

Agricultural dynamics and food security in Senegal

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Abstract

The objective of this paper is to analyze the dynamics of the Senegalese agricultural economy and the food security. Analysis of secondary data shows that agricultural growth is low over the period 1961-2014. The average annual growth rate is 6.3% and conceals large disparities between periods. This evolution leads to low production and agricultural productivity. Hence the contribution of agriculture in value creation at the national level to a downward trend. From more than 24% in 1987, it rose to 18% in 2016, when other sectors are becoming more productive.

The food security is analyzed largely through the environment of the agricultural sector from the point of view of the production of its various parameters. According to the prevalence of undernourishment measured from the minimum dietary energy requirements and the global hunger index, food security is improving more and more from 1992 to 2016. The IFM increases from 19.7 points in 1996 to 13.8 in 2016, but does not yet allow Senegal to leave the zone of insecurity "serious". There is also a linear decline in the prevalence of undernourishment over the period 1992-2016.

Key words: Agricultural economics, Food security, agricultural growth

I. Introduction

The agricultural sector is an important lever of the national economy. The strategic dimension of the sector in terms of food security and the promotion of macroeconomic balances, in addition to the large share of the population directly dependent on it, make agriculture a key sector for the economic and social development of a country.

Senegal has 755,532 farming households living mainly in rural areas (ANSD, 2013). However, Senegalese agriculture remains unproductive in view of the poor performances it has recorded for decades. The sector employs about 73.8% of the rural population, concentrates 28% of the labor force and paradoxically provides only 7.8% of production (DPEE, 2013).

This poor productivity performance has negative effects on food security due to the close link between agriculture and food security (Berthé and Keita (2009), Faye et al (2007), Diallo et al (2013)). This concept of food security was the subject of a long discussion at the World Food Summit in Rome in 1995. This definition of food security was adopted: "Food security is ensured when all people at all times have economic, social and physical access to sufficient, safe and nutritious food that meets their nutritional and dietary preferences to enable them to lead active and healthy lives".

There are four components to food security: food availability, accessibility, stability and use.

- ❖ The availability of food products remains difficult to control because of low production, which depends on factors such as rainfall, access to land and inputs, soil richness, and so on. In addition, in Senegal, most producers are smallholders. In fact, 82.1% of farming households cultivated less than 5 parcels during the 2012-2013 season (ANSD, 2013). Thus, at the individual level the availability in kilocalorie per person on average and that in kilogram per person becomes low. This largely justifies the lack of matching between supply and demand for food products.
- ❖ The issue of access to food is highly dependent on availability but also on market structure and consumer income. In his famous analysis of famine, Sen (1981) argues that every individual must enjoy the "right to food" and this depends, among other things, on his income and the property he owns. Sen's (1981) analysis shows that in addition to the food supply, demand factors are important for ensuring food security at the individual level (Harrigan et al, 2012). The higher the income increases in the consumer, the more he tends to demand more value in the food product requested.
- ❖ Regarding the third component, namely stability, we find that arable land for irrigation is very low in Senegal and represents less than 5% of total arable land in the period 2000-2016; which raises the food dependency rate and makes the country sensitive to exogenous food shocks as was the 2008 food crisis. The variability of food supplies by \$ I and Kcal is low over the period 2000-2016.
- ❖ For use, there is progress on access to improved sanitation services (78.5% in 2015 according to FAO, 2018) and the level of access to improved water services (47, 6% in 2015 according to FAO, 2018).

Thus, the problem of food insecurity is of a certain acuity and would be difficult to control without efficient agriculture. The typology of cultures is thus problematic. In fact, practiced crops remain mainly food (91%). The main industrial crop remains groundnuts (75%) (RGPHAE, 2013). These crops are grown mainly in winter (58.1%). The farmer relies on winter logging revenue from 3 to 4 months to deal with 12 months of expenses. This situation makes vulnerable actors in the sector who also face the hazards of climate change.

Thus, the objective of this research is to analyze the dynamics of agriculture and the record of food security in Senegal.

II. Literature review:

Many authors consider that agriculture is responsible for feeding the population and providing income to the whole value chain. Thus, theoreticians of the agricultural economy have focused on the importance of studying upstream factors of agricultural production. The first theories attributed the increase in agricultural production to changes in factors such as land, labor and capital. Other factors are also important for increasing production and especially productivity. According to Douillet and Girard (2013), this is the climatic context (which is a non-controllable factor), available technologies, agricultural practices and public policies that can directly or indirectly affect the agricultural sector.

