Empirical analysis of the role of population mutations on agricultural productivity in Sub-Saharan Africa

Abstract

This paper aims to analyze the role of population growth in the explanation of agricultural productivity in the context of Sub-Saharan African countries. Based on available data, we collected data on a sample of 24 Sub-Saharan African countries over the period 2000-2018. The empirical method consists of estimating an agricultural production function in turn by Generalized Least Squares (GMM) estimators on panel data and Generalized Moments (GLS) estimators in system. The results suggest that pesticide use is positively and significantly correlated (at the 1% threshold) with agricultural productivity in SSA. They also show that life expectancy at birth positively and significantly explain agricultural productivity in SSA. This means that the larger the population, the more important agricultural productivity is. The rural population is negatively correlated with agricultural productivity, reducing agricultural employment as rural populations migrate in search of better living conditions. We therefore suggest that African governments step up financial support programs for young people to limit the brain drain and encourage agricultural employment.

Keywords : Agricultural productivity, population growth, GLS, GMM.

1. Introduction

In most of the developing countries, a large majority of people lives in rural areas and depends mainly on agricultural activities. This is the case in SSA, where up to 60% of the working population lives mainly from agriculture. At the Malabo Declaration in 2014, African heads of state pledged to eliminate hunger by 2025 by doubling agricultural productivity. Africa has the largest area of uncultivated arable land in the world (202 million hectares). According to a report by the World Food Program (WFP, 2016), the continent has the highest rate of undernourishment, and around one person over four is food insecure. In addition, African countries are increasingly importing agricultural products (production of which is insufficient or totally absent), which is putting an even greater strain on their meager foreign currency reserves. It is therefore important to improve African agricultural production. On way to achieve this aim is to increase agricultural productivity. Block (1994) defines productivity as the relationship between physical inputs and physical outputs, ignoring intrinsic price movements in the calculation of agricultural value added. Productivity is also defined as output per unit of input, total output per hectare, yield per crop and output per worker. However, despite the importance of the agricultural sector in Africa, both economically and culturally, its productivity is considerably lower than in other developing regions.

Theoretically, Mellor (1995, 1996) formulated a set of hypotheses that may result from agricultural productivity growth, including: (1) increased farm income and profitability, resulting in improved welfare for farmers and the rural poor; (2) lower food prices, benefiting poor rural and urban consumers, including small farmers who could be net buyers of food; (3) nominal wage reductions, in line with real wage increases, allowing the industrial sector to reduce costs; (4) increased domestic demand for manufactured goods; (5) increasing competitiveness of agricultural and industrial exports, with a positive impact on hard currency earnings; (6) expansion of the domestic industrial sector, drawing investment and labor out of agriculture. This analytical framework has been defined in various forms in several places, but with little effort at formal modeling or empirical verification. However, African soils vary from region to region and require a more tailored approach (Nin-Pratt and McBride, 2014; World Bank, 2008). Also, low use of irrigation in Africa is often inadequate for agriculture and hampers the continent's low agricultural productivity.

High population growth also raises a major risk of famine on the continent in the future. In fact, Africa has been experiencing strong demographic growth for some decades now. This poses the problem of a mismatch between the population to be fed and the resources available. With a projected population of 2.2 billion by 2050 and more than 4 billion by 2100, Africa is the only region where the maximum population size will not be reached this century: it will even expand beyond that (FAO, 2017). SSA is a region of Africa where demographic growth is among the fastest in the world. The population in this region could account for more than half of the world's demographic growth between 2019 and 2050, with a projected addition of 1.05 billion people. Here the population is growing at 2.8% per year, twice as fast as in South Asia, four times as fast as in East Asia and the Pacific, and around 50% faster than in the Middle East and North Africa region (Mabiso and Benfica, 2019). According to FAO estimates, the agricultural population of Africa is 530 million, with projections of 580 million by 2020. The population living from agriculture represents 48% of the total population (up to 70% in East Africa). As the world's population continues to grow at a sustained rate, demand for food, agricultural products and associated natural resources continue to rise. Population growth is putting considerable pressure on the agricultural sector to meet this growing demand. However, agricultural resources such as arable land, water and soil nutrients are limited, making it essential to improve agricultural productivity to achieve higher yields with fewer resources.

