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EVALUATION OF THE ECONOMIC CONTRIBUTION OF HORTICULTURE IN CAMEROON: AN APPROACH USING THE VECTOR ERROR CORRECTION MODEL

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Abstract: *The heterogeneity of the agricultural subsectors leads to a disparity in their economic contributions which can be detrimental to the definition of optimal sectorial policies if it is poorly evaluated or ignored. The objective of this paper is to assess the contribution of the horticultural subsector to Cameroon's economic growth through a relatively innovative approach that combines statistical and econometric analyses. To do so, we mobilize two methods. The first estimates the value added of the horticultural subsector and its weight in GDP. The second analyse the interactions of horticulture with the industrial and services sectors using vector error-correction modelling. The results obtained show that Cameroonian horticulture, although very informal, has a relatively significant positive long-term contribution to the country's growth. However, its influence is greater in the services sector than elsewhere.*

JEL classification: C13, E17, O47, Q10

Key words: Horticulture, Economic Growth, Value Added, Gross Domestic Product, VECM model.

1. INTRODUCTION

In the economic literature, the debate on the notions of economic development and economic growth concerns whether or not qualitative variables should be taken into account in the construction of indicators (Berr and Harribey, 2005). For some, economic growth only uses quantitative indicators (which is the main criticism levelled at it), for others, economic development is more qualitative (Berr and Harribey, 2005). Moreover, while some believe that one can have strong economic growth without being developed, others believe that economic development would follow economic growth. In any case, it emerges from this debate that while economic growth is not a sufficient condition for a country's development, it is a necessary condition.

The founding work of Kuznets (1934) made it possible to establish a universal measure of the internal wealth of countries through the Gross Domestic Product (GDP) indicator, whose evolution over a period provides information on their economic growth. The calculation of this indicator has evolved over time, and three variants can be distinguished today: The expenditure approach, the revenue approach and the production approach (Banque Mondiale *et al.*, 2013). In this article, we focus exclusively on the production approach. In this approach, GDP refers to *"the sum of gross value added of the different institutional sectors and industries, plus taxes minus subsidies on products (which are not allocated to sectors and industries)"* (INSEE, 2016).

In Cameroon, an examination of the national accounts shows that GDP from a production perspective is broken down into several branches of activity grouped into three sectors: the primary sector (agriculture of food products, industrial and export agriculture, fishing, livestock, forestry), the secondary sector (extractive industries, agri-food industries, other manufacturing industries, etc.) and the tertiary sector, which includes all services (trade, restaurants and hotels, transport, warehouses, communication, banking and financial institutions, etc.). Moreover, statistics on the contribution of each of these sectors to GDP growth in recent years show that the tertiary sector is in first place (2.3 points in 2018, 2017 and 2.6 points in 2016), followed by the secondary sector (0.8 points in 2018, 0.3 points in 2017 and 1 point in 2016) and the primary sector (0.7 points in 2018, 0.4 points in 2017 and

0.7 points in 2016). GDP growth is estimated at 4.1% in 2018, 3.5% in 2017 and 4.6% in 2016 (INS, 2019).

However, although the primary sector (or the agricultural sector in the broad sense) is not the main contributor to GDP, it is nonetheless a key sector in Cameroon's economic development. The great informality of agricultural activities in Cameroon (Parrot *et al.*, 2008) could partly explain the low economic weight of the primary sector. Moreover, it should be noted that its implications in other sectors (secondary and tertiary) make the agricultural sector the basis of growth in Cameroon. However, these interactions are sometimes ignored in the evaluation of the agricultural sector's contribution to economic growth. It is therefore necessary to put these statistics, which are based essentially on formal activities and direct contributions, into perspective.

Furthermore, the fact that decisions taken on the basis of these aggregate statistics ignore the heterogeneity of the subsectors and thus the disparity of their economic contributions could be detrimental to the effectiveness and efficiency of the policies that support them. Indeed, if the disparity of the economic contributions (regardless of socio-cultural considerations) of the subsectors is systematically ignored, it is very likely that in this case the gap between the expected results and the results obtained from the policies implemented will widen further. However, if such information were available by subsector, commodity group or agricultural chain, the effectiveness of policies could improve. Indeed, this information will allow the definition of even more targeted sectorial development policies and therefore more efficient in terms of fund allocation.

For this study, we limited ourselves to the horticultural subsector, due to the multitude and great informality of the activities it generates. The objective of this paper is therefore, to assess the contribution of the horticultural subsector to Cameroon's economic growth through an approach that combines statistical and econometric analyses. The hypothesis is to assume that Cameroonian horticulture, given its nature and current level of development, contributes positively but marginally to economic growth.

It is therefore important, first of all, to briefly present in section 2 the situation of horticulture in Cameroon. Section 3 will present the materials and methods used, section 4 will discuss the results obtained and section 5 will conclude our study.

2. STATE OF HORTICULTURE IN CAMEROON

Horticulture is a generic[1] term that refers to all agricultural activities producing fruits, vegetables and flowers (Janick, 1972). However, in the absence of recent data on national flower production, we limit ourselves here to fruits and vegetables.

