to attain food security as all models have shown. Education and farmers' literacy would help to increase food production. Several studies, such as Kidane *et al.* (2005) and Abdullah *et al.* (2017), confirm that improving human capital, especially in terms of farmers' literacy, can boost food security. Meanwhile, a high level of poverty would limit food production. This result is found to be significant only in Model 2. The negative relationship between poverty and food security can be explained from both producer's (food availability) and the consumer's (food accessibility) side. From the producer's side, poor farmers in African countries, for instance, will not have access to mechanized machinery, finance, and other inputs (such as herbicides and pesticides) that will help in higher food production that can lead to achieving food security. On the other hand, the poor individual (from the consumer's side) would not have the money to demand agricultural produce.

International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
Vol. 9, No. 2, 2021, pp. 125-141

Table 4. System-Generalized Method of Moments

Variable	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Two-Step	One-Step	Two-Step	One-Step	Two-Step	One-Step	Two-Step	One-Step	Two-Step	One-Step	Two-Step	One-Step
Agriculture Production Index (-1)	0.85 (0.00)*	0.82 (0.00)*	0.79 (0.00)*	0.77 (0.00)*	0.84 (0.00)*	0.79 (0.00)*	0.80 (0.00)*	0.78 (0.00)*	0.78 (0.00)*	0.78 (0.00)*	0.79 (0.00)*	0.76 (0.00)*
Agriculture Investment	6.96 (0.00)*	8.20 (0.00)*	8.94 (0.00)*	8.53 (0.00)*	6.67 (0.00)*	8.41 (0.00)*	8.99 (0.00)*	8.69 (0.00)*	8.33 (0.00)*	8.40 (0.00)*	7.76 (0.00)*	8.83 (0.00)*
Inflation	1.47 (0.00)*	0.97 (0.26)	1.41 (0.00)*	1.04 (0.21)	1.10 (0.07)***	1.03 (0.22)	1.00 (0.14)	1.00 (0.23)	1.23 (0.02)**	0.95 (0.26)	1.48 (0.00)*	0.99 (0.24)
GDP	-3.22 (0.01)*	-4.51 (0.00)*	-4.97 (0.00)*	-3.80 (0.01)*	-3.99 (0.00)*	-4.25 (0.00)*	-4.28 (0.00)*	-3.79 (0.00)*	-3.79 (0.00)*	-3.16 (0.01)*	-3.55 (0.00)	-3.41 (0.01)*
Human Capital	10.69 (0.07)***	15.73 (0.01)*	20.93 (0.00)*	16.81 (0.01)*	13.15 (0.01)*	16.18 (0.00)*	14.27 (0.01)*	14.92 (0.01)*	15.74 (0.02)**	11.19 (0.09)***	16.30 (0.02)**	14.77 (0.03)**
Government Stability	6.24(0.30)	9.22(0.11)	--	--	--	--	--	--	--	--	--	--
Socio-Economic condition	--	--	2.65(0.13)	0.87(0.61)	--	--	--	--	--	--	--	--
Internal Conflict	--	--	--	--	2.51(0.01)*	1.60(0.07)***	--	--	--	--	--	--
External Conflict	--		--		--		2.06(0.09)***	0.94(0.49)	--	--	--	--
Religious Tension		--		--		--		--	1.26(0.38)	2.78(0.12)	--	--
Ethnic Tension	--	--	--	--	--	--	--	--	--	--	-0.06 (0.97)	0.81 (0.71)
Poverty	-0.26 (0.18)	-0.28 (0.24)	-0.35 (0.00)*	-0.33 (0.16)	-0.10 (0.60)	-0.27 (0.24)	-0.42 (0.11)	-0.34 (0.15)	-0.04 (0.82)	-0,34 (0.13)	-0.35 (0.21)	-0.38 (0.10)
No of Obs.	360	360	360	360	360	360	360	360	360	360	360	360
Cross-section	24	24	24	24	24	24	24	24	24	24	24	24
Number of Instruments	47	47	47	47	47	47	47	47	47	47	47	47
Wald	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR(1)	0.01		0.01		0.01		0.01		0.01		0.01	
AR(2)	0.17		0.17		0.16		0.17		0.17		0.16	
Sargan test prob	0.99	0.00	0.99	0.00	0.99	0.00	0.99	0.00	0.99	0.00	0.99	0.00

Note: ***, ** and * denote 1%, 5% and 10% levels of significance, respectively

Source: Authors' Computations

Thus, a decline in agricultural demand would lead to a decline in the agricultural supply. Looking at the high level of poverty in Africa, we expect a negative relationship between poverty and food security as supported by the studies of Maitra & Rao (2015) and Loopstra & Tarasuk (2013).

Concerning the effect of institutional quality on food security, all six institutional variables employed in this study are not significantly correlated with food security, except for internal and external conflict in Models 3 and 4. Both variables have a significant and positive effect on food security. This supports the study of Bruck *et al.* (2016) where there is a positive effect of conflict on food security. This implies that conflict, either internal or external, increases African coping strategies in sourcing for food by relying heavily on food importation. This narration also explains why food import is greater than food export in Africa countries as shown in Figure 2. The results imply external and internal conflicts only succeeded in increasing the demand for food thereby increasing the importation of food in the sub-region.

5. Conclusion and Policy Implications

This study aims to evaluate the effect of agricultural investment and institution on food security in 24 Sub-Saharan African (SSA) countries between 2001 and 2016. Countries are chosen based on data availability. The research employs a two-step GMM estimation technique to achieve the study objectives. Findings show that agricultural investment improves food security in the selected SSA countries, whereas internal and external conflicts as measures of governance positively influence food security.

It is concluded that investment in agriculture and institutional quality have significant roles to play in ensuring food security in the selected countries. The implication is that investing in agriculture through the acquisition of agricultural land and purchasing of livestock or agricultural equipment can go a long way towards increasing agricultural food production, which in turn will help in attaining food security in the selected SSA countries. This is also reflected in an innovative public-private partnership, called the Africa Agriculture and Trade Investment Fund (AATIF) aimed at ensuring food security and providing additional income to farmers, entrepreneurs, and labourers alike by investing patiently and wisely in productive local chains. Internal and external conflicts in the selected SSA countries contributing positively to food security implies that conflict can aggravate Africa's desire in sourcing food outside their region, thereby encouraging food importation.

From the foregoing, the study recommends further investment in the agricultural sector to boost agricultural food production, thereby ensuring food security in the selected African countries. This can be achieved by providing social safety nets like cash transfers and food stamps; helping farmers through the provision of fertilizers and seeds, obtaining more agricultural land, purchasing of agricultural machinery, and providing research and developments; implementing supporting policies; collaborating with the private sector; and providing basic amenities in rural areas, such as electricity, good road networks, storage facilities, and education, to discourage rural-urban migration. Internal and external conflict should also be discouraged to ensure food security. Hence, brokering peace among citizens is very crucial to enable improved agricultural productivity, since sustainable peace would promote investment in agriculture, thereby, reducing over-reliance on food importation. This research is not without restriction. Other studies may consider other factors responsible for attaining food security in SSA countries.

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