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Effects of Agricultural Growth on Food Security in Cameroon

MBOCK Martini Rodrigue[1], FOTIE NKUETE Jean Ronald[2], YAKAN Hervé Bertrand[3], DJOAH Yves Thierry[4]

[1,2,3,] *Faculty of Economics, University of Yaoundé 2-Cameroon, Research Assistant for the Research Institute for Agricultural Development.*

[4] *Faculty of Sciences, University of Ngoa ékélé-Cameroon, Research Assistant for the Research Institute for Agricultural Development.*

Abstract: This paper analyses the effects of agricultural growth on food security in Cameroon. The main objective is to examine the influence of agricultural production growth on food security in Cameroon. The methodology used to achieve this objective is the JOHANSEN model. The data used are from the World Bank's World Development Indicators (WDI) and the United Nations Agriculture Fund's FAOSTAT from 1988 to 2018. Our results show that increasing agricultural production does not reduce the proportion of undernourished people in Cameroon.

Keywords: agricultural growth, Food security, Johansen, Cameroon.

1- Introduction

Today, about 33% of the population in sub-Saharan Africa is undernourished, i.e. 200 million people, 60% of whom live in countries in conflict (FAO, 2006). Thus, chronic undernourishment affects the entire region but has increased particularly in countries in conflict. In other countries, however, there has been a general, albeit uneven and slow, improvement. Overall, the region remains at constant risk of famine and food crises, easily triggered by obstacles such as drought, floods, economic recession, etc. Sub-Saharan Africa is the only region in the world where hunger is expected to worsen over the next twenty years if measures are not taken to contain the various obstacles.

In terms of the source of supply for these countries, cereals, roots and tubers play an important role, although their production does not keep pace with population growth. In order to meet the demand for food, these countries have imported about 25% of cereals (FAO, 2006). This percentage is higher in poor countries with trade deficits, high debt levels and where imports do not have a positive long-term impact. Some countries depend on food aid, which was high during the 1970s but is currently stagnating at three per cent (op cit).

Furthermore, to reduce poverty and hunger, it is important to prioritise the sectors where the poor work the most, and where the factors of production belong to the poorest: this is the agricultural sector. It is the main sector that provides export earnings and employment. It is also a sector that can generate surplus capital, shift labour to other sectors and enable a country to be competitive, thereby stimulating domestic demand.

Unfortunately, the agricultural performance, marked by uneven developments, has not lived up to expectations. Despite this, annual agricultural growth has averaged 3.9%, a rate that CAADP says does not address the problem of hunger. It is important to praise the production of foods such as cassava, fruit and vegetables, tea and fish.

Cameroon, a Central African country, has a food insecure population of 6.7% in regional capitals (0.7% severe and 6% moderate) and 9.6% in rural areas in 2013 (SRHR, 2016). In rural areas, 10.5% of households are relatively food insecure, and 30.3% of this population is vulnerable to food insecurity (SRHR, 2016).

The state of Cameroon has placed a lot of hope on agriculture since 1960 and the establishment of the five-year plans aimed at increasing agricultural productivity and production. The agricultural sector is also important for this country because it represents more than 40% of the active population and contributes 20% of the national GDP as a major activity in rural areas, where the population was estimated in 2000 at 56% of the population according to the FAO (2012). It should also be noted that agricultural performance in Cameroon is mixed.

Previous studies on this subject have been carried out at the microeconomic, mesoeconomic and macroeconomic levels in West Africa (Sandrine Dury et al., 2017). As an improvement on previous studies, this paper assesses the effects of agricultural growth on food security in the Cameroonian context while incorporating potential variables that could explain this relationship, such as food import, food export, rural population and agricultural value added per worker. In addition, studies on this topic have had other methodological approaches. Our study uses the Johansen cointegration test approach. The development of this problem will be done in three parts, the first one will be devoted to the review of the literature. The second part will be reserved for the presentation of the methodological approach. The third part will illustrate the results of the research.

2- LITERATURE REVIEW

Empirical studies on the relationship between agricultural growth and food security focus on the effects of agricultural growth on food security on the one hand and on the influence of other variables (climate and population growth) on food security on the other.