In poor countries, the agricultural sector is the main activity of rural households. The latter practice agriculture to satisfy the subsistence needs first and foremost. Badouin (1971) finds three main channels to

demonstrate that the growth of agricultural production is a prerequisite for the economic development of a country:

- ❖ First, it allows the economy to cross the "hunger threshold". This channel eliminates the risk of famine and raises the level of the food ration. Food availability, accessibility and nutritional quality have a positive impact on human resources;
- ❖ It then allows the "isolation threshold" to be exceeded. The part of the production not consumed represents a marketable surplus. With such a surplus, the agricultural sector enters into relations with urban and external markets and actively participates in the "monetization of the economy";
- ❖ The growth of agricultural production finally allows the "threshold of stagnation" to be exceeded. The surplus income generated in agricultural production constitutes savings that, invested productively, will bring about further progress for both agriculture and the rest of the economy.

According to Diallo et al. (2013), increasing productivity and agricultural production are a sure way of ensuring food security and improving living conditions in rural areas. Similarly, "the improvement of agricultural performance helps to reduce the food expenditure of urban households through the fall in prices of basic necessities". The gain from a surplus income is, however, allocated to non-agricultural product expenditures. As a result, the performance of the agricultural sector leads to the economic transformation of goods and consequently to the basket of urban and rural households. This abundance and this fall in prices benefit the criterion of access to food products for both urban and rural households.

Rostow's (1960) work on the stages of economic growth highlights this interdependence between agriculture and the secondary sector. According to Rostow, economic development cannot be successful without a successful transition from the agricultural economy to the industrial economy. Indeed, the agricultural economy guarantees the satisfaction of the livelihood needs of rural households and consequently reduces poverty and food insecurity.

In the same way the cost of materials falls for the manufacturer in addition to the regularity of stocks. Thus, the price of the food product drops for the household. This increases his income and even that of the worker who benefits from an increase in hours of work.

Based on Engel's law that "the income elasticity of demand for food products is less than 1, productivity improvement in agriculture benefits the industry," Bertheliet et al. (2005) state that the decline in agricultural prices is not fully absorbed by an equivalent increase in demand for agricultural products; it thus refers to industrial products.

Mellor (1976) analyzes the importance and vitality of agricultural productivity growth. As the non-farm population steadily increases with increasing demand for food, agriculture, through productivity, is expected to grow at a near-pro rata pace to meet demand. This might answer Malthus' (1798) concern that the population would increase in geometric progression if it is not controlled, while the subsistence would only increase in arithmetic progression. For Malthus, for example, "the happiness of a country depends on the extent to which the annual increase in population is close to the annual increase in agricultural production."

From the agriculture-poverty relationship, Valdès (2007) defines three transmission channels "namely the labor market, farm income and food prices". Developed agriculture provides a considerable increase in the

level of employment both directly in the agricultural sector and indirectly in the industrial sector. This increases the level of incomes not only of farmers but also of industrial and therefore the wealth of rural and urban households. The third channel of Valdès is central in the fight against food insecurity.

In a document of the Department of International Development (DFID¹, 2004), the authors, looking for the linkages between agriculture and poverty reduction, find four "transmission mechanisms" namely: (i) the direct impacts of poverty; improvement of agricultural performance on rural incomes; (ii) the consequences of lowering the price of food for the rural and urban poor; (iii) the contribution of agriculture to growth and the creation of economic opportunities outside the sector; (iv) the fundamental role of agriculture in stimulating and sustaining economic transition, when the sector ceases to occupy first place in a country (and in the livelihoods of the poor) and gives way to more variety of processing and services (Cervantes-Godoy, D. and J. Dewbre (2010).

Thus, according to the literature, agricultural growth has a significant positive impact on a country's economic development and food security.

III. Dynamics of the Senegalese agricultural economy

III.1. Agricultural growth

The agricultural sector must feed the population, provide income to farmers, create jobs and self-employment, provide foreign exchange to the economy and supply the industrial sector with raw materials. From 1961 to 2014, agricultural production generally grew in a linear fashion. From 1,887,159 tons in 1961, it rose to more than 5,397,755 tons in 2008, maximum production. Production then drops to 4,268,097 tons in 2014². During the period 1961-2014 the annual average production is 2 921 502 tons.