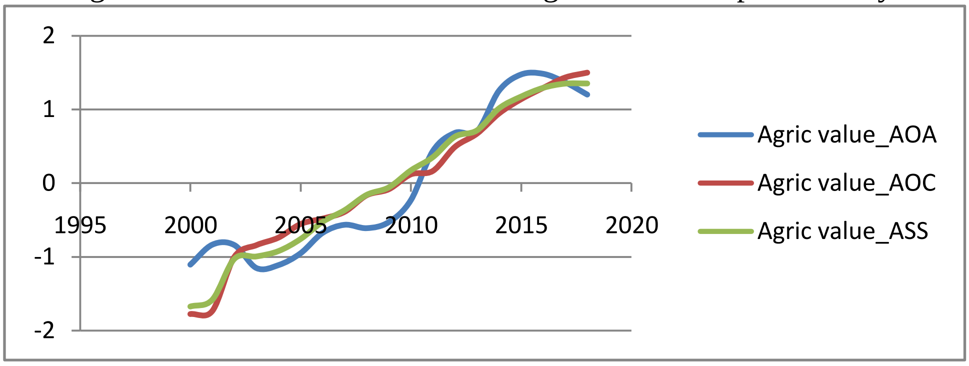
While it may seem trivial to establish a relationship between population growth and growth in the agricultural population, it is necessary to point out that this relationship is not always true. In the light of the demographic dividend, and within the theoretical framework of multi-sectoral models linking the cohabitation of a modern sector and a traditional sector in the economy, the increasingly young population may turn away from the traditional sector in favor of the modern sector. The aim of this study is to establish the link between demographic growth and agricultural productivity. This is an important contribution to literature in two ways. First, to our knowledge, no paper has analyzed this link focusing on the African context. Secondly, we use original empirical methods to evaluate the contribution of the population growth to agricultural productivity.

The rest of this paper is organized into four sections. The first presents the African agricultural sector and its performance. The second section reviews the literature, both theoretical and empirical, on the role that population growth can play in agricultural productivity. The third section presents the statistical and econometric tools used to examine this relationship in the context of sub-Saharan Africa. Finally, we will conclude this study by presenting and discussing the results, as well as the economic policy implications arising from them.

2. **Some facts about agricultural productivity in Sub-Saharan Africa**

Agricultural productivity is of crucial importance to African economies, particularly for food security. In Africa, a large proportion of the population depends on agriculture for its livelihood. It is also important for poverty reduction and job creation. Agriculture is often the main economic sector in many African countries, employing a large proportion of the rural population. However, among the developing regions, Sub-Saharan Africa has the lowest level of agricultural productivity. The following figure shows the evolution of agricultural value added in Sub-Saharan Africa between 1995 and 2020. To correct for problems of scale, the data has been brought back to the same scale. To do this, they have been centered and reduced.

Figure 1: Trends in agricultural productivity by region

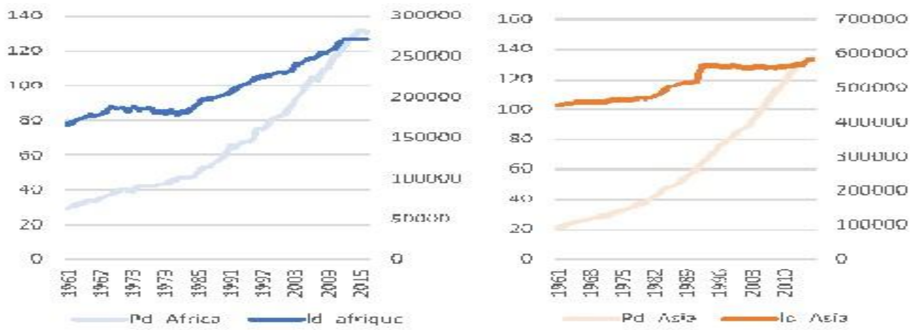


Source: author

Firstly, agricultural productivity in SSA remains well below that in other developing regions. This low level of agricultural productivity in SSA can be explained by the low level of R&D funding in this area. Virtually all countries spend less than US$100 million on agricultural research, with only Nigeria and South Africa, the largest economies in the sub-region, spending more than twice that amount, i.e. $200 million, on agricultural research and development.

Secondly, the low level of infrastructure is weighing on regional agricultural productivity. Non-agricultural expenditure is a key element in the growth of the agricultural sector. Consequently, good management of this expenditure remains a priority. Growth in agricultural activity is closely linked to the quality of infrastructure in rural areas, including: access to water, access to energy, asphalted roads, railway lines, storage facilities and even ICT.