2.1 Presentation of the horticultural subsector

In Cameroon, horticulture is practiced in its five agro-ecological zones. However, according to the pedoclimatic characteristics of these zones, it is noticeable that horticulture is better developed in the southern part of the country than in the northern part. Moreover, these conditions mean that the cultivation of certain crops is relatively abundant in some areas rather than in others (MINAGRI, 1991). In addition, factors such as access to land, availability of water resources and the location of farms in relation to centres of high consumption (urban areas), influence the spatial distribution of the subsector (Temple *et al.*, 2006).

Horticultural production in Cameroon is carried out by three categories of farms: *peasant farms* (seedlings, small orchards) with an area of less than one hectare; *semi-industrial farms (*owned by former civil servants, elites or young graduates from the training centres of the Ministry in charge of agriculture) with an area of between four and ten hectares; and *industrial farms* (owned by large companies or multinationals such as the PHP (Plantations du Haut Penja) or the CDC (Cameroon Development Corporation)) with an area of more than ten hectares (MINAGRI, 1991).

These farms offer a wide range of fruits and vegetables (banana, pineapple, watermelon, papaya, citrus fruits, guava, mango, avocado, white pepper, tomato, green beans, onion, pepper, carrot, lettuce, etc.) and sometimes benefit from technical supervision thanks to the actions of the support services of the Ministry of Agriculture and Rural Development (MINADER), agricultural research institutes such as Institute of Agricultural Research for Development (IRAD), the International Centre for Agricultural Research for Development (CIRAD) of the International Institute of Tropical Agriculture (IITA). These enable the

[1] Contrary to the general idea that equates horticulture with the exclusive production of flowers.

country to increase its supply of horticultural products on the Central African sub-regional market.

With respect to marketing, the literature on the commodification of horticultural products addresses a multitude of issues: The low level of organization of stakeholders, the constraints of production, processing and marketing systems, the lack of information on farmers' product perceptions and consumer preferences (Ngo Nonga *et al.* , 2007). However, a diagnosis of the marketing of these products reveals a more or less anarchic character. Indeed, fruits and vegetables are sold in bulk either in local markets or along major transport routes. Cross-border trade in these products is often informal and involves neighbouring countries such as Gabon, Central African Republic, Equatorial Guinea, Congo, Chad and Nigeria (Nkendah *et al.*, 2012).

As far as consumption is concerned, Temple (2001) already mentioned that in Cameroon the consumption of fruits and vegetables is relatively low compared to the standard required (i.e. about 400g of fruits and vegetables per day and per person) by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). One of the main reasons for this low fruit and vegetable consumption is the population's eating habits (Ganry and Le Guilloux, 2007). Nevertheless, the awareness and information campaigns observed here and there have led to an improvement in this situation compared to the 1980s.

2.2 Socio-economic implications of horticulture

In Cameroon, horticulture is involved in various socio-economic aspects.

In terms of food and nutrition security, horticulture increases food availability and generates income that allows for the acquisition of other products. This improves food and nutrition security, especially in rural areas (Temple, 2001). In addition, regular consumption of fruits and vegetables reduces the risk of chronic diseases such as obesity, diabetes, cardiovascular diseases and certain cancers (CIRAD, 2009).

In terms of the fight against unemployment and poverty, horticulture constitutes an employment opportunity for young people and women (IRAD, 2013). The substantial income obtained from these activities enables farming households to improve their living conditions and reduce poverty (Temple, 2001).

In terms of increasing value added, horticulture is one of the high value-added activities. Indeed, fruits and vegetables are among the five most income-generating speculations of family farms (IRAD, 2013). Thus, in principle, an increase in productivity and an improvement in the competitiveness of this subsector would contribute to significantly increase the overall value added of the economy. However, the significant informality of this subsector in Cameroon (Parrot *et al.*, 2008) could underestimate its contribution to economic growth.

Despite all this, and in view of the dynamics observed in this subsector, we have every reason to believe that the horticulture is (or will be in the near future) an important lever for economic growth in Cameroon, especially since it can influence or interact with the secondary and tertiary sectors of the economy.

3. MATERIALS AND METHODS

The data used in this study are secondary and come from a variety of sources. Data on gross production of fruits and vegetables come from FAOSTAT; data on value added in local currency in the agricultural, industrial and service sectors, GDP and conversion factors from the international dollar to local currency come from the World Development Indicators (WDI) database. Intermediate consumption coefficients are calculated from Cameroon's National Accounts data.

Furthermore, depending on the availability of data for as many horticultural products as possible, our analysis was conducted over a 27-year period (1990-2016). We use Eviews 8.0 for our estimates and Excel 2010 for preliminary data processing and graphs.
The approach adopted combines two distinct but complementary methods. The first involves descriptive statistics, while the second uses econometrics.

3.1 The statistical method

The statistical method is adopted by most national statistical and economic institutes. The weight of a sector in the formation of a macroeconomic aggregate (e.g. GDP) is estimated.