Thus, with regard to the effects of agricultural growth on food security, Lourme-Ruiz et al. (2016) focus on the relationship between the diversity of agricultural production and the diversity of food consumption. Based on a survey of 580 farms in the cotton and cereal-growing zone of western Burkina Faso, these authors show that dietary diversity is well below the recommended thresholds for meeting nutritional requirements in micronutrients, which are essential for good development. They also show that agricultural production on farms, described by different indicators (volumes produced, value of farm receipts, variety of crops), is little related to dietary diversity. On the other hand, women's specific income, whatever its nature (donations received, income from an independent activity), and the presence of trees on the farm plots are positively associated with dietary diversity. Thus, and more generally, Lourme-Ruiz (2017) shows that in this context, and as written by Malapit et al. (2015) in the case of Nepal, women's "empowerment" mitigates the negative effects of low agricultural diversity on women's and children's nutrition.

According to Hervé Guilbert et al (2016), the intensification of maize cultivation in North Cameroon solves the problem of food insecurity. They also find that there is good technical profitability but that economic profitability can be improved. The authors test 32 maize fields, 16 of which are fertile and 16 degraded in the city of Garoua.

Diedhou (2020) makes a study based on the interactions between society and the choices of individuals to contribute to the food security of the population of Ziguinchor (Senegal). They also show that urban agriculture through market garden products, cereals, livestock products and the exploitation of the arnacade nut contribute to food security in this city. The methodological approach used is the monograph.

Considering a sample of 360 farming households in Kouritenga and Zondoma (Burkina Faso), using a microdosing technology with compost, H. Sigue et al. (2019) demonstrate with a simultaneous equation model that in addition to the positive effects and meanings of the use of this technology, there is also food availability (food security) in the study area.

Vonthron et al (2016) offer a reflection on the integration of the two notions of resilience and food security, in the context of development in Africa in particular, based on a literature review. The authors show, among other things, the difficulties encountered by field actors in charge of various food security actions to integrate the systemic, dynamic and multiscalar notion of 'resilience'. In an effort to operationalise the concept, various initiatives, particularly those aimed at measuring resilience, are tested and discussed. Finally, it appears that

resilience is one of the resources mobilised to better integrate the various short- and long-term interventions of different sectors aiming of food security: agricultural policies, social policies, economic policies (e.g. price regulation) and emergency food aid.

Furthermore, using variables other than agricultural growth, Aggarwal et al. (2010) in India analyse the impact of climate change on rice and wheat yields between 1969 and 1990. They look at climate change with variables such as solar radiation, temperature, rainfall and wind speed. The study concludes that climate change does affect rice and wheat crops.

Ibrahima Mbaye (2022), on the perception of climate change in the peri-urban area of Ziguinchor in Senegal, shows with surveys and statistical tables that non-native populations suffer from food insecurity while natives are more resilient.

ET-Touile Houria and Arib Fatima (2021), on an econometric study of the impacts of climate change on food security in Morocco, demonstrate from the ARDL approach that rainfall has a positive effect on agricultural GDP, temperature has a negative effect on agricultural GDP and arable land does not directly influence food security.

Mathauda et al (2000) study the impact of temperature change on rice yields in India over the time horizon 1970-1990. Temperature change is understood by the authors as the different levels of temperature change namely extreme heat, great heat, moderate heat and slight heat. Thus, they conclude that as temperature increases, rice yields decline and get worse.

Southworth et al (2000) analyse the combined effects of temperature and rainfall on maize yields in the Midwest over the period 1987-1990. They show that, during the maize tasselling period, high temperatures lead to a significant reduction in productivity. Similarly, Olesen et al. (2000) in an analysis of the impact of (carbon dioxide) CO2 emissions from temperature and precipitation on grain yields in Denmark over the period 1971-1997 conclude that high temperatures reduce the life span of some crops.

Using Ricardian approach while analysing the impact of rainfall and temperature on net farm income in Odisha locality during 1979-2009, Mishra and Sahu (2014) show that rainfall in the month of July was significant for agriculture and that, increase in temperature has adverse effects on agricultural activities.

Salvo et al (2013) show that there are generally beneficial effects of climate change in Germany and the UK between 2003 and 2007. However, they show that at the same time climate change leads to a decrease in the average annual net income in Italy in the Alpine region. Deressa and Hassan (2011) show that in Ethiopia, temperature and rainfall affect net crop income. They also observe that small temperature variations in winters have a negative impact on net crop income.