Figure 2: Evolution of land and agricultural production in Africa/Asia



Source: Fao data (2020)

The figure suggests that in Sub-Saharan Africa (SSA), agriculture employs 60% of the working population, with the exception of the countries of Southern Africa, a few oil-producing countries in the Gulf of Guinea, and notable exceptions such as Nigeria, Côte d'Ivoire and Cameroon, where agriculture employs half or more of the working population (World Bank, 2015).

According to FAO estimates, the agricultural population of Africa is 530 million, with projections of 580 million by 2020. The population living from agriculture represents 48% of the total population (up to 70% in East Africa). Over the last 30 years, African agriculture has differed from the rest of the world in its ability to absorb a large proportion of the working population. Despite this particularity, the African agricultural production model differs significantly from the dynamics observed in Latin America and Asia.

3.Literature review

Major works in development economics have highlighted the role that population growth can play in explaining agricultural production. Some works analyze the impact (positive or otherwise) of population growth on resource use (traditional and new population theories).

For classical economists, sustainable production cannot keep pace with rapid population growth. This theory is based on the work of Malthus in 1914. For the proponents of the Malthusian thesis, demographic pressure would lead to growing food dependency and could result in population progressivity, either through famines, migrations or wars. In the modern version of this theory, famine gradually replaces the rural exodus when there is an imbalance between agricultural profitability and the satisfaction of people's needs.

Malthus asserts that the population increases at a geometric rate, while the food supply increases linearly. As the population increases, it will at some point outstrip the food supply, leading to a decline in living standards. Malthus then assumes a diminishing return from increasing the labor force for a fixed area of land.

This Malthusian theory was widely discussed and criticized in the 19th and early 20th centuries by numerous authors and theorists. Karl Marx rejected this theory, arguing that overpopulation was relative and had nothing to do with the means of subsistence as such, but rather with the way in which they were produced.

In the same vein, the theory of populationism ran counter to Malthusianism. For its precursors, notably F. Quesnay and J. Bodin, people are the strength of a nation, and the more they increase in number, the more production will follow, making the country all the more powerful. In other words, population growth is a permissive factor in economic growth and wealth creation.

Boserup (1965) proposed a theory according to which demographic growth would stimulate technological innovation and the adoption of intensive farming practices. According to her, when the population increases, farmers are encouraged to find ways of increasing food production to meet growing demand. This highlights the role of demographic pressure in the development of agriculture. For Boserup, a rapidly growing population is not necessarily a problem if the available resources are used optimally.

Brown et al (1987) state that many developing countries are stuck in the intermediate stage of demographic transition (high birth rate and low death rate). The resulting high population growth rate has strained the carrying capacity of many countries, leading to environmental degradation. Countries find themselves in a "demographic trap", i.e. they cannot move to the final stage of the demographic transition because they are caught in a vicious circle where high population growth is necessary to ensure the viability of the economy.

With regard to resource degradation, some economists, using arguments from the natural sciences, argue that population growth and the unequal distribution of wealth are the fundamental causes of land degradation.

Empirically, numerous studies have demonstrated the contribution of agricultural productivity to food security. Averbeke and Khosa (2007), following their study in rural South Africa, concluded that the food security of the populations studied would be reduced if they did not farm, especially for the extreme poor.

At a national level, Talbot (1989) studies soil degradation in Kenya, particularly in arid and semi-arid lands that are mainly used for livestock farming. He argues that pastoralists have traditionally expanded their herds onto new land as their populations have grown. Now that there is no more unused land, due to the increase in the number of farmers and pastoralists, the growing populations are putting pressure on land resources. As the capacity of the land is exceeded by the number of cattle and people, overgrazing and soil erosion are inevitable.

Bloom et al (1998) examined data from 123 countries and found that population growth had a positive impact on agricultural productivity. The authors suggested that the growing demand for agricultural products associated with population growth stimulated investment in agriculture, the adoption of modern agricultural technologies and increased productivity.

Similarly, Pinstrup-Andersen and Herforth (2008) analyzed data from 116 countries and confirmed a positive correlation between population growth and agricultural productivity. The authors stressed that population growth can stimulate agricultural modernization, the adoption of sustainable practices and improved access to agricultural resources and technologies. These empirical studies, among many others, suggest that there is a link between population growth and agricultural productivity, although the precise mechanisms of this relationship may vary depending on the regional context and the specific characteristics of agriculture.