Several studies use this method to determine the importance of a sector in the constitution of a country's wealth. However, authors such as Eba'a Atyi et *al.* (2013) and the cabinet JUDICOME-JEXCO (2004)[2], distinguish two levels of analysis: a macroeconomic analysis which evaluates the weight of the sector in macroeconomic aggregates (GDP, employment, etc.) and a microeconomic analysis which evaluates the impact of the sector's activities on the individual incomes of farmers (producers, processors, traders). Here, we retain only the macroeconomic approach. We estimate the weight of the horticultural subsector (**W_{ss}**) in the GDP per year using the following formula:

$$W_{ss}\ (\%\ of\ GDP) = \frac{Value\ Added\ of\ the\ subsector}{GDP} \times 100 \quad (1)$$

The evolution of this proportion expresses the subsector's effort to boost economic growth. Moreover, even if the calculation of this proportion seems simple, estimating the value added of the horticultural subsector remains a major challenge. The main difficulty lies in the fact that small horticultural operators, who are the majority in the subsector, do not keep regular and regulatory accounts. This does not allow us to have a precise enough idea of the amount of intermediate consumption. To get around this difficulty, we have made a hypothesis in this paper. We assume that the value of intermediate consumption represents a fixed coefficient of the value of output. Its formalization is presented as follows**:**

$$IC_t = \alpha P_t \quad (2)$$

This hypothesis has already been put forward in several similar works, notably those of MAHRH (2007), Kaboré et *al* (2005) and DEPF (1998). As a result, the value added then becomes:

$$VA_t = P_t - IC_t$$

$$VA_t = P_t - \alpha P_t$$

$$VA_t = (1 - \alpha)P_t \quad (3)$$

[2] Cabinet JUDICOME - JEXCO/January 2004/ Study for the elaboration of the development plan of the fruit and vegetable sector/ Final report. Study carried out at the request of the Ministry of Agriculture, Hydraulics and Fishery Resources of Burkina Faso.

Where: α is the technical coefficient

VA is the added value;

P is the production in monetary value;

IC is the intermediate consumption;

t is the date of the time series.

Although they provide an idea of the direct contribution of a sector of activity to the economy, the estimated relative weights are not sufficient to fully capture the influence of that sector on each segment of the economy. Indeed, it may happen that the economic weight of a sector is not very significant in relative terms, but its influence on other sectors (e.g. the industrial and services sectors) has a considerable impact on economic growth. In this case, an econometric analysis is necessary.

3.2 The econometric method

The econometric approach is in great demand to measure the influence of a sector on the economy. Traditional econometric models already estimated such influences, but considered the sector in question to be exogenous and the relationships were simultaneous. There is no reason to believe that this is the case, hence the criticisms of these types of models by Granger (1969) and Sims (1980).

Fortunately, recent developments in time series econometrics have led to the development of new models, including VAR (*Vector Autoregressive*) models. These models correct the limitations of previous models (Bourbonnais, 2003). VAR models are generalizations of Autoregressive models (AR(p)) to the multivariate case, and do not make in principle, a restrict on the exogenous nature of the variables. They can take the form of a simple VAR model, an error-correction model (ECM) or a vector error-correction model (VECM) depending on whether or not one or more co-integration relationships have been detected. These models have been used by Yao (2000) to assess the contribution of agriculture to the Chinese economy, by Katircioglu (2006a) to estimate the impact of agriculture on the growth of the industrial and service sectors in the northern part of Cyprus, as well as on its economic growth (Katircioglu, 2006b).

In our case, the aim is to estimate the influence of the horticultural subsector characterised by its value added (VAH) on the economic performance of the industrial (VAI) and services (VAS) sectors. The model of our study is then specified as follows:

$$\begin{pmatrix} D^iVAH_t \\ D^iVAI_t \\ D^iVAS_t \end{pmatrix} = \begin{pmatrix} C_1 \\ C_2 \\ C_3 \end{pmatrix} + \sum_{p=1}^{P} \theta_p \begin{pmatrix} D^iVAH_{t-p} \\ D^iVAI_{t-p} \\ D^iVAS_{t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix} \quad (4)$$

Where: VAH= value added of horticultural subsector;

VAI= value added of industrial sector;

VAS= value added of services sector;

t= date of the period;

C = vector of constants;

Θ(4,4) = Matrix of model parameters ;

ε *= vector of the error terms;*

D = series differentiation operator;

i= number of times the series is differentiated;

p = number of delays.

The estimation procedure then consists of testing the stationarity of the variables, testing their co-integration, verifying their causality, regress the identified model, and performing some shock simulations on the values of the variables (impulse response functions and variance decomposition).

4. RESULTS AND DISCUSSIONS

The results of the study are presented in terms of the estimated economic weight of the horticultural subsector by year and the influence of the subsector on the performance of the industrial and services sectors.

4.1 Economic weight of the horticultural subsector

From simple calculations of proportions made on the production and intermediate consumption data of Cameroonian GDP (production perspective), we have determined an approximate average technical coefficient of intermediate consumption ***α*≈0,4** (*Table 1*). This coefficient allowed us to estimate the value added of the horticultural subsector and its weight in agricultural value added and GDP per year (*Table 3*). However, it should be noted that the estimation of horticultural value added was based only on a few speculations (*Table 2)* and refers only to direct value added (i.e. only production).