Cereals represent on average 35% of the production over the period 1961-2014. Legumes and sugar follow with respectively 29% and 16% on average. The groundnut sector with unshelled groundnuts dominates the legume group with an annual average of 94% of the production of this group of products.

In the early 1960s, production was driven by the groundnut industry, which averaged 38.6% of the total over the period 1961-1984 and 27.6% over the period 1961-2014. The period 1961-1984 was marked by the first agricultural policy which focused mainly on the groundnut sector. Several policies and strategies followed one another after the first agricultural policy, namely: the New Agricultural Policy for the period 1984-1994, the Agricultural Sector Adjustment Program (PASA) and the sectorial policy letters for the period 1994-2000, the agricultural policies of the post-occupation period of 2000 such as the LOASP, the REVA plan and the GOANA. PRACAS is the agricultural policy of the second political alternation of 2012.

Despite the agricultural policies implemented, the annual growth rate of production has been fluctuating and averaged 6.3% between 1961 and 2014.

¹ Department for International Development is an executive department of the UK government responsible for humanitarian aid and international development assistance

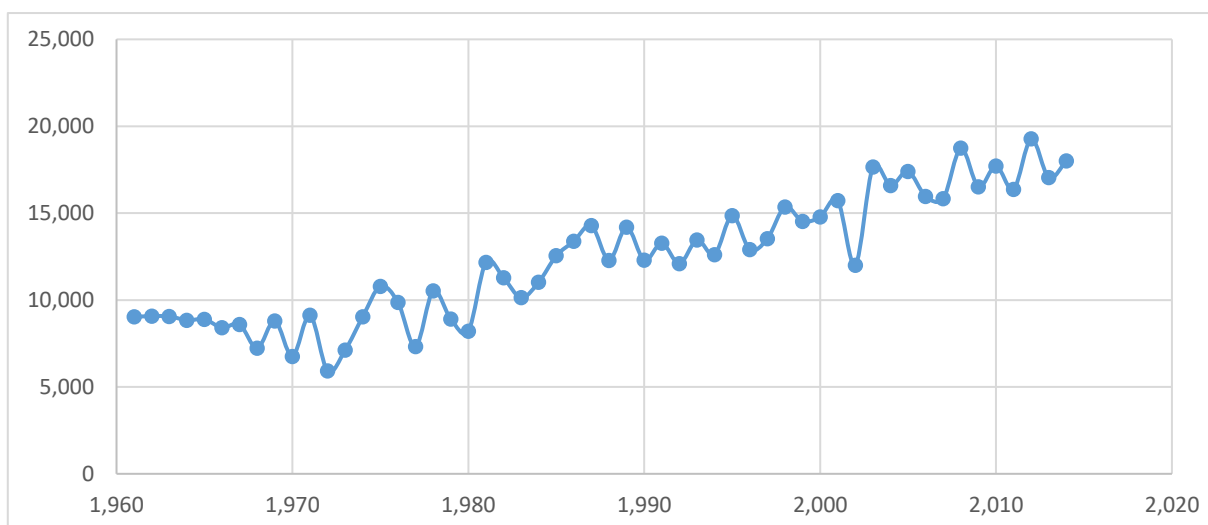
² FAOSTAT, 2018 and author's calculations

The annual growth rate of agricultural production hides large disparities from one year to the next. There are glorious moments of increase (39.4% in 1971, 27.5% in 1974, 37.7% in 1999, 36% in 2003 and exceed the threshold of 40% in 1978, 1981 and 2008) and periods down to below zero percent (down from 20 to 40 percent in 1970, 1972, 1977, 1979, 1983, 2002 and 2011). This makes it difficult to maintain stable growth in agricultural production.

There is more stability in the other sectors than agriculture, which concentrates a larger share of the population. From 1961 to 2016, on average, the growth in agricultural value added was 2.58% at a time when the industry grew on average by 3.81% and services by 3.09%. This is in line with Malassis (1973)'s analysis that "the growth of non-agricultural production is higher than that of agricultural production in general". The intensification of factors for better agricultural productivity is becoming a priority.

