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Food Insecurity in Selected African Countries: Effect of Food Imports among Other Predictors

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Abstract

It has been envisaged that Sub-Saharan Africa would remain the region with the highest level of food insecurity over the 2015-2025 period. This study, therefore, further investigates food insecurity and food imports in some selected African countries. The regression results based on the fixed effects model show that food imports, employment in agriculture, and food production have helped to reduce food insecurity in the five biggest African economies. However, livestock production, crop production, cereal yield as well as agricultural land area have not been able to reduce food insecurity in these countries. Agriculture value added per worker/food insecurity nexus was insignificant.Although, food importation remains a strong option for African countries in reducing their levels of food insecurity, policy measures by each country should be conceptualized based on their food security historical paths, environmental concerns, as well as their political, social and economic health.

Key words: Food insecurity, Food imports, African countries, Panel Regression, Fixed effects model, Predictors
JEL Classifications: C33, E49, Q18

1. Introduction

Food insecurity remains a challenge in Africa despite the efforts by its governments in addressing it through its food policies including importation of foods (see Siamwalla and Valdes, 1980; Zakari et al., 2014). The food predicaments come in different forms in Africa. In Nigeria, for example, food import-dependence level has been high (see Idachaba, 2009; Ojo and Adebayo, 2012; Central Bank of Nigeria (CBN), 2014). The efforts to ensure food security in South Africa, for instance, have continually been confronted with the major challenge of insufficient access to food by some groups of people in the country who are poor

(Du Toit, 2011). Algeria has been one of the world's most food import-dependent regions with a growing population recorded at 9 million in 1962 and rising to 40.05 million people in January 2016.

The issues surrounding finding a proper definition for food insecurity as well as interpreting it have been laid to rest (Maxwell, 1996). What remains a concern is measuring it in an efficient and effective manner (see Maxwell, 1996 and Maxwell et al., 1999). Conventional approaches (which benchmarks are on consumption, nutrition and poverty level) when compared with coping strategies, the later either complement or are more or less alternatives (see Maxwell et al., 1999; Haddad et al., 1994 and Chung et al., 1997). Coping strategy, as an index of food insecurity is context-definite that sums up and ranks coping behaviours on individual basis (Maxwell, 2008).

Although much has been argued about the necessity for every economy to ensure the availability of staple foods, especially through domestic production (see Food and Agriculture Organization of the United Nations (FAO), 2013), the tendency among African economies to meet this need through the importation of food, most notably brings to bear a great deal of strain on each country's foreign exchange reserves (Davies, 2009). Consequently, mercantilists recommend imports restrictions in order to force the local economy to grow (see Bhatia, 2006). Allowance of imports, especially in African developing economies, however, paves the way for the local economy's market to be flooded with foreign products. Thus the continual emphasis on restrictions on imports results from the socio-economic implications of high levels of food imports (Olofin, 2001; Umo, 2007). However, in spite of negative effects of importations including those on foods on the economy, it has the capacity of making the country food secured.

The peculiarity of the African continent with regard to food production is its advantage in terms of abundant labour and available land resources that can be utilized to address the food deficit challenge. Unfortunately, most African economies still lag behind in ensuring that there are enough staple foods (Akinboyo, 2008). Most African countries are neglecting the agricultural sector and gradually becoming service-oriented economies while the industrial sector remains grossly underdeveloped. This has led to their parade of weak service sector dominance. Developed countries themselves, especially the United States and European countries have attained a high level of food security.

A study by the United States Department of Agriculture (USDA) (2015) showed that Sub-Saharan Africa would remain the region with the highest level of food insecurity over the 2015-2025 period. The evident decline in Africa's average per capita food supply has also raised some concern (see Labadarios et al., 2011). Also, there have been increasing policy responses by African governments in reducing food insecurity. In particular, their somewhat approaches either implicitly or explicitly to augment domestic food supply through resort to allowance for food imports in spite of its delimiting effects calls for more research to this effect. This was the motivation for this study. Its particular interest on food insecurity is from the perspective of food availability. The rest of this paper is made up of four sections. Section two is on the theoretical and empirical review of previous studies, while section three provides a robust description of the methodology. Section four contains the analysis and empirical results of the study, while the concluding remarks are given in section five.