Mamy Soumaré et al (2020) analyse the effects of population growth on food security in the cotton zone of Mali between 1960 and 2020. They show that the increase in population from 1987 to 2013 has a positive influence on the quantities of cotton and cereals (maize, millet and sorghum). Similarly, Yadh Zahar (2001) concludes on the impact of population growth control on food security that population growth has a positive effect on irrigated cereal production for the forecast periods 2010, 2020 and 2030.

On the other hand, Jean-Etienne Bidou and Pierre Janin in an article published in 2013 on the case of Mali in relation to "population and food security" show that the very strong growth of the population is considered to be a drag on food security.

In Burkina Faso in general and the commune of Koumbia in particular, Luc Cambrezy and Gabriel Sangli (2018) analyse population growth and the evolution of agrarian systems in 2019. They demonstrate, as Esther Boserup does, that the increase in population has resulted in a twofold process of agricultural intensification.

Cathy Chatel and Gwenaelle Raton (2019) also mention the role of population on food security in African countries. The authors argue that beyond the pessimistic (Malthus) and optimistic (Boserup) visions, populations are finding a new paradigm in the name of 'resilience' that allows them to solve some food insecurity problems.

3- Methodology

To verify whether agricultural growth has an effect on food security in Cameroon, we chose the Johansen model, which is only appropriate if the variables tested are stationary in first difference. The analysis of

cointegration in the sense of Johansen thus consists of studying the independence between two variables without making any a priori hypothesis on the values of the coefficients that link them. As for any dynamic model, we will use the information criteria (Akaike-AIC, and Shwarz-SIC) to determine the optimal lags (p, q) of the Johansen model.

In our study, we seek to capture the effects of agricultural growth (VAPT: value added per worker) on food security (PPSA: proportion of undernourished people). To capture the effects of agricultural growth on food security in Cameroon, we chose annual data of exogenous and endogenous variables covering the period 1988-2018. The choice of this sample is justified by the availability of data collected from the World Bank database. We draw on the theoretical model of Thiam and Touré (2020) which presents the empirical links between agricultural finance and food security. This model is derived from Jeanneney and Kpodar (2008) with modifications by the authors. Thus, the model written and developed in the Cameroonian context is written as follows

PPSA = c + VAPT + IAL + PRU +EAL +Vt

With,

VAPT: Value added per worker

FRI: Food import rate

EAL: Food export rate

PRU: Rural population rate

PPSA: Proportion of undernourished people

4- Results

4-1- Stationarity tests

The main results of the ADF and PP unit root tests are carried out using Eviews 10 software and presented in a table indicating the order of integration of the series and the associated p-values.

Table 1:

	In level			In first difference			Conclusion on the order of integration
	ADF	PP	KPSS	ADF	PP	KPSS	
PPSA	-0.6768 (0.4187)	-10.073 (0.0000)	(0.2290)	-2.3270 (0.4107)	-4.0476 (0.013)	(0.096)	I(1)
TIAL	-1.7654 (0.7016)	-2.5183 (0.3184)	(0.0512)	-0.5645 (0.4660)	-3.8039 (0.0252)	(0.0612)	I(1)
TEAL	-2.3965 (0.1483)	0.2142 (0.7441)	(0.0878)	-3.6654 (0.0351)	-3.8652 (0.0046)	(0.0733)	I(1)
TPRU	-2.4845 (0.1776)	-5.6849 (0.0001)	(0.1124)	-2.3292 (0.0208)	-13.988 (0.0000)	(0.1363)	I(1)
VAPT	-3.2440 (0.0888)	-2.3372 (0.4065)	(0.1322)	-5.9155 (0.0001)	-4.3228 (0.0012)	(0.032)	I(1)

Source: Author based on Eviews 10

This table shows that the series are integrated of order 1 (i.e. I(1)). The estimation method we consider in this case is the Johansen multi-variate cointegration.

4-2- Cointegration tests

Table 2 :

Series: PPSA TEA TIA TPRU VAPT Lags interval (in first differences): 1 to 4							
Hypothesize No. of CE(s)	Eigenvalue	Unrestricted Cointegration Rank Test (Trace)			Unrestricted Cointegration Rank Test (Maximum Eigenvalue)		
		Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.994452	357.3015	69.81889	0.0001	223.3529	33.87687	0.0001
At most 1 *	0.875000	133.9486	47.81813	0.0000	89.41590	27.78434	0.0000
At most 2 *	0.436967	44.53292	29.79707	0.0005	24.69994	21.13162	0.0150
At most 3 *	0.356482	19.83278	15.49471	0.0104	18.95464	14.26460	0.0084
At most 4	0.020215	0.878143	3.841466	0.3487	0.878143	3.841466	3.841466

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Our estimates from Eviews 10.
From the results of Table 2 above, it appears that there are at most four cointegration relationships between the PPSA variable and the different explanatory variables. This is confirmed by both the trace and the maximum eigenvalue tests. Therefore, we will estimate a vector error correction model (VECM).