Agricultural productivity refers to the ability of farmers to better combine inputs to maximize outputs. The average agricultural yield over the 1961-2014 period is 12,298 hg / ha. The average annual growth rate of returns is 1.3%. Agricultural yield, in this graph, gives us the production of one hectare of land in hectogram. The maximum yield was recorded in 1972 at 5914 hg / ha and the highest yield in 2012 at 19273 hg / ha.

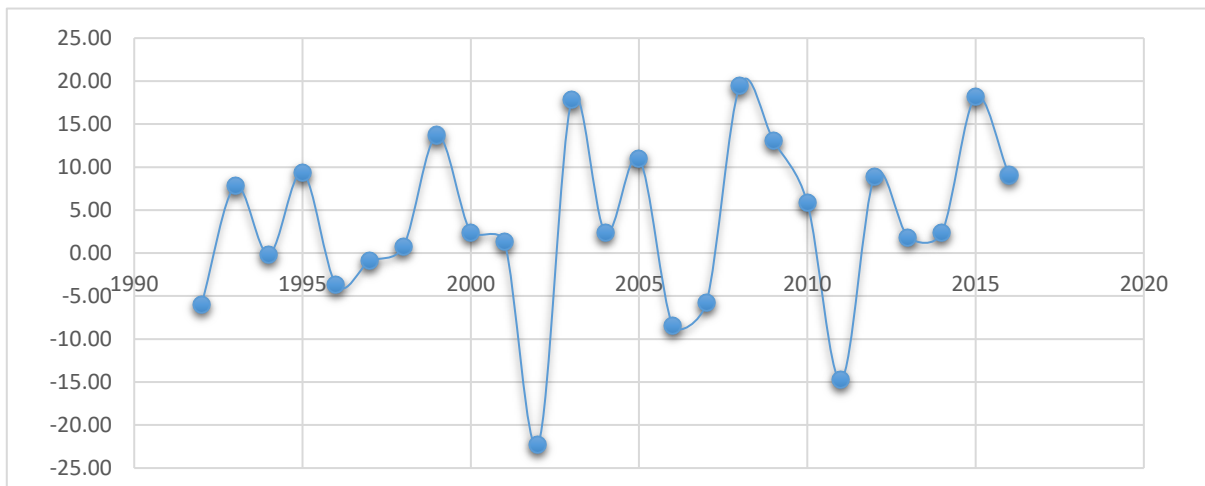
Fig. 1: Agricultural yield (hg / ha)



Source: FAOSTAT, 2018 and author's calculations

Agricultural value added is another measure of agricultural performance. It makes it possible to analyze the efficiency of the output and the efficiency in the use of the factors. The following graph shows a saw-tooth pattern of annual growth in agricultural value added. An increase in value added translates into increased production and farmers' incomes. A decline, especially a negative trend, reflects a very expensive remuneration of the factors and / or a low production linked to endogenous and exogenous factors.

Fig. 2: Agricultural value added (annual growth %)



Source: FAOSTAT, 2018 and author's calculations

This difficulty in maintaining stable growth in agricultural value-added leads to a decline in the share of agricultural value added in GDP. From 1980 to 2016, agriculture represents on average 18.83% of the national production.

The state can act in favor of the peasants by granting subsidies in agricultural equipment or inputs. The problem in this case lies in the implementation of these subsidy policies. Depending on the area harvested, the annual average is 2 368 836 ha from 1961 to 2014. The harvested area was 2,091,235 ha in 2016. This rate multiplied only 1,137 times to reach a modest 2,378,273 ha. 2014, in 54 years. This largely justifies the foreign dependence on food products to fill the gap that is widening further with the level of increase in demographics. In this context, Malthus's thesis that the population would increase in geometric progression, if it is not controlled, while the subsistence in arithmetic progression.

After the adoption of the LOASP in 2004, subsequent policies such as REVA and GOANA led to harvests of up to 3 123 469 ha. However, there is still a fall to 2,262,807 ha in 2012.

The availability of arable land is not fully cultivated. On average, from 1961 to 2014, harvested areas represent 75% of arable land. As a result, 25% of the average arable land in this period is not harvested and therefore not well exploited.