2. Theoretical and Empirical Review

Although emphasis is not on population, food insecurity has its foundation in the Malthusian theory of population of 1798. The theory shows unaligned agricultural output in relation to population growth that invariably leads to an increase in food demand. Malthus (1798) painted a situation where food and population increases take the form of arithmetic and geometric progressions, respectively, in a simultaneous manner. This asymmetrical growth portends a situation in the future where food resources for the population may be inadequate thereby leading to food insecurity which calls for population control among other factors which food import may be an alternative (see Wiebe, 2003; Todaro and Smith, 2006; Demont et al., 2006; Mathieu, 2014; Desiere and D'Haese, 2015).

On the other hand, Boserup, in her seminal work of 1965, did not reject the Malthusian idea, but with a divergent view critiqued the Malthusian theory of population, stating that with the help of modern technology and use of improved seeds and modern farming techniques, food supply would increase to match the needs of an increased population **(**Turner and Fischer-Kowalski, 2010**).** Furthermore, Boserup (1965), contrary to Malthus' view, was of the opinion that an increasing population does not eventually lead to a fall in agricultural output. She argued that though agricultural output may fall in the short run in the face of a protracted population increase, with an increase in workers' efficiency in the long run, agricultural output would rise. With the aid of a division of labour, the increasing population would bring about improved efficiency and the resulting increase in output in the long run would net out the effect of a fall in output in the short-run (Richerson and Boyd, 1998). The contribution of Boserup (1965) is that unavailability of food is avoidable in the long-run.

Food insecurity is affected by many factors (Maxwell et al., 1999, Misselhorn, 2005). As a result, it is conceptualized in different ways (see Allen, 2013, Brunori, et al., 2013, and Kneafsey et al., 2013). The emphasis has been on food availability, sustainability and affordability (Fish et al., 2013). Nonetheless, availability of food appeared to be of more interest to stakeholders and researchers (see Fish et al., 2013). According to Napoli et al. (2011), variables such as food import, food aid and production fall under availability. Other issues apart from sustainability or stability are utilization and access which is the same thing as affordability. Bashir and Schilizzi (2013) states that availability includes factors such as food aid, production, trade (import) and stocks; utilization comprises factors such as hygiene, dietary safety, health status and dietary intake, while accessibility includes factors such as food prices, income distribution and income.

Earlier suggestions by Hazell (1989) and Braun et al. (1992) indicated that fluctuations in a country's capacity to import food (which is posited to be a function of export earnings, world prices and debt services obligation) also contribute to food insecurity by affecting the local availability of food. This is somewhat connected to the mercantilists' proposition, urging the need to limit imports so as to increase productivity. It has been noted that the mercantilists proposed imports restrictions, noting that state's intervention on trade were a means to an end, and not an end in itself (Bhatia, 2006).

The study by Reutlinger (1978) shows that stable supply of food programs at global level is not enough to curtail food insecurity. Rather, the paper suggests that insurance arrangement on food import bill could be the solution to food insecurity. Similarly, Diakosawas (1989) using regression method found out that food import and export as well as per capita income have effects on food insecurity but the most influencing variable is food production. However, Abafita and Kim (2014) found out that livestock possession among other variables is strongly and positively associated with food security.

Studies by Hazell (1989), Braun et al. (1992), Dahlberg (1998), Gollin et al. (2002), Wiebe (2003), the FAO (2006, 2012, 2013) and the USDA (2015) have again supported the need to accelerate world agricultural output, including that of Africa. There is a paucity of studies showing whether it is safe for Africa to increase food security through food importation. The contributions by Dauda (2006), Bello (2009), Otaha (2013) and Ekpenyong (2015) on the determinants of food security are all based on an agricultural economics perspective. Bello (2009) extended previous studies by considering exchange rate as a proxy for food imports. This index is grossly inadequate to capture food imports in Nigeria, which his study was based on. Davies (2009) appropriately used food imports as a variable among other predictors in accounting for food insecurity in Nigeria. Specifically, the work of Hazzel (1989), Braun et al. (1992), Davies and (2009) showed a delimiting effect of food importation on food security. These studies are country specific, which calls for more regional-based or global studies. A regional study on the southern and eastern Mediterranean countries (SEMCs), including Egypt and Algeria, by Talks (2016), suggested that fighting food insecurity requires significant food imports in these countries.

