IMPACTS OF CLIMATE CHANGE ON THE AGRICULTURAL INCOMES IN CAMEROON

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ABSTRACT:

This article aims to assess the impact of climate change on agricultural incomes in Cameroon. Indeed, with nearly 60% of the agricultural workforce (wikipedia.org, 2003), the country is heavily dependent on agricultural income and is therefore very sensitive to variables on which it depends. It is therefore interesting to identify and analyze the impact of climate variability in the high country farm population. For this, it is among other to answer the following question: What is the impact of climate change on agricultural production in Cameroon? To answer this question, the methodology used is an OLS model using time series data from the database of the FAO (Food and Agriculture Organization). The results of the study are generally significant, it appears that the marginal impact of temperature on farm income is negative while the precipitation is positive, in other terms, the decrease in precipitation and / or the Rising temperatures are very damaging to agriculture Cameroon because of climatic conditions already difficult. As a recommendation, we can say that these impacts can be mitigated by adopting coping strategies such as the practice of irrigation.

Keywords: *Climate change, agricultural income, OLS modeling, Cameroon.*

Introduction

The strong growth in emissions of greenhouse gases Greenhouse is now warming the planet, with consequences for the melting of glaciers, increased precipitation, the multiplication of extreme weather events such as hurricanes, and shifting seasons. These climatic changes are noticeable in several countries where it is more difficult to define with precision the different seasons and especially to estimate their duration.

Agriculture is highly sensitive to climate change and this is because the cycle of plants is highly dependent on the content of CO_2, humidity, water content of the medium in which they grow. It is therefore legitimate to think that climate change would have overall negative impacts on agriculture and food security and threaten the world. Populations in developing general and especially African countries, already vulnerable and food-insecure countries are likely to be most seriously affected.

Like the Sub Saharan Africa income countries depend heavily on agriculture, Cameroon has an economy heavily dependent on agriculture and therefore the factors that influence. In fact, over 60% of its agricultural population, it exports more than 50% of the products of agriculture, in addition, that agriculture contributes over 30% of its GDP.

This country is strongly influenced by its agricultural income, it would be interesting to measure the impact of climate change on the income of its population.

It is in this context of climate uncertainty that we propose in this study to measure the impact of climate change on the income of farmers in Cameroon, in other words it is to answer the following questions: Climate change do they affect the Cameroonian agricultural population? If yes what will be the impact of climate change on agricultural production in Cameroon? To answer these questions, this study is primarily to assess the impact of changes in temperature and precipitation on agricultural value added in Cameroon goal. The control of these impacts is essential for farmers who can adapt their farming methods to climate change and thus better support its negative effects. It is also advantageous for international organizations and will organize an adequate global response to the decisions to limit the negative impact of climate change on agriculture in general and particularly on agricultural efficiency.

To achieve this goal, this paper focuses on three main areas: It will first make an inventory of existing studies on this subject. This will be in the proper context to carry out this study, then it will be about making a comparative study of the evolution of our variables. This paper will conclude with econometric modeling that will address the various scientific questions in this study.

Several recent studies have addressed the issue of the impact of climate change on agriculture. According to climate models, and the assumptions of evolution of global warming will be a rising temperatures average between *1.4 °C* and *5.8 °C* in the 21st century with a net change of rainfall *(Cubasch et al, 2001).* The confirmation of this upward trend *(temperatures)* is remarkable on the African continent through the long periods of drought especially in the Sahelian countries *(Drine, 2011).* This climatic instability is causing many changes in vegetation, and promotes been advanced drought *(Abderrahmani, 2006).* For *Rosenzweig* and *Parry (1994),* climate change will reduce the potential global food production and increase the risk of hunger in small economies. It is therefore likely that agricultural production in some countries known as *Cline (2007)* shows a sharp decline. *Lobell (2010)* confirms the negative impact of climate change on agriculture in Sub-Saharan countries. It clearly establishes the negative effects on agricultural yields. *Tao et al (2003 and 2005), Parry et al* (2004) and *Drin (2011)* also showed the negative effects of climate variability on agriculture, particularly on agricultural productivity. It is the same in *Burkina Faso* where he was shown a negative impact of climate change on agricultural income *(Ouedraogo, 2008).*

The remainder of this paper is organized as follows. *Section2* presents the econometric methodology used in the analysis of the impact of climate change on the agricultural population. It describes the data in the study and shows the different stages of the modeling, and the estimates and tests used. In *Section3,* we analyze the results that emerge from the estimates and tests described in the previous section. We derive different results measures to help mitigate the impact of climate change on Cameroon's agricultural population *(Section 4).* We finish with a conclusion.

2. Econometric methodology

This section presents the data and the analytical approach to study the impact of changes in temperature and precipitation on agricultural income method.