4-3 Results of the estimations

We present here in turn the econometric results relating to the analysis of some explanatory factors of the evolution of the PPSA. Before estimating the model, it was necessary to determine the optimal number of lags. For this purpose, we used the Schwarz (SC) and Akaike (AIC) information criteria method.

Short and long term results

The VECM model is unique in that it provides both short-run and long-run dynamics results. The results obtained in our work are summarised in the following table:

Table 3: Long and short term dynamics

Long-term dynamics		Short-term dynamics	
Variables	Coefficients	Variables	coefficients
PPSA(-1)	1.000000	D(PPSA(-1))	0.899191 [4.09152]***
EAL(-1)	-1.364850 [-2.89888]***	D(EAL(-1))	0.012448 [0.83242]
IAL(-1)	0.554348 [1.02923]	D(IAL(-1))	0.000619 [0.08011]
PRU(-1)	-23.05962 [-8.06830]***	D(PRU(-1))	-2.192441 [-5.29957]***
VAPT(-1)	16.41277 [7.97430]***	D(VAPT(-1))	-0.003689 [-0.13857]
CointEq1	-0.001809 [-8.23513]		
R-squared	0.962683		
F-statistic	48.15467		

Source: Our estimates from Eviews10.

NB: *, ** and *** indicate the significance of the coefficients at the 10%, 5% and 1% thresholds respectively. The values in square brackets represent the t-statistics associated with the coefficients.

In this case, the error correction coefficient is -0.001809. This is negative and significant and therefore the estimated VECM model is valid. In addition, the coefficient of determination associated with the estimates is 0.96, which means that the variance of the endogenous variable is explained to about 96% by the exogenous variables of the model.

5- Interpretation of the Results

In the following paragraphs, it is appropriate to interpret the various results we have obtained. We are interested in both the econometric and economic aspects of the analysis of the short-term dynamics and the long-term equilibrium.

a- Interpretations of the results for long-term dynamics.

Here we interpret the results for the long-term relationships, focusing in each case on the sign and significance of the coefficients.

In the long run, the prevalence of undernourished people depends positively on food imports and agricultural value added per worker. In contrast, food export and rural population negatively affect the prevalence of undernourished people in the long run. However, these effects on the prevalence of undernourished people are not significant on all variables. Indeed, the test statistic associated with the coefficient of the LAI variable is 1.02923 lower in absolute value than the critical value at the 5% threshold at 30 degrees of freedom, i.e. 2.042. Nevertheless, the influences of the variables EAL, PRU and VAPT are significant.

Thus, in the long run, an increase in Food Exports by 5 points decreases the prevalence of undernourishment by 136.4 points. Similarly, a 5-point increase in rural population decreases the prevalence of undernourishment by 230 points. But, an increase in value added per agricultural worker by 5 points increases the prevalence of undernourishment by 164 points.

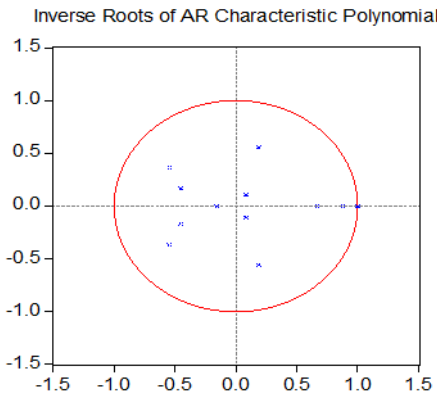
The EAL has a negative and significant effect on the PPSA because exporters buy in large quantities and at high prices to the disadvantage of local buyers. This behaviour reduces the availability of food for local populations and increases prices on the local market, thereby increasing the number of undernourished people. This result supports that of Mohamed Naji (2003) who argues that the export of fisheries products in Morocco deprives children of a highly nutritious diet on a national scale and reduces export revenues due to the presence of intermediaries and speculators who will absorb a good part of the surplus coming from the improvement of the terms of trade. In contrast, Idohou, Orou and Mounirou (2019) show that increased agricultural exports lead to increased income in Benin.