On average, arable land represents 16% of the country's land area. Their average annual growth rate is almost zero (0.003) over the period. This is largely due to the fact that the available arable land exceeds the demand for land for crops or pastures. In fact, agricultural land represents on average 46% of arable land over the period 1961-2015, with an average annual growth rate of almost zero (0.001). The use of arable land for permanent crops and pastures is low. For example, 54% of arable land is for temporary harvests or is not grown or used for grazing.

From the 1980s, the quantity of seeds decreased, partly because of the droughts experienced during these periods, combined with massive rural exoduses. In 1997, this amount was 102,871 tonnes, which is approximately the same amount of seed used in 1961. This decline follows the same trend to reach a lower level in 2014 with 873 38 tonnes of seed being grown.

In summary, the dynamics of rising agricultural growth are timid. Despite the sector's stakes in the fight against poverty, on the part of the population that depends directly or indirectly on it and food insecurity, its share in GDP does not allow to respond proportionally to the demand of the actors. The food balance sheet is analyzed largely through the environment of the agricultural sector from the point of view of agricultural production but also of the agricultural population.

III.2. Food balance sheet

One of the priority objectives of the agricultural sector is to ensure sufficient and regular production. But it is not enough to guarantee food security, which has four components: food availability, accessibility, stability and use. As a result, food security becomes multidimensional and difficult to identify through an aggregate indicator. However, there are proxy indicators that provide information on the overall food security situation in a country.

Food availability is not simply a matter of self-sufficiency but rather a market supply of food products in line with demand. From independence to the present day, production and imports are increasing while exports are falling. Between 1960 and 2013, agricultural production grew by 113%, imports by 648%, and exports by 38%. The weakness of the exports can be explained by the low level of the cultivations of exploitation which represent 9% against 91% for the food crops (ANSD, 2013).

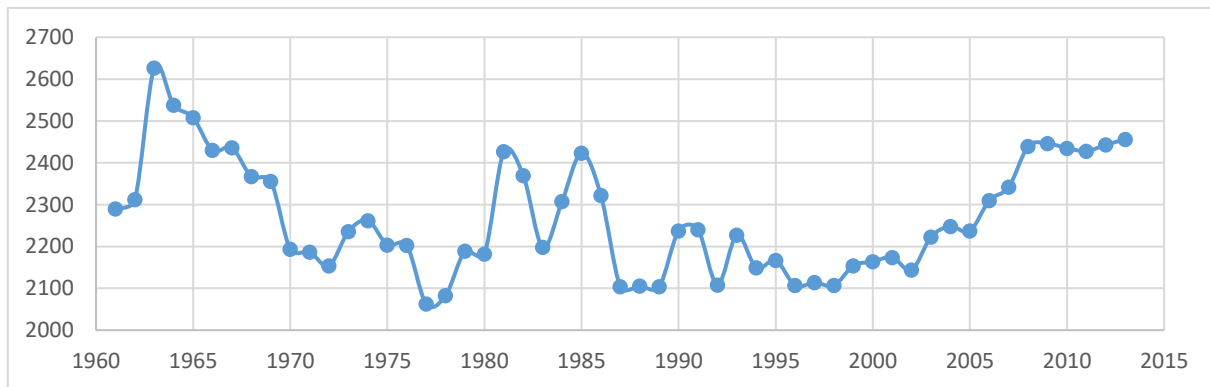
After the independence, this availability, which is 415 kg / person in 1961, increases to 466 in 1965. Very quickly we reached a decrease of 385 in 1970 because of the droughts of the 70's. The latter continue to exert their after-effects alongside structural adjustment policies and trade liberalization for the next three decades. In 2000, with the new political alternation and the priority given to agriculture, there is a linear upward trend in individual availability.

Senegal records a slight change in food availability in kg / person, compared to Brazil. The latter has a strong linear trend upwards regarding its food availability in kg / person. From 498 kg/person in 1961, it is 669 in 2011.

Another parameter for measuring food security via its "availability" facet is the minimal food energy requirement. It is estimated in kilocalories per person per day. Food energy requirements differ by gender and age, and for different levels of physical activity. As a consequence, the minimum food energy requirements, the amount of energy required for light activity and the minimum acceptable weight for the size reached, vary by country and year according to the distribution of the population by gender and age (FAO, 2008). The WAEMU countries are in the range 1700 - 1780 from 1990 to 2008, the last year of updating these indicators. Senegal's minimum energy requirements are 1740 Kcal / person / day in the years 1990-92, then 1750 in 1995-02 and finally 1760 in the period 2006-08.