Table 1 - Estimate of the technical coefficient of intermediate consumption (IC)

Year	1993	1994	1995	1996	1997	1998	1999
Interm. Cons. (IC)	2020.22	2471.85	3078.91	3182.29	3466.69	3473.59	4080.71
Production (P)	5415.39	6234.92	7289.06	7710.46	8385.83	8829.02	9797.99
alpha (α = IC/P)	**0.37**	**0.39**	**0.42**	**0.41**	**0.41**	**0.39**	**0.41**

2000	2001	2002	2003	2004	2005	2006	2007
4117.81	4690.73	4756.15	5202.22	5489.51	5797.7	6146.3	6614.6
10232.28	11202.7	11761.03	12531.74	13230.62	13885.3	14788	15635.2
0.4	**0.41**	**0.4**	**0.41**	**0.41**	**0.41**	**0.41**	**0.42**

2008	2009	2010	2011	2012	2013	2014	2015	2016
6685.3	6687	6992.8	10 566.90	11 064.80	11 261.60	12 105.40	12 485.50	12 464.10
16317.9	16871.6	17828.4	23 543.70	25 005.90	26 283.70	28 207.10	29 313.60	30 040.20
0.4	**0.39**	**0.39**	**0.44**	**0.44**	**0.42**	**0.42**	**0.42**	**0.41**

Source: Authors' calculations (data are taken from Cameroon's national accounts (INS, 2012; 2017))

Table 2 - List of speculations used in the calculation of horticultural value added.

Fruits	Vegetables
Pineapples, Avocados, Bananas, Dates, Figs, Fresh fruit, Citrus fruit, Mangoes, Mangosteen and Guavas, Coconuts, Grapefruit and pomelos, Papayas, Watermelons.	Eggplant, cabbage and other brassicas, Cucumber and gherkins, Ginger, okra, Fresh vegetables, Dried onions, Sweet and spicy pepper, Hot peppers, fresh sweet pepper, Leek and other alliaceous vegetables, Pepper (subspecies piper), Potatoes, Fresh tomatoes.

Source: FAOSTAT 2018

Table 3 - Horticultural Value Added and Weight in Agricultural Value Added and GDP

Year	VAH (xaf)	VAA (xaf)	W. hort (%VAA)	GDP (xaf)	W. hort (%GDP)
1990	34926185646	7.44819×10^{11}	4.69	6.79541×10^{12}	0.51
1991	38423955795	7.15027×10^{11}	5.37	6.5366×10^{12}	0.59
1992	39076299585	7.57928×10^{11}	5.16	6.33396×10^{12}	0.62
1993	56158037302	8.51968×10^{11}	6.59	5.83155×10^{12}	0.96
1994	63202776192	9.0102×10^{11}	7.01	5.95541×10^{12}	1.06
1995	67664563674	9.01909×10^{11}	7.50	6.16205×10^{12}	1.10
1996	68157282277	9.5082×10^{11}	7.17	6.43078×10^{12}	1.06
1997	66012564363	9.77085×10^{11}	6.76	6.76719×10^{12}	0.98
1998	67422203263	1.02826×10^{12}	6.56	7.07187×10^{12}	0.95
1999	79577585462	1.08688×10^{12}	7.32	7.3754×10^{12}	1.08
2000	84229578860	1.13738×10^{12}	7.41	7.63747×10^{12}	1.10
2001	84114127232	1.20849×10^{12}	6.96	7.97108×10^{12}	1.06
2002	89085691896	1.24481×10^{12}	7.16	8.30883×10^{12}	1.07
2003	90901157320	1.21682×10^{12}	7.47	8.68831×10^{12}	1.05
2004	92986091182	1.31315×10^{12}	7.08	9.27747×10^{12}	1.00
2005	1.04469×10^{11}	1.333×10^{12}	7.84	9.46493×10^{12}	1.10
2006	1.12697×10^{11}	1.32379×10^{12}	8.51	9.7922×10^{12}	1.15
2007	1.18939×10^{11}	1.384×10^{12}	8.59	1.02722×10^{13}	1.16
2008	1.29841×10^{11}	1.43816×10^{12}	9.03	1.06306×10^{13}	1.22
2009	1.45348×10^{11}	1.44956×10^{12}	10.03	1.08643×10^{13}	1.34
2010	1.58048×10^{11}	1.53249×10^{12}	10.31	1.12362×10^{13}	1.41
2011	1.69466×10^{11}	1.57246×10^{12}	10.78	1.17001×10^{13}	1.45
2012	1.82526×10^{11}	1.63002×10^{12}	11.20	1.22317×10^{13}	1.49
2013	1.91246×10^{11}	1.74451×10^{12}	10.96	1.28927×10^{13}	1.48
2014	1.82462×10^{11}	1.85243×10^{12}	9.85	1.36514×10^{13}	1.34
2015	1.90899×10^{11}	1.95042×10^{12}	9.79	1.44229×10^{13}	1.32
2016	2.08761×10^{11}	2.08346×10^{12}	10.02	1.50648×10^{13}	1.39

Source: Authors' calculations

However, the results obtained show that the fruit and vegetable subsector generates significant revenues in Cameroon. Indeed, in absolute terms, the subsector generates an added value of at least XAF 34 billion each year. But in relative value, this subsector is not very significant. Over the study period (1990-2016), it contributes at most 11% of agricultural value added (VAA) and at most 1.5% of GDP (*Table 3*). This proportion is insignificant in view of the number of speculations retained, compared to the only Cocoa and Coffee crops that have a relatively large contribution.

Furthermore, an analysis of the evolution over time of the economic weight of the horticultural subsector in agricultural value added and GDP (*Figure 1*) allows several observations to be made.