4. Data and methods

In this section, we will describe the various statistical and econometric tools that will enable us to analyze the impact of population growth on farmers' productivity in the context of sub-Saharan Africa. Thus, we will begin by presenting the model that will serve as our basis.

Derivation of the model

Assuming that the output of this sector (O) depends on physical capital (K) and human capital (H) and labor (L), we formulate the following Cobb-Douglas agricultural production function:

$$O = AK^{\alpha}H^{\beta}L^{\gamma} \qquad (1)$$

In this expression, the term A refers to farmers' productivity (taking total factor productivity as the indicator of productivity). Our hypothesis here is that the latter is a function of the population in the agricultural sector. As a result, we can write the following equation:

$$A = \pi POP^{\delta}$$

The empirical analysis consists of estimating two equations, both derived from the previous agricultural model. The first stage of our analyses will consist of a static analysis. The second stage consists in a dynamic model analysis. the equations to be estimated take the following form:

$$O = a_{it} + \beta_0 K_{it} + \beta_1 H_{it} + \beta_2 POP_{it} + \gamma X_{it} + \square_{it} \qquad (3)$$

$$O_{it} = a_{it} + \beta_0 O_{it-1} + \beta_1 K_{it} + \beta_2 H_{it} + \beta_3 T_{it} + \gamma X_{it} + \square_{it} \qquad (4)$$

$\square_{it}$ refers to the error term. The matrix X is a matrix of exogenous variables.

Overall, we can retain the same form for the µ-error term. The term now captures β-convergence, i.e. the rate at which output tends towards its mean value (here, this is the intra-individual mean). For the convergence process to begin, this coefficient must be negative.

Description of variables

Dependent variable

The variable O captures Agricultural value added per worker: this variable is an indicator of labor productivity in this sector. As a tool for inter-country comparisons, it is an imperfect indicator of labor productivity in the agricultural sector because it assumes that all workers have access to the same capital stock and that they operate plantations of the same size. We will consider the value added per worker in current dollars. The relative data are taken from the World Bank (WDI, 2015).

Variables of interest

- Life expectancy at birth: this measures the effects of improved living conditions in SSA on agricultural productivity.

- Rural population and number of mobile phone lines (as a proportion of the population): Africa has seen a massive rural exodus and a growth in the urban population. We test the effects of this development on agricultural productivity.

- The working population: another important demographic change in Africa is the rejuvenation of the population. As a result, a major part of the population is active. This should normally enable the continent to benefit from a significant demographic dividend. We test the existence of a demographic dividend in the agricultural sector in SSA.

Control variables

- Farm size: it seems to be increasingly accepted in the specialised literature that there is an inverse relationship between farm size and productivity, particularly in developing economies. We will further test the validity of this hypothesis in the context of African economies. Since our logic is macroeconomic, the following variables will allow us to capture farm size: the number of hectares of arable land per person and agricultural land (as a proportion of total land).

- Agricultural technology: farms using technology should be more profitable than others. Therefore, we capture technology by the proportion of fertiliser products used per 1000km2 of arable land

- Household welfare: well-nourished and healthy workers should perform better. We integrate this aspect into our analysis by considering the variables household consumption (as a proportion of GDP) which captures the level of household income and migrant remittances received.

- Political stability: political stability and peace are important for economic activity.

Data

Our sample is composed of 20 Sub-Saharan African countries over the period 2000-2018. The choice of sample is justified by the availability of data. The series used are all taken from the World Bank's development indicators (WDI, 2020). As the variables do not have the same scale, using them as they are could have led to aberrant results with very high coefficients, thus biasing the results. To deal with this problem, we centered and reduced these series using the following transformation:

$$X'_{it} = \frac{X_{it} - \overline{X}_i}{\sigma_i}$$

With $\overline{X}_i$ the mean of the annual data in the series for country i and σ_i the standard deviation for each country. The following table shows the descriptive statistics for some of these series.