Food availability in Kcal / person / day is above average for all periods and follows trend of availability in kg / person / day. This comes down to the crucial importance of good agricultural production.

Fig. 3: Food availability in kilocalories (Kcal / person / day)



Source: FAOSTAT, 2018 and author's calculations

Cereals represent on average 62% of total supplies and 68% of plant products. Rice alone occupies on average 27% of the total food supply and 29% of the availability of plant products. Millet occupies a significant place in Senegalese consumption. It is on average 16% of global availability and 18% of those related to plant products. However, it should be noted that the contribution of this product decreased by 65% from 1961 to 2013.

At the level of animal products, meats bring in Kcal / person / day on average annual 35% and dairy products 28% on total animal products. However, the caloric intake of dairy products has a downward trend of 41% over the period 1961-2013 while meat increases by 19% over the same period.

In Senegal, the food self-sufficiency rate (CAS) averaged 82.8% over the period 1961-2013. Its evolution has a downward trend over the period. From 1961 to 2013 the CAS decreased by 33%. The analysis shows that the country has higher self-sufficiency rates in animal products than in plant products. On average, the CAS of animal products is 90.7%. This rate knows a relative increase of 16% over the period 1961-2013. However, the plant-based TAS has a rate of change of -39%. For these plant products, the CAS average is 81.6%.

The State may decide to increase availability through agricultural production (supply-side policy) or to improve the distribution or accessibility of resources (demand policy). Analyzing the level of accessibility involves questioning the markets, trade policies, the level of inflation, household income, the level of infrastructure, etc. The level of GDP / hbt can be an indicator that influences overall accessibility. It allows, among other things, to track the purchasing power of the household.

GDP per capita (2011 constant international PPP \$) is evolving positively in a linear fashion (Figure 26). From \$ 1907.6 in 2000, Senegal rose to \$ 2,380.4 in 2016, a relative increase of 24.8%. This jump is due to a relative average annual growth of 1.4% per year from 2000 to 2016.

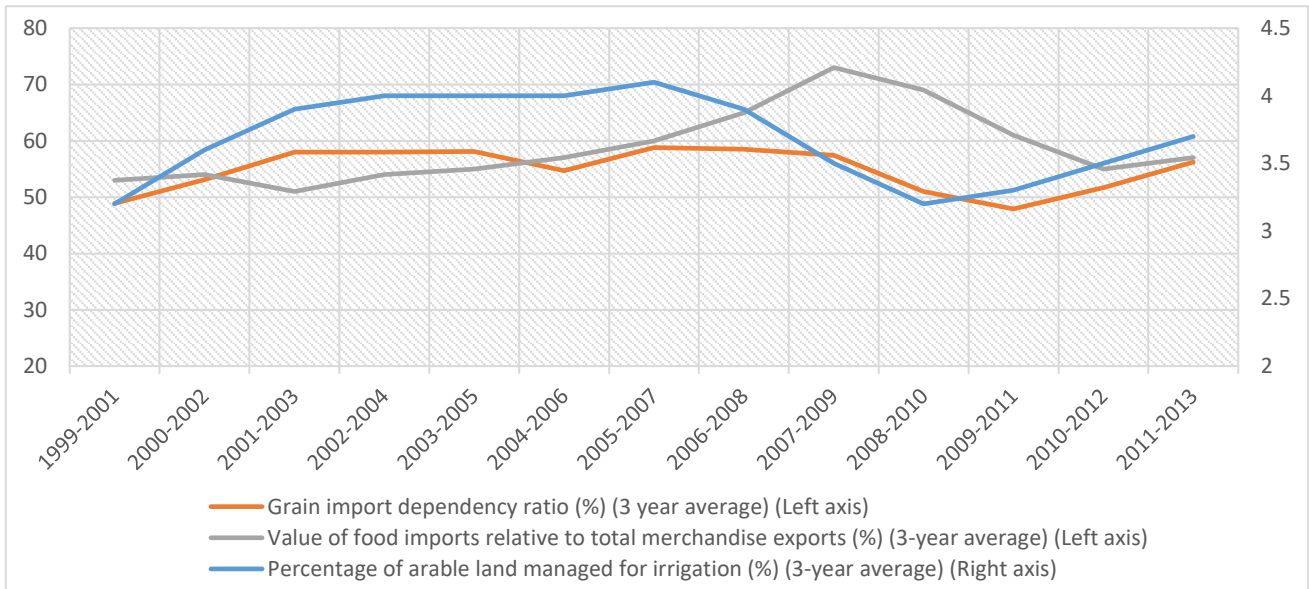
From the point of view of stability, the measurement indicators may relate to dependence on cereal imports, on the value of imports over total merchandise exports, on the percentage of arable land managed for irrigation and / or on the variability of food availability.