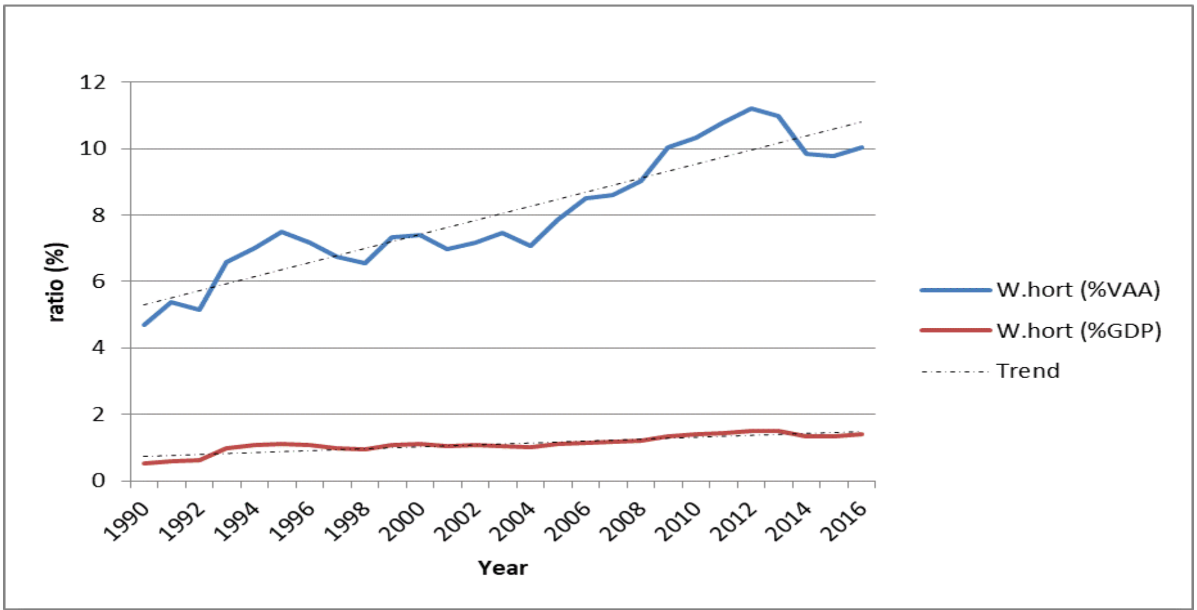

Fig. 1 - Evolution of the weights of the horticultural subsector in GDP and VA of Agriculture

The share of the horticultural subsector in agricultural value added is unstable and oscillates in the range 4 - 11%. This fluctuation is linked, among other things, to the strong dependence of agricultural production on climatic hazards. The variability of quantities is also reflected in prices. However, this relative contribution tends to increase over time (*Figure 1*).

On the other hand, we note that the share of the horticultural subsector in the formation of GDP is more stable and relatively constant over time (around 1%). This stability is mainly due to the value added of the industrial and services sectors incorporated in GDP, which dampens the fluctuations observed in the agricultural sector.

The calculation of the economic weight of the horticultural sector and the analysis of its evolution over time, while providing information on its economic performance, is however not sufficient. Indeed, such an analysis only gives us the direct contribution or simply the weight of the subsector in the economy, but does not give us its impact or likely influence on the performance of other sectors (industrial and services), or the interactions that may exist between them. Therefore, in order to further assess the subsector's contribution to economic growth, supplementary econometric analysis is required. This assesses the interactions through the shock simulations.

4.2 Influence of the horticultural subsector on the performance of the industrial and services sectors

The evaluation of the impact on industrial and services value added of a shock in the horticultural subsector, reflecting the effect of a policy to improve productivity and/or competitiveness in this branch, was possible thanks to vector autoregressive modelling (VAR). The main results of the estimation procedure showed, firstly, that the variables are all integrated of order 1 (*Table 4*). There is therefore a risk of co-integration of the series. The co-integration between the variables was confirmed by the two-stage test of Engel and Granger (1987) and the Johansen Trace test (1988). The latter identified two co-integrating relationships between the variables. We then specify a vector error correction model (VECM (p)) rather than a VAR (p) model.

In addition, four information criteria, with the exception of the Schwarz criterion, were used to select an optimal delay $P = 2$. We therefore estimate a VECM (1) whose specification is given as follows:

$$\begin{pmatrix} DVAS_t \\ DVAH_t \\ DVAI_t \end{pmatrix} = \begin{pmatrix} C_1 \\ C_2 \\ C_3 \end{pmatrix} + \begin{pmatrix} \alpha_1 & \beta_1 \\ \alpha_2 & \beta_2 \\ \alpha_3 & \beta_3 \end{pmatrix} \begin{pmatrix} \varphi_1 & \varphi_2 & \varphi_3 \\ \theta_1 & \theta_2 & \theta_3 \end{pmatrix} \begin{pmatrix} VAS_{t-1} \\ VAH_{t-1} \\ VAI_{t-1} \end{pmatrix} + \begin{pmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ d_1 & d_2 & d_3 \end{pmatrix} \begin{pmatrix} DVAS_{t-1} \\ DVAH_{t-1} \\ DVAI_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix} \quad (5)$$

Table 4 - Unit Root Tests and Order of Integration

Serial	ADF statistical test[3] P-value.	ADF test equation P-value Regressors	Const.	Trend	Decision
VAH	0.9193	0.3065	0.1099	0.1796 (6)	I(1)
DVAH	**0.0247****	0.0008*** 0.1358 (4)	0.1967	0.2190	
VAI	0.9962	0.0171 (4)			I(1)
DVAI	**0.0325****	0.0414**			
VAS	0.0524*	0,0016***	0,0238**	0,0000*** (6)	I(1)
DVAS	**0,0498****	0,0016***	0,3829	0,0507*	

*significant at 10%; ** significant at 5%; *** significant at 1%.