3. Methodology

Modifying Reutlinger (1978), Diakosawas (1989), Bello (2009) and Abafita and Kim (2014) to accommodate other relevant variables based on the food availability argument (see for instance, Napoli et al., 2011, and Bashir and Schilizzi, 2013), the food insecurity model for the selected African countries is specified as

$$DFODF = f(FOPDI, CRPDI, LSPDI, FOIMP, AGRLD, AVPWK, EMAGR, CEYLD \ldots\ldots\ldots\ldots\ldots (1)$$

Where the variables as defined by World Bank (2015) in its World Development Indicators for 2015 are summarized as follows:

DFODF represents depth of the food deficit(defined by kilocalories required to raise an underfed person from his/her dietary position, all things being equal, which is derived by subtracting average nutritional energy consumption from average nutritional energy requirement of the malnourished population multiplied by the numeral of the country's malnourished population, standardized by the aggregate population); *FOPDI* stands for food production index (which covers edible and nutritional food crops with coffee and tea being excluded because they lack nutrients; *CRPDI* represents crop production index (value of all crops except fodder crops); *LSPDI* symbolizes livestock production index (value of meat and milk from all sources including dairy products); *FOIMP* stands for food imports (indexed by food import trade, which includes food and live animals, beverages and tobacco, animal and vegetable oil and fats, oil seeds, oil nuts and oil kernels);*AGRLD* signifies agricultural land (percentage of land area, which is estimated as part of the land area that is arable and is under lasting/transitory cropping; lasting/temporary pastures including land under market/kitchen gardening and under temporary fallow); *AVPWK* represents agriculture value added per worker (obtained from agricultural output less value of intermediate inputs); *EMAGR* symbolizes employment in agriculture (percentage of total employment); and *CEYLD* represents cereal yield (which is in kilogram per hectare and relates to yearly harvested cereal crops for dry grain only). All the data were obtained from the World Bank World Development Indicators, 2015. The selected countries are Nigeria, South Africa, Egypt, Algeria and Angola. They were purposively selected based on their sizes in terms of real

gross domestic product in Africa. The data employed covered the period 1992-2013, because available data on the variables starts from 1992. The static panel data estimation technique was employed because the emphasis of the study is not on dynamics of adjustment, which often calls for dynamic panel data analysis.

Specifying a static panel model for the countries' food insecurity, equation (1) is explicitly specified as:

$$DFODF_{it} = \beta_0 + \beta_1 FOPDI_{it} + \beta_2 CRPDI_{it} + \beta_3 LSPDI_{it} + \beta_4 FOIMP_{it} + \beta_5 AGRLD_{it} + \beta_6 AVPWK_{it} + \beta_7 EMAGR_{it} + \beta_8 CEYLD_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, β_0 denotes constant term, β_1-β_8 are the coefficients, and ε_{it} is the stochastic error term. The prior expectation is that β_1-β_8 should have negative signs, that is, less than zero. An increase in each of the predictors is expected to reduce food deficit, hence food insecurity. Since five countries are selected over twenty years, the panel is a macro one. In recent times, it has become a common practice among applied researchers to test unit roots in panels (see for instance, Levin et al. (2002) and Im et al. (2003). The Levin et al. (2002) method is adopted for the unit roots test. Levin et al. (2002) suggest a more potent panel unit root test than performing individual unit root tests for each cross-section. The equation for the non-stationary null hypothesis is stated as:

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{L=1}^{\rho_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where d_{mt} represents the vector of deterministic variables and α_{mi} stands for the related vector of model coefficients. The test method used by Kao et al. (1999) is adopted for cointegration. This test is like the test method used by Pedroni (1999), which is a residual-based cointegration test based on the Engle-Granger (1987) two-step approach and single-equation structure.