Apart from the years 2008 - 2010, there is an evolution, albeit a weak one, of the first three indicators. Arable land for irrigation is very low in Senegal and represents less than 5% of total arable land in the period 2000 - 2016. The period 2008 - 2010 corresponds to the world food crisis which did not spare

Senegal. From 2007 to 2010, the percentage of arable land managed for irrigation decreased by 22%, from 4.1% to 3.2%.

The rate of food dependency is growing. This makes the country vulnerable to exogenous food shocks as was the 2008 food crisis. This compromises food stability.

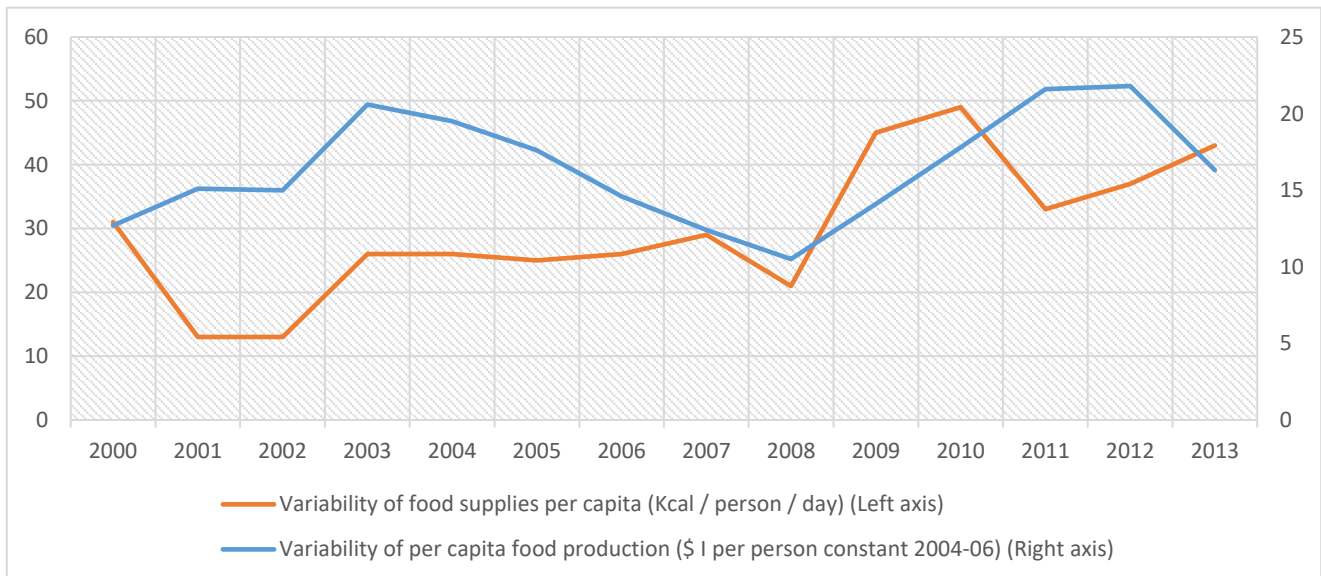
Fig. 5: Stability of food products



Source : FAO (2018) et calculs de l’auteur

Food availability does not change steadily. The variability of food supplies by \$ I and Kcal is low in 2008, the year of the food crisis with soaring prices at the international level. The following graph shows the resumption of variability in food availability from 2009 but with a decrease in variability in Kcal / person / day in 2011.

Fig. 6: Evolution of the stability of food products



Source : FAO, 2018 et calculs de l’auteur

Use, the ultimate source of food security, can be understood through household access to improved sanitation services, improved water sources, the percentage of children under 5 years of age being behind of growth, the percentage of children under 5 years wasted.