D: first-order differentiation

I (1): integrated of order 1

(6): model with trend; (5): model with drift; (4): model without drift

Source: *Authors' tests*

Estimation of the parameters of this model by the maximum likelihood method gives the following results (*Table 5*).

Table 5 - Estimation and significance of VECM (1) coefficients

Explanatory variables	***DVASt :*** [1] Coef.	t-stat.	Prob.	***DVAHt :*** [2] Coef.	t-stat.	Prob.	***DVAIt :*** [3] Coef.	t-stat.	Prob.
α	-0.400***	-2.819	0.010	0.008	1.329	0.199	0.192**	2.645	0.015
β	9.945***	4.029	0.000	-0.19*	-1.864	0.077	1.439	1.137	0.269
$DVAS_{t-1}$	0.410**	2.182	0.041	-0.001	-0.136	0.893	-0.113	-1.181	0.252
$DVAH_{t-1}$	2.930	0.503	0.620	0.377	1.531	0.142	-5.712*	-1.915	0.070
$DVAI_{t-1}$	0.553**	2.266	0.035	0.004	0.431	0.670	0.49***	3.948	0.000
C	5.3×10^{10}	0.928	0.364	4.3×10^{9}	1.798	0.088	9.2×10^{10}	3.150	0.005

Source: Our estimations *, **, *** significant at 10%, 5% and 1% respectively

[3] *NB: the hypothesis of the ADF test is H0: the series has a unit root (non-stationarity hypothesis)*

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Coat rack test and Lagrange multiplier test indicate a lack of autocorrelation of the residues. The Jarque-Bera test concluded that the residues were normal. White's test reveals their non-heterosedasticity. These tests thus validate our model. Moreover, most of the adjustment coefficients (***α*** and ***β***) are significantly different from zero and have the expected signs.

In addition, two long-term relationships between horticultural value added and services value added on the one hand, and horticultural value added and industrial value added on the other hand, were obtained from the estimates:

***VASt-1 = 1.22×1012 + 32.447VAHt-1*:** [4]

***VAIt-1* = 8.63×1011 + 15.34 *VAHt-1*:** [5]

In both equations, we observe a positive relationship between the variables. This means that in the long term, the economic performance of the horticultural subsector positively and significantly influences (p-value < 0.001) the economic performance of the industrial and services sectors.

However, a careful analysis of the estimation results (*Table 5*) reveals that, in the short-term dynamics, the previous horticultural value added only influences industrial value added at the 10% threshold. However, this influence is negative (-5.712) which is surprising. Moreover, horticultural value added seems not to be influenced by its past values (P-value = 0.142). Furthermore, we find that the past value added of the industrial and service sectors have no influence on the present value added of the horticultural sector (p-value is 0.670 and 0.893 respectively). This suggests that in the short term there is a relative disconnection between the horticultural sector and the other sectors. The Granger causality test in the VECM confirms these results. However, analysis of the residue covariance matrix reveals that there is more instantaneous causality between the variables than delayed causality. This therefore explains the significant influence of horticultural value added in both long-term relationships. Furthermore, the fact that in the short term horticultural value added negatively influences industrial value added can be understood in at least two ways: first, in Cameroon the industrial sector is made up of formal modern industries and artisanal industries (very often informal) that limit the processed quantities of horticultural products (Temple, 2001). Thus, when the value added of artisanal industries increases (following an improvement in horticultural value added), this translates into a loss of value added in modern industries, which are the ones for which we have data. Secondly, the fact that we have a small sample of data does not guarantee the robustness of the estimates.

The analysis of impulse response functions (*Figure 2*) obtained from the Cholesky decomposition highlights the effects of any possible policy to improve profitability. This reveals that an innovation (shock) that is driven in the horticultural subsector has an immediate effect in the industrial and services sectors.

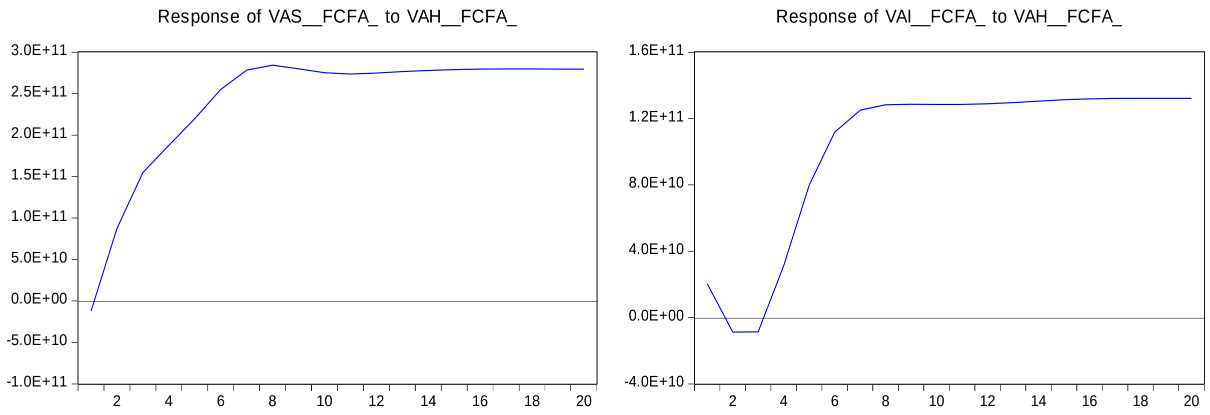

Fig. 2 - Impulse response functions

On the value added of services, the effect is initially negative before becoming positive from the second period onwards. It then increases until the seventh period, when it peaks, before stagnating throughout the following periods. However, the magnitude of the impact is large.