The fixed effects and the random effects models are specified in equations (4) and (5), respectively.

$$y_{it} = X_{it}\beta + F_i + \varepsilon_{it} \ldots\ldots\ldots (4) \text{ for t= 1992,.....,2013 and i= 1,.....5.}$$

$$y_{it} = X_{it}\beta + (F_i + \varepsilon_{it}) \ldots\ldots\ldots (5) \text{ for t= 1992,.....,2013 and i= 1,.....5.}$$

Where, y_{it} stands for food deficit observed for each country at time t; X_{it} represents the observed explanatory variables for each country over the 20 years; β stands for the panel regression coefficient; ε_{it} is the stochastic disturbance term; and F_i is the unobserved heterogeneity, which can be individual specific or cross-section fixed (that is, individual country) effect or time specific (period) fixed effect. Both the cross-section fixed and period fixed are dummy variables. The fixed effects suggest that each country is different and that such a difference may probably affect other explanatory variables (regressors). In the same vein, the fixed effects connote that each time is different and that may also affect other regressors. Therefore, the fixed effects suggest that country and time specifics can correlate

with other explanatory variables. Based on this, the fixed effects model is not good for making generalizations about the population of the study. Interpretation of findings and making inferences about the study must be limited to the selected five countries. The random effects model, on the other hand, assumes that the country and time specifics do not correlate with other explanatory variables. This creates the problems of autocorrelation and heteroscedasticity, which must be solved. However, the random effects model is good for making generalizations.

4. Empirical Results

A. Pre-testing Procedure

This first step entailed an elaborate descriptive analysis to investigate the features of the panel variables before conducting the panel unit root tests.

Based on the result, 96.61 kilogram of food deficit or food insecurity and 13.37 percent of food in merchandise imports, both annually, are found on the average. Other annual averages are 22.45 percent of agriculture in total employment; 44.80 percent of land area for agriculture; 92.76 as food production index; 97.04 as livestock production index; 91.34 as crop production index; $2272.01 as agriculture value added per worker; and $2577.83 as cereal yield per hectare. Therefore, from the foregoing, it is evident that employment in the agricultural sector (percentage of total employment) has been considerably low even with a large portion of the countries' land area put under agriculture. Although, cereal yield and agricultural value added per worker seem to be reasonably high among these economies, such findings were peculiar to Egypt and South Africa.

Table 1: Pooled Descriptive Statistics

	DFODF	FOPDI	LSPDI	FOIMP	EMAGR	CRPDI	CEYLD	AVPWK	AGRLD
Mean	96.60909	92.76000	97.04091	13.37273	22.44545	91.33909	2577.827	2272.009	44.80182
Median	41.50000	89.50000	94.65000	16.00000	21.00000	90.80000	1422.000	2158.000	46.20000
Maximum	507.0000	213.4000	145.2000	33.00000	49.00000	236.4000	7556.000	6655.000	80.90000
Minimum	14.00000	41.80000	55.80000	0.000000	5.000000	32.60000	268.0000	0.000000	3.000000
Std. Dev.	131.2149	30.04559	20.80633	10.86773	15.24153	34.21535	2377.773	1649.090	31.08644
Skewness	2.098101	1.169967	0.228520	0.076241	0.393443	1.351076	1.133286	0.431373	-0.092569
Kurtosis	6.133963	5.422385	2.136168	1.508577	1.846086	6.505131	2.732442	2.767992	1.357309
Jarque-Bera	125.7201	51.98987	4.377501	10.30147	8.940741	89.77639	23.87429	3.658232	12.52492
Probability	0.000000	0.000000	0.112057	0.005795	0.011443	0.000000	0.000007	0.160555	0.001907
Sum	10627.00	10203.60	10674.50	1471.000	2469.000	10047.30	283561.0	249921.0	4928.200
Sum Sq. Dev.	1876690.	98398.40	47186.49	12873.72	25321.17	127605.2	6.16E+08	2.96E+08	105334.0
Observations	110	110	110	88	110	110	110	110	110

Source: Computed by the authors

Table 2: Panel Unit Roots Test Using Levin, Lin and Chu Procedure

Panel Data	**Levin, Lin and Chu(LLC) test** (Common Unit Root process)			
	t stats	P-values @ Levels	t stats	P-values @ 1st difference
DFODF	-1.10085	0.1355	-1.73619	0.0413**
FOPDI	-1.08112	0.1398	-1.70983	0.0436**
LSPDI	0.35565	0.6389	-4.25471	0.0000**
FOIMP	-0.71424	0.2375	-5.10879	0.0000**
EMAGR	1.01023	0.8438	-0.34224	0.3661
CRPDI	1.10585	0.8656	-3.37637	0.0004**
CEYLD	-1.12304	0.1307	-4.39961	0.0000**
AVPWK	0.71650	0.7632	-5.69742	0.0000**
AGRLD	-0.66986	0.2515	-2.17941	0.0147**