The PRU acts negatively and is significant on the PPSA because the more rural people there are the less available. This supports Malthus' argument that population growth is the cause of famine. Edoun E. Guy and Mongbo L. Roch (2020) make the same point and show that an increase in the population of the commune of Karimama in Benin negatively impacts land availability and satisfaction of needs. This result contradicts that of Luc Gambrezy and Gabriel Sangli (2018) who show that a strong increase in population resulting from both immigration and natural growth has led to a dual process of agricultural intensification and the continuation of extensive practices in Burkina Faso in the commune of Koumbia.

The VAPT is positive and significant relative to the PPSA. This means that the VAPT has a positive influence on the PPSA, which leads to the conclusion that the more value added there is, the more food security there is not. This supports SEN's theory of lack of access to food causing a food crisis in Bengal. This result is antinomic to that of Yabi and Ayena (2013) for whom the increase in agricultural production in general and cotton in particular improves the income and consequently the food security of 80 producers in Banikoara, Mali. However, it confirms the analysis of Iknane et al (2013) who found the "Sikasso paradox" in that an increase in cereal production led to malnutrition in a quarter of the children in the town of Sikasso.

As for the error correction coefficient, it has a value of -0.001809 and is significantly different from zero at the 5% threshold, which means that in the event of a short-term imbalance in relation to its actual level, the prevalence of undernourished people converges towards equilibrium at a speed of about 0.18%. The stability test of the model shows that the model is stable. This is shown in **Figure 1**.

Figure 1: Stability test of the VECM model



Source: Author based on Eviews 10

From the observation of this graph, we can see that all the roots of the delay polynomial are in modulus inversely lower than 1, which allows us to conclude that the estimated VECM model is stable.

b- Interpretations of the results of the short-term dynamics.

The results of the short-term dynamics are those obtained by taking into account the lagged variables. As in the case of the long-run models, we will focus on the signs of the coefficients and their significance.

In the short term, apart from the variables food export, the level of prevalence of undernourishment and food import which positively influence the prevalence of undernourished people, the rural population and the value added per agricultural worker have rather negative effects. The variables D(PPSA(-1)) and D(TPRU(-1)) are significant. Thus, a 5% increase in the rural population decreases the prevalence of undernourishment by 2.192441%. This result is consistent with that of Appolinaire Alinenou et al (2021) who find that a large increase in population has implications for the agrarian landscape of the town of Glazoué in Benin, thus implying a food security problem. It also supports neo-Malthusians who promote birth control by advocating the use of contraceptives.

6- Economic Policy Recommendations

The results of our estimations allow us to state that in Cameroon, the value added per agricultural worker is not sufficient to reduce the number of undernourished people. Also, the rural population and food exports do not also reduce the number of undernourished people. This set of findings leads us to propose some economic policy recommendations to minimise this phenomenon and improve the country's economic climate:

- The introduction of an export tax on certain products.

This is a tax placed on a product that is exported from a country. This tariff specifically increases the cost of selling domestic products abroad. It is used to stabilise domestic demand, stop inflation and protect national commodity reserves. This is in response to excessive exporting at the expense of domestic demand while creating a price increase.

- Invest in infrastructure.

This means investing in roads and storage facilities for products. On the road infrastructure, these investments will allow products to be transported from rural to urban areas and vice versa. As for storage, it is important because of the unavailability of food products during the "lean season", especially in areas that are subject to certain constraints such as flooding.

7- Conclusion

This study was motivated by the desire to determine the short and long term effects of agricultural growth on food security in Cameroon. To establish this relationship, we applied Johansen's methodology while drawing

on the empirical model of Jeannenay and Kpodar (2008) adapted to the Cameroonian context. Among the multiple results, food export is negative and significant in the long run, noting that it reduces availability for local populations and raises prices on the local market, thereby increasing the number of undernourished people. Rural population is a negative and significant variable, both in the long and short term; this result highlights the non-positive influence of rural population growth on food availability. The value added per agricultural worker is a positive and significant variable only in the long run on the proportion of undernourished people. Finally, the analysis of the model shows that agricultural growth does not lead to food security in Cameroon.

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Corresponding Author: ***MBOCK Martini Rodrigue, Faculty of Economics, University of Yaoundé 2-Cameroon, Research Assistant for the Research Institute for Agricultural Development.***

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