On industrial value added, the effect of the shock is initially positive before declining and becoming negative during the second and third periods. This effect becomes positive again from the fourth period onwards and increases continuously until the seventh period, when it reaches its maximum and then stagnates.

The magnitude of the impact appears to be greater in the services sector than in the industrial sector. This reflects the fact that the majority of horticultural products are traded in their natural state. Therefore any improvement in the profitability of the horticultural subsector improves the economic performance of the services sector much more. This is evident from the above long-term relationships (the marginal propensities of VAS and VAI are 32.45 and 15.34 respectively). The variance decomposition of the forecast error variance of the model's variables confirms this result. Indeed, in the long run, innovations (shock) in the horticultural subsector account for 78% of the variance of VAS and 76% of the variance of VAI. Therefore, a shock on the value added of the horticultural subsector has a greater impact on the value added of the service sector than it does on the value added of the industrial sector. On the other hand, a shock in the services sector has a greater impact on the forecast of horticultural value added (20%) than a shock in the industrial sector (1%). The interaction of the horticultural subsector with the tertiary sector is therefore much more important than it is with the secondary sector.

The results obtained then partially validate our research hypothesis. Indeed, although it appears that the horticultural subsector contributes marginally to the formation of GDP, it nevertheless influences more or less significantly and instantaneously the economic performance of the industrial and services sectors in the long term. Thus, in Cameroon, the contribution of the horticultural subsector to economic growth is complex and depends on its very informal nature. The main consequence of this informality is the lack of reliable data.

5. CONCLUSION

In this paper, the contribution of the horticultural subsector to Cameroon's economic growth was assessed using an approach that combines statistics and econometrics. The interest was to provide more relevant information for better decision-making in the framework of sectorial development policies. At the end of the statistical estimation, it appeared that the Cameroonian horticultural subsector has a marginal weight in the formation of GDP. On the other hand, econometric analysis shows that this subsector has, in the long term, a relatively significant positive influence on the value added of the industrial and services sectors. These results thus partially validate our research hypothesis. In any event, decisions to boost or abandon a subsector in view of its contribution to economic growth will also have to take account of its role with regard to other aspects. Indeed, its contribution to food security, to the reduction of unemployment and poverty, to health, in short to the well-being of populations, are all elements to be taken into consideration. This is then a matter of analysing the multifunctionality of the subsector under study.

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REFERENCES

1. Berr E. & Harribey J.-M. (2005). Le concept de développement en débat. *Economies et Sociétés, Série Développement, croissance et progrès*, 3 (43): 463-476. https://gretha.cnrs.fr/wp-content/uploads/2020/02/Berr-Harribey-ES-2005.pdf.
2. BM, CE, FMI, OCDE & ONU (2013). *Système de comptabilité nationale 2008*. New York. https://unstats.un.org/unsd/nationalaccount/docs/SNA2008FR.pdf.
3. Bourbonnais R. (2003). *Économétrie*. Paris, Dunod, 5e édition.
4. CIRAD (2009). Fruits et Légumes, la santé du monde. Etude, Montpellier, 18p. http://agritrop.cirad.fr/551474.
5. DEPF/MINEFI (1998). Impact de l'agriculture sur l'économie à travers une version améliorée du modèle de demande 28 (scenario de croissance pour 1997-98). *Document de travail No.30.*
6. Eba'a Atyi R., Lescuyer G., Ngouoho Poufon J. & Moulende Fouda T. (2013). *Étude de l'importance économique et sociale du secteur forestier et faunique au Cameroun*, Yaoundé, Rapport final CIFOR-Yaoundé. https://afrique-centrale.cirad.fr/publications-et-ressources/ouvrages/etude-de-l-importance-economique-et-sociale-du-secteur-forestier-et-faunique-au-cameroun.
7. Engle R.F. & Granger C.W.J. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica*, 55(2): 251–276. https://www.jstor.org/stable/1913236.
8. Ganry J. & Le Guilloux, M. (2007). *Synthèse des réponses au questionnaire d'enquête sur la situation dans les pays d'Afrique Francophone*. Yaoundé, Rapport atelier PROFEL, OMS/FAO.http://www.fao.org/fileadmin/templates/agphome/documents/horticulture/WHO/Yaound%C3%A9/Profel_Analyse__Finale.pdf.
9. Granger C.W.J. (1969). Investigating causal relations by économetric models and cross spectral methods, In : Bourbonnais R. (ed) *Économétrie*, Paris, Dunod, 5e édition.
10. INS (2019). *Les comptes Nationaux de 2018*. Rapport annuel, Juillet, Cameroun.