*Note: ** denotes rejection of the hypothesis of non-stationarity at 5% significance level*
Source: Computed by the authors

On the basis of the Levin, Lin and Chu t-statistical test, the assumption of non-stationarity cannot be rejected for the levels of all the variables at the 5 percent significance level. This implies that all the variables are non-stationary at levels. Although, after the first difference, the variables are stationary except for employment in agriculture. Other than this variable, the p-values associated with the t-values are less than 0.05 or 5 percent.

B. Panel Co-integration Tests

The panel co-integration test is carried out to ascertain whether the variables converge in the long run despite that one of them is not stationary at first difference. The results are shown in Table 3.The p-value associated with the Fisher-Augmented Dickey-Fuller (ADF) t-statistic value is less than 5 percent, hence implying that the variables converge in the long run or have an equilibrium relationship.

Table 3: Kao (Engle-Granger Based) Co-integration Test Results

	t-Statistic	**P-value**
ADF	-2.508522	0.0061
Residual variance	81.55212	
HAC variance	150.5605	

Source: Computed by the authors

The fixed effects model is estimated to account for possible unobserved heterogeneity across the five countries.

Table 4: A Fixed Effects Model of Food Insecurity

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-159.7077	144.1643	-1.107817	0.2714
FOPDI	-7.527849	1.538086	-4.894297	0.0000
LSPDI	1.597440	0.648685	2.462583	0.0161
FOIMP	-2.575256	0.687315	-3.746838	0.0003
EMAGR	-3.299078	1.353962	-2.436610	0.0172
CRPDI	3.582599	1.135056	3.156318	0.0023
CEYLD	0.038753	0.011017	3.517686	0.0007
AVPWK	-0.003295	0.009128	-0.361048	0.7191
AGRLD	10.90195	3.463684	3.147502	0.0024

R-squared	0.971620	Mean dependent var	96.60909
Adjusted R-squared	0.959297	S.D. dependent var	131.2149
S.E. of regression	26.47270	Akaike info criterion	9.638540
Sum squared resid	53261.10	Schwarz criterion	10.47323
Log likelihood	-496.1197	Hannan-Quinn criter.	9.977096
F-statistic	78.84576	Durbin-Watson stat	1.005129
Prob(F-statistic)	0.000000		

Source: Computed by the authors

Based on the results in Table 4, the coefficients of the predictors of food insecurity appear quite diverse in magnitude and sign. Nonetheless, not all fixed effects are significantly different from zero. In testing whether there is unobserved heterogeneity, the redundant fixed effects test, which is built into Eviews, is used. The results are shown in Table 5.

Table 5: Redundant Fixed Effects Test Output

Effects Test	Statistic	d.f.	Prob.
Cross-section F	55.013035	(4.97)	0.0000
Cross-section chi-square	130.279079	4	0.0000

Source: Computed by the authors

The null hypothesis is that the fixed effects are all equal to each other. This hypothesis is rejected because the p-values associated with the F-statistic and the chi-square statistics are both 0.0000. By implication, there is unobserved heterogeneity. Therefore, a pooled regression is not appropriate. Estimating a pooled regression would result in having unbiased estimated coefficients. The fixed effects model helps to eliminate unobserved heterogeneity by demeaning the variables using the within transformation. The random effects result is shown in Table 6.

Table 6: A Random Effects Food Insecurity Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	260.5259	35.30684	7.378907	0.0000
FOPDI	-7.053237	2.378839	-2.964991	0.0038
LSPDI	4.633504	0.776568	5.966644	0.0000
FOIMP	-3.388749	0.908271	-3.730990	0.0003
EMAGR	-2.402704	0.453396	-5.299351	0.0000
CRPDI	2.875621	1.771707	1.623080	0.1077
CEYLD	-0.008273	0.002738	-3.022007	0.0032
AVPWK	-0.045900	0.004835	-9.493920	0.0000
AGRLD	0.064818	0.340250	0.190500	0.8493

R-squared	0.877326	Mean dependent var	96.60909
Adjusted R-squared	0.867610	S.D. dependent var	131.2149
S.E. of regression	47.74319	Akaike info criterion	10.64783
F-statistic	90.29026	Durbin-Watson stat	0.603204
Prob (F-statistic)	0.000000		

Source: Computed by the authors

The results of the random effects are not dramatically different from those of the fixed effects. The estimated coefficients as well as the standard errors are somewhat similar. The results of the Hausman test are provided in Table 7. This compares the fixed effects with the random effects and shows which one is preferable.