Table 1: Descriptive statistics for variables

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
utipesticide_sd	437	-.74346	5.692903	-44.6120	3.274204
AgricVA_sd	437	-.125586	1.166501	3.851914	2.416674
GHI_sd	437	-3.0e-07	.9744441	-3.03464	2.311381
Stabpo_sd	437	1.628236	7.931139	-36.5152	24.13825
Emploiagri_sd	437	-16.3479	14.23048	-64.4823	4.463189
Acceselect_sd	437	-5.09192	4.872405	-24.9979	-1.41589
arabeland_sd	437	.0133178	.9613355	-3.29348	2.474782
Pop15à64_sd	437	-.03078	.9850248	-2.38257	3.369406
Popru_sd	437	-.007621	.9853101	-3.18553	4.03816
Espevie_sd	437	-.001118	.9885746	-2.74178	2.97247

Before estimating this relationship, we tested the existence of unit roots in our series. To do this, we performed the Pesaran (2003) test. This test has the advantage of taking inter-individual dependence into account. This test is a generalisation of the IPS test, since it is based on an average IPS-type statistic called CIPS, for Cross-Sectionaly Augmented IPS.

This test shows that almost all our series are not stationary at level, but at first difference. In our estimates, we have therefore taken them in first difference.

Estimation methods

To estimate the first equation, we will use traditional estimators for traditional panel models. However, these estimators do not take into account the risk of endogeneity between variables. Economic variables are generally linked by bidirectional causality. We have therefore chosen the Generalized Equation Estimator (GEE), the Generalized Least Squares (GLS) estimator, the Constrained Least Squares (CLS) estimator and the Random Effects (GLS) estimator.

5. Discussion of results

The following table presents the estimates of equation 2.4. It is composed of three columns. The first column presents the demographic and traditional determinants of agricultural productivity. In the second column, macroeconomic variables are added. Finally, in the last column, we introduce institutional variables.

Table 2: Determinants of agricultural productivity in SSA

VARIABLES	(1) AgricVA_stad	(2) AgricVA_stad	(3) AgricVA_stad
Espevie	0.333***	0.111***	0.239***
	(0.0796)	(0.0793)	(0.0776)
Popru	-0.262***	-0.447***	-0.648***
	(0.0822)	(0.0764)	(0.0747)
Pop15_ 64ans	-0.289***	-0.294***	-0.269***
	(0.0543)	(0.0485)	(0.0476)
Emploidanslagri	0.0129**	0.0275***	0.0246***
	(0.00657)	(0.00663)	(0.00676)
utipesticides_Std	0.0535***	0.1077***	0.0169***
	(0.0111)	(0.0107)	(0.00105)
arabeland_stad	0.0468	-0.0839	-0.110**
	(0.0577)	(0.0529)	(0.0520)
Acceselectricité		0.00284	0.0153
		(0.0196)	(0.0200)
PIB		0.555***	0.585***
		(0.0615)	(0.0604)
GHI		-0.393***	-0.584***
		(0.0613)	(0.0729)
Stabpol			0.0479***
			(0.0104)
Constant	0.115	0.315*	0.251
	(0.146)	(0.177)	(0.180)
R2	0.765	0.798	0.816
Wald (prob)	0.000	0.0001	0.000
Observations	437	437	437
Number of code	23	23	23

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author

Overall, the results are stable regardless of the estimator or the human capital indicator considered. Indeed, the signs of the coefficients are, for the most part, the same. The same is true of the coefficients whose values change little from one model to another. In fact, both the R-squared and the Wald statistic are associated with probabilities of less than 1%. In addition, the coefficients associated with each variable change very little from one column to another. The same is true of their significance level. This demonstrates the robustness of our estimates.

The results also suggest that the traditional determinants of agricultural productivity remain valid in the context of Sub-Saharan Africa. For example, pesticide use is positively and significantly correlated (at the 1% level) with agricultural productivity in SSA. The same is true of the agricultural employment variable. In relation to demographic variables, the results suggest that life expectancy at birth positively and significantly explain agricultural productivity in SSA. Medical advances and improved living conditions in Africa have greatly improved people's health and life expectancy. These advances have an impact on people's ability to work harder and longer. This result is in line with those obtained by Djoumessi (2018) in the same context.

However, demographic changes do not only have a positive effect on agricultural productivity in SSA. Thus, the results suggest that rural population is negatively correlated with agricultural productivity in this context. As the bulk of agricultural production and the agricultural population are obtained on small rural holdings, the strong internal migration of rural populations to the cities is greatly reducing agricultural employment. This results in a significant drop in the productivity of farms in rural areas, and also in the abandonment of certain family farms when all the living family members move to the towns. This result is in line with multi-sector theories that see two sectors coexisting in the economy.