11. INSEE (2016). Le produit intérieur brut au prix du marché/PIB. https://www.insee.fr/fr/metadonnees/definition/c1365.
12. IRAD (2013). *Productions et sureté alimentaire : Élaboration des systèmes de production intégrés intensifs et compétitifs des cultures maraîchères et fruitières*. Cameroun, rapport du projet C2D horticulture. https://afrique-centrale.cirad.fr/content/download/4335/33202/version/2/file/Projet+7+Horticulture.pdf.
13. Janick J. (1972). *Horticultural science*. San Francisco, W.H. Freeman and Company, 2nd edition.
14. Johansen S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, 12(2-3): 231-254. https://doi.org/10.1016/0165-1889(88)90041-3.
15. JUDICOME/JEXCO (2004). *Étude pour l'élaboration du plan de développement de la filière fruits et légumes*. Ouagadougou, rapport final adopté par l'atelier national. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiMw7uGssTqAhUQZMAKHXzqDgcQFjACegQIAxAB&url=https%3A%2F%2Fdocplayer.fr%2F21822517-Etude-pour-l-elaboration-du-plan-de-developpement-de-la-filiere-fruits-et-legumes.html&usg=AOvVaw0I8oHTCBMpfA5PfUZIshNr.
16. Kabore B., Badji G. & Ouattara B. (2005). *Évaluation de la contribution socio-économique de la pêche au PIB et au développement rural*. Burkina Faso, version finale du projet pilote 1 du « programme pour des moyens d'existence durables dans la pêche » de la FAO. http://www.fao.org/tempref/FI/DOCUMENT/sflp/SFLP_publications/French/Contribution_peche_Burkina_nov04.pdf.
17. Katircioglu S. T. (2006a). Co-intégration and Causality between GDP, Agriculture, Industry and Services growth in North Cyprus: Evidence from time series data, 1977-2002. *Review of Social, Economic & Business Studies*, 5(6): 173-187. https://www.researchgate.net/publication/326478485_Co-Integration_and_Causality_Between_GDP_Agriculture_Industry_and_Services_Growth_in_North_Cyprus_Evidence_from_Time_Series_Data_1977-2002_Salih_KATIRCIOGLU.

18. Katircioglu S. T. (2006b). Causality between agriculture and economic growth in a small nation under political isolation: A case from North Cyprus. *International Journal of Social Economics,* 33 (4): 331-343. https://doi.org/10.1108/03068290610651643.
19. Kutznets S. (1934). National income, 1929-1932. *National Bureau of Economics Research*: 1-12. http://www.nber.org/chapters/c2258
20. MINAGRI (1991). *Introduction à l'étude sur la définition d'un programme de développement de la production et de la commercialisation des fruits et légumes au Cameroun*. MINAGRI, synthèse des rapports d'études.
21. Ngo Nonga F., Minkoua J.R., Moma C. & Malaa D. (2007). *Volet économique du PRP Maraîchage : l'économie du maraîchage* (Miméo). Yaoundé, Rapport du REPARAC/ IRAD.
22. Nkendah R., Ako E., Tamokwe B. & Melingui E. (2012). *Le Commerce Transfrontalier Informel des Produits Agricoles et Horticoles entre le Cameroun et ses voisins de la CEMAC: Implications sur la Sécurité Alimentaire Sous régionale*. ICBE-RF Research Report No. 07/12. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjJj_HdocTqAhXDnFwKHVFiDUkQFjACegQIBBAB&url=http%3A%2F%2Fwww.trustafrica.org%2Fen%2Fpublications-trust%2Ficbe-research-reports%3Fdownload%3D74%3Ale-commerce-transfrontalier-informel-des-produits-agricoles-et-horitcoles-entre-le-cameroun-et-ses-voisins-de-la-cemac-implications-sur-la-securite-alimentaire-sous-regionale%26start%3D60&usg=AOvVaw1lCM25cL6ESYomJstBQ0D4.
23. Parrot L., Dongmo C., Ndoumbe M. & Poubom C. (2008). Horticulture, livelihoods, and urban transition in Afrique: evidence from South-West Cameroon. *Agricultural Economics*, 39: 245-256. https://doi.org/10.1111/j.1574-0862.2008.00330.x.
24. Sims C. (1980). Macroeconomics and reality, In: Fève P. (2005). *La modélisation macro-économétrique dynamique*, Toulouse, Banque de France. https://www.banque-france.fr/sites/default/files/medias/documents/working-paper_129_2005.pdf.
25. Temple L. (2001). Quantification des productions et des échanges de fruits et légumes au Cameroun. *Cahiers Agriculture*, 10(2): 87-94. http://publications.cirad.fr/une_notice.php?dk=480243

26. Temple L., Marquis S., Simon S., Mahbou G. & David O. (2006). Localisation périurbaine du maraîchage en Afrique Subsaharienne et naissance de système de production localisée : cas des bas-fonds de Yaoundé. Version provisoire du document de travail sur le thème : Développement rural environnement et patrimonial, présenté au colloque international : ALIMENTATION et TERRITOIRES- ALTER 2006 Baeza(Jaén). http://agritrop.cirad.fr/553722.
27. Yao S. (2000). How important is agriculture in China's economic growth? *Oxford Development Studies*, 28 (1): 33-49. https://doi.org/10.1080/713688306.