Table 7: Correlated Random Effects- Hausman t

Test Summary	Chi-Square Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	25.115590	8	0.0015

Source: Computed by the authors

The Hausman test rejects the null hypothesis that the individual country and time specific effects do not correlate with other explanatory variables since the p-value is significant at both 1 percent and 5 percent levels. Therefore, it is problematic for the study to use the random effects results. The fixed effects model is appropriate and there is no need to solve autocorrelation and heteroscedasticity problems.

The fixed effects result shows that food imports, employment in agriculture and food production have helped to reduce food insecurity in the chosen African countries. This is in consonance with the work of Diakosawas (1989) which revealed that food import is significantly associated with reduction in food insecurity but more potently is the effect of food production. Conversely, Hazell (1989) and Braun et al. (1992) reiterated that food imports also contribute to food insecurity by affecting the local availability of food, that is, not encouraging domestic food production. They also attest to the fact that food import as a measure of addressing food insecurity is not sustainable. Similarly, Davies (2009) and

Blanchard (2009) also emphasized the delimitating effect of food import on aggregate productivity.

Therefore, our result may be at best a short-run policy option for addressing food insecurity. Besides, the conformity of food production index to the a priori expectation is related to the finding of Bello (2009), although his study is country specific. However, livestock production, crop production and cereal yield, as well as agricultural land area have not been able to reduce food insecurity in these countries. This is contrary to the study by Abafita and Kim (2014) that revealed a positive effect of livestock possession on food security in rural Ethiopia. The result of Wiebe's study (2003) that increased resource use had notably facilitated agricultural productivity and invariably global food production is contrary to our finding on agricultural land area. It is probably because some countries such as South Africa, Egypt and Algeria are facing environmental and weather challenges, hence land use for agriculture is yet to provide a positive result. This substantiation is relevant because Wiebe (2003) also found out that land use is significant in the reduction of food insecurity in countries with good soils and climate but not for those with poor soils and climate. Agriculture value added per worker was found to be insignificant in influencing the level of insecurity in these countries. This could be due to the high level of energy loss and the cost of production in some of these countries, for instance, Nigeria and Angola. These two countries have also been faced with serious neglect of agriculture for the oil industry until the recent fall in crude oil price which started in 2015. Improving agricultural value added per worker had seemingly been emphasized as important in addressing food insecurity according to Tripp et al. (2005) and Murshed-E-Jahan and Pemsl (2011). These authors submitted that training contributes to the enhancement of farmers' skills and has yielded a variety of results.

5. Conclusion and Recommendations

Food importation remains a potent option for African countries in reducing levels of food insecurity. However, policy measures by each country should be conceptualized based on their food security historical paths, environmental concerns, and their political, social and economic health.In general, while efforts to match or meet food demand-supply shortfalls or gaps through food importation seems to be popular in Africa, such a policy would be 'healthy' to a country only as a short-run or short-term measure. Such a policy measure should be tolerated only within a specified timeline.

Food production and employment in agriculture are also critical in solving food insecurity problems. Therefore, African leaders need to further harness the opportunities in agriculture as a way of providing jobs for the high percentage of unemployed youth. Community-based agricultural participatory frameworks are laudable initiatives that must be enhanced. Such initiatives would facilitate the absorption of significant human resources (the able unemployed young population) in the agricultural sector development process. Since crop production, livestock production, cereal yield and agricultural land area have not been able to reduce food insecurity, governments should critically look at issues relating to these factors. The value chain of agriculture also remains a critical issue that must be addressed in solving food insecurity problem. Urgently, there should be adaptation strategies inclusive of options for handling land use patterns, the post-harvest agricultural value chain, and food trade and policy responses to global change, particularly as regards the prevalent climate changes that impact more on countries with arid conditions.

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