Similarly, the results suggest that the working population reduces agricultural productivity in the region. Indeed, as the African population is essentially young and lives in urban agglomerations, they are mainly employed in the tertiary sector. This obviously reduces agricultural employment. Another explanation is the strong demographic growth in Africa, which increases the gap between agricultural production and the real needs of the population.

Finally, the results show that the quality of political institutions has a positive impact on agricultural productivity in SSA. The coefficients associated with the political stability variable are positive and significant at the 1% level.

Robustness tests

In order to test the robustness of these results, we first changed

estimation method. We estimated the previous model using the Generalized Least Squares (GLS) and GEE estimators. The results of the robustness test are shown in Table 3.

Table 3: Robustness tests

VARIABLES	(GEE) AgricVA_stad	(MCG) AgricVA_stad
utipesticides_Std	0.0523***	0.0302***
	(0.0111)	(0.00488)
arabeland_stad	0.488***	0.644***
	(0.0575)	(0.0744)
Popru_stad	-0.258***	-0.306***
	(0.0832)	(0.0887)
Pop15Ã 64ans_stad	-0.289***	-0.267***
	(0.0542)	(0.0576)
Espevie_stad	0.323***	0.236***
	(0.0803)	(0.0821)
AcceselectricitÃ©_Stad	0.0112	-0.00489
	(0.0201)	(0.00827)
Stabpo_stad	0.0170***	0.0661***
	(0.00924)	(0.00865)
Constant	-0.0435	-0.128*
	(0.142)	(0.0758)
Observations	437	437
R-squared		0.210
Wald (prob)	0.000	0.000
Number of code	23	23

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, the estimates are robust and consistent with previous results. The signs of the coefficients and their significance did not change from one technique to another. The same is true of the magnitude of the coefficients.

Evaluation of transmission channels

We then assessed the channels through which demographic variables affect agricultural productivity in SSA. To do this, we constructed interaction variables between demographic variables (life expectancy, rural population, working population) and macroeconomic and institutional variables. We estimated these equations using the CGM estimator. Table 4 below presents the cross-effects of life expectancy. Table 5 analyses the cross-effects of the agricultural population and Table 6 presents the cross-effects of the rural population and the control variables on agricultural productivity.

Table 4: Cross-effects of life expectancy and macroeconomic variables on agricultural productivity

	(1)	(2)	(3)	(4)	(5)
VARIABLES	AgricVA_stad	AgricVA_stad	AgricVA_stad	AgricVA_stad	AgricVA_stad
espvi_pbi	0.166***				0.159**
	(0.0569)				(0.0648)
espvi_stab		0.0343***			0.0409***
		(0.00686)			(0.00688)
espvi_pesti			0.0221***		0.0146*
			(0.00799)		(0.00812)
espvi_arable				0.148**	0.0969
				(0.0602)	(0.0683)
Constant	-0.224**	-0.0299	-0.121	-0.192**	-0.146
	(0.0936)	(0.0913)	(0.0899)	(0.0909)	(0.0957)
Observations	437	437	437	437	437
Number of code	23	23	23	23	23

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 **Source** : Auteur

Table 5: Cross-effects of farm population and macroeconomic variables on agricultural productivity

	(1)	(2)	(3)	(4)	(5)
VARIABLES	AgricVA_stad	AgricVA_stad	AgricVA_stad	AgricVA_stad	AgricVA_stad
agri_pbi	-0.0161***				-0.0188***
	(0.00223)				(0.00321)
agri_stab		0.000242			-0.000403
		(0.000305)			(0.000303)

agri_pesti			-0.00870***		-0.00554***
			(0.00161)		(0.00166)
agri_arable				-0.00822***	0.00709**
				(0.00250)	(0.00323)
Constant	-0.194**	-0.120	-0.0958	-0.133	-0.190**
	(0.0906)	(0.0887)	(0.0902)	(0.0880)	(0.0959)
Observations	437	437	437	437	437
Number of code	23	23	23	23	23

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 **Source** : Auteur

Table 6: Cross-effects of rural population and macroeconomic variables on agricultural productivity