Access to improved sanitation services increased from 67.4% in 2000 to 74.1% in 2009 and 78.5% in 2015.

The level of access to improved water services is 40, 3% in 2000 to 44.6% in 2009 and 47.6% in 2015.

Senegalese households' access to improved sanitation and water services has an upward trend from 2000 to 2015. The former is growing by 18% in this 15-year period and the latter by 16%. Both have an average annual change of 1.12% and 1.02% for the same period 2000 - 2015. For the use there is an improvement, although slow, but almost stable in this period.

Several variables are used to assess in a comprehensive manner the state of food security in a given country. These variables aggregate several parameters related to food availability, accessibility, stability and use. The prevalence of undernourishment is one of the most commonly used variables in determining the proportion of the undernourished population.

In Senegal, the prevalence of undernourishment follows a downward trend from 1990 to 2016. From 24.5% in 90-92, this prevalence is 31.5% in 97 - 99 (highest rate in the period 1990 -2016). Then the prevalence rate declined gradually to a level of 10% in 2014-2016. This decline is on average 6% between 1998 and 2016.

This represents a clear step forward in the fight against food insecurity. Thus, improving food availability in Kcal / person / day and kg / person / day, leaps forward in utilization and stability, has implications for the prevalence of undernourishment at the national level.

The variable defined by IFPRI, the World Hunger Index (IFM), also remains one of the most used in economic analysis. A country whose index is greater than or equal to 30, with a level of hunger extremely alarming, seeks to improve its situation by aiming first at the level simply of alarming MFIs (between 20 and 29.9) then a level of Serious MFI (between 10 and 19.9) then a moderate MFI situation (between 5 and 9.9) and finally an almost zero hungry MFI situation with a low index (MFI <4.9).

From 1996 to 2001, Senegal was in a situation of "severe" hunger with an index of 19.7, 19.2 and 19.3 respectively in 1996, 2000 and 2001. It was close to an alarming level of hunger according to the scale above. From 2005, the index is 13.7, maintained almost until 2013. Thus, we approach the "moderate" situation.

This is a breakthrough in the march towards a control of food security in all these aspects: availability of food, accessibility, stability and use.

According to the prevalence of undernourishment measured from minimum energy requirements and the global hunger index, although not available for all years, Senegal's food balance sheet remains improved and tends towards a progressive situation allowing to eradicate little by little hunger. This improvement may be due to several factors endogenous to food security, such as the evolution of these different components or factors exogenous to these components, such as agricultural financing.

IV. Conclusion

In the underdeveloped countries, agriculture has as main mission to assure the subsistence of the peasants constituting the frankness of the most vulnerable population. This form of agriculture is highly family-based and easily exposed to uncontrollable factors such as climatic variations and inadequate agricultural policies. What is first sought is to cross "the threshold of hunger" (Badouin, 1971). After having crossed the threshold of hunger, agriculture makes it possible to increase the income of the producers and generally actors of the agricultural value chain, in favor of nonagricultural expenditures. Thus, at this level the stage of subsistence farming is reinforced by that of exploitation. The evolution of the process leads to crossing the "threshold of isolation" with the integration of foreign markets. Thus, one of the functions of the agricultural sector is to provide foreign exchange to the economy (Faye et al., 2007) through exports. Finally, developed agriculture can actively contribute to economic and social development by crossing the "threshold of stagnation" (Badouin, 1971). This level consists in positively and strongly impacting the economic growth of a country. This growth is a corollary to social development through the access of households to quality food products, competitiveness, the adequate and regular supply of the industrial sector, the reduction of unemployment.

Overall, agricultural growth has a weak upward trend over the period 1961-2014 (annual average production of 2 921 502 tonnes). The average annual growth rate is 6.3%. The weak evolution of agricultural growth has a negative impact on agricultural output and consequently on the level of food security. Thus, agriculture contributes to the national GDP. From more than 24% in 1987, its contribution rose to 18% in 2016, when other sectors are becoming more productive.

The food balance sheet, according to the prevalence of undernourishment measured from the minimum dietary energy requirements and the global hunger index, is improving more and more from 1992 to 2016. The IFM has gone from 19, 7 points in 1996 to 13.8 in 2016, but does not yet allow Senegal to leave the zone of insecurity "serious". There is also a linear decline in the prevalence of undernourishment over the period 1992-2016.

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