VARIABLES	(1) AgricVA_stad	(2) AgricVA_stad	(3) AgricVA_stad	(4) AgricVA_stad	(5) AgricVA_stad
ruralp_pbi	-0.106**				-0.0976*
	(0.0486)				(0.0562)
ruralp_stab		-0.0340***			-0.0366***
		(0.00713)			(0.00705)
ruralp_pesti			0.0213**		0.0270***
			(0.00881)		(0.00869)
ruralp_arable				-0.109**	-0.107*
				(0.0523)	(0.0607)
Constant	-0.192**	-0.0207	-0.0983	-0.179**	-0.0930
	(0.0912)	(0.0921)	(0.0905)	(0.0896)	(0.0959)
Observations	437	437	437	437	437
Number of code	23	23	23	23	23

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 **Source** : Auteur

These results suggest that life expectancy positively affects agricultural productivity in SSA through the channels of market size (captured by GDP), political stability and pesticide use. Improved life expectancy amplifies the positive effects of political stability and the size of the economy on agricultural productivity.

In relation to the agricultural population, the results suggest that the decline in the agricultural population reduces the positive effects of GDP, pesticide use and political stability on agricultural productivity in SSA. Finally, rural-urban migration reduces the positive effect of GDP and political stability on agricultural productivity.

6. Conclusion

In the context of African economies south of the Sahara, agriculture is an essential link in the economy. However, compared with other regions, sub-Saharan Africa has low agricultural productivity. And yet, a significant proportion of the region's population still suffers from malnutrition and is exposed to famine. It is therefore important to look for ways and means of improving productivity, and hence agricultural production, in this region. One way of doing this is to take advantage of SSA's population potential. As Boserup (1965) argues, SSA could use this potential for technological innovation and improve its agricultural productivity to meet ever-increasing demand.

The aim of this paper was to analyze the importance of demographic change in explaining agricultural productivity in a sample of 24 Sub-Saharan African countries between 2000 and 2018. In other words, the aim was (i) to analyze the balance between the increase in agricultural productivity and the increase in population, and (ii) to analyze population growth as an opportunity or a constraint for agricultural productivity.

Our various estimates show that pesticide use is positively and significantly correlated (at the 1% threshold) with agricultural productivity in SSA. They also show that life expectancy at birth positively and significantly explain agricultural productivity in SSA. This means that the more the population increases, the more men are available for agricultural labor. This relates to the theory of human capital.

The rural population is negatively correlated with agricultural productivity, reducing agricultural employment as rural populations migrate in search of better living conditions.

It is therefore incumbent on public decision-makers to increase the number of financial support programs for young people in order to limit the brain drain and encourage agricultural employment.

References :

Aker, J. (2011) "Dial A for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries." Agricultural Economics. Vol 42 (6). PP. 631-47.

Averbeke, W. V & Khosa, T. B. (2007). "The contribution of smallholder agriculture to the nutrition of rural households in a semi-arid environment in South Africa" Walter SA 33(3).

Bloom, D. E., Sachs, J. D., Collier, P., & Udry, C. (1998). Geography, demography, and economic growth in Africa. Brookings papers on economic activity, 1998(2), 207-295.

Bloom, J. S., Frail, D. A., & Kulkarni, S. R. (2003). Gamma-ray burst energetics and the gamma-ray burst Hubble diagram: promises and limitations. The Astrophysical Journal, 594(2), 674.

Boserup, E. (1981). Population and technology (Vol. 255). Oxford: Blackwell.

Brown, J. K., & DeByle, N. V. (1987). Fire damage, mortality, and suckering in aspen. Canadian Journal of Forest Research, 17(9), 1100-1109.

Chavula (2014), "The role of ICTs in agricultural production in Africa", Journal of Development and Agricultural Economics, vol6, pp. 279-289.

Djoumessi, Y. F., & Bergaly Kamdem, C. (2020). Water Use Input and Agricultural Productivity Growth in Sub-Saharan Africa.

Mabiso, A., & Benfica, R. S. (2019). IFAD RESEARCH SERIES 61: The Narrative on Rural Youth and Economic Opportunities in Africa: Facts, Myths and Gaps. Myths and Gaps (December 4, 2019).

Malthus, T. R. (1914). An Essay on Population: By TR Malthus. Dent.

Mellor, J. W. (1995). Agriculture on the road to industrialization. Baltimore, MD: Published for the International Food Policy Research Institute.

Nin Pratt, A., Yu, B., & Fan, S. (2008). The total factor productivity in China and India: new measures and approaches. China Agricultural Economic Review, 1(1), 9-22.

Pinstrup-Andersen, P., & Herforth, A. (2008). "Food security: achieving the potential;" Environment, 50 (5).