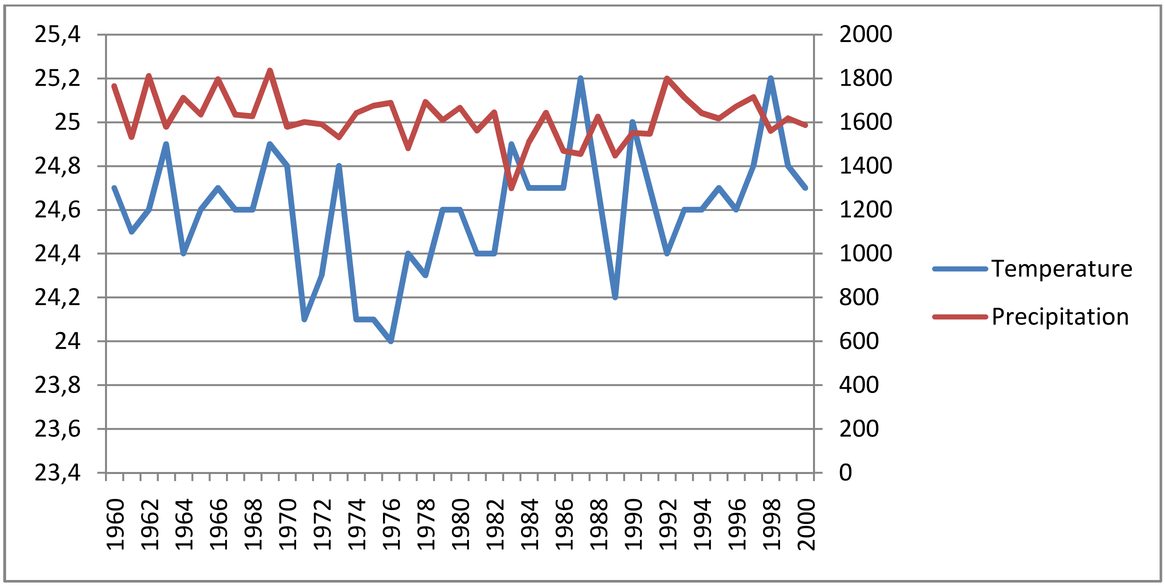
2.1 Study Data

Before presenting the empirical results, we make a description of the data used. The data are annual and cover the agricultural value added *(rev)* is used here as farm income because it is a more relevant measure of the increase in earnings of farmers in Cameroon and the temperature *(temp)* used here is the annual average temperature all over Cameroon measured in degrees Celsius *(° C),* with respect to precipitation *(pre)* are measured by the number of millimeters (mm) passed on average a year and is equivalent to the number of liters of water per square meter. These variables will be supplemented by so-called "control" variables to better measure the impact. This is the amount of arable land and land permanently used for crops *(land)* and the economically active population in agriculture *(labour).* It should be noted that in this study, we use the logarithms of the variables for easier interpretation of the estimated coefficients. Thus, for a variable *X*, the notation of the logarithm of *X* is *LX*. Series that are aggregated are from 1960 to 2000 and come from the database of the World Bank in terms of agricultural value added, and FAO regarding climate data. The graphs below show the evolution of the respective variables.

During the study period, precipitation experiencing a relative decline during this period, from *1764mm* annual average in 1960 to less than *1600 mm* on average in 2000 *(Graph1).* The temperatures on the other hand remained more or less stable trends that experiencing regular oscillations *(24.7 ° C).*

The added value for its being continually improved over the period, it is difficult to capture the effect of changes climate thereon. Reason why more sophisticated technology such as the econometric analysis is essential.

Graph 1: Evolution of climatic variables between 1960 and 2000.



Source: Our Calculations

2.2 Method of analysis

The estimation method will be used in this study is that proposed by Engle and Granger (1987). It follows a two-step procedure. In a first stage OLS estimated the cointegration equation.

$$Lrev = \alpha + \beta_1 Ltemp + \beta_2 Lpre + \beta_3 Lland + \beta_4 Llabour + \varepsilon \qquad (1)$$

Then we test the stationarity of the estimated residuals well. The second step is to estimate by OLS model with error correction, replacing the equilibrium error estimate.

$$Lrev = \alpha + \beta_1 D(Ltemp_t) + \beta_2 D(Lpre_t) + \beta_3 D(Lland_t) + \beta_4 D(Llabour_t) + \beta_4 \hat{e}_{t-1} + u_t \qquad (2)$$

To test the stationarity of our series we used the *Augmented Dickey Fuller (ADF)* test and *Phillips Perron (PP).* These two tests are based on the search for roots unit in the series.

3. Results and discussion.

3.1. Results of the stationarity tests.

We consider initially the model with constant and trend variables and we test the significance of the trend. The results of this test are shown in Table1. It appears from this test that the trends for all variables are not significantly different from zero, since the t-statistics are below the critical value tabulated by *Dickey Fuller* at 5%. We therefore consider the model with constant without trend, the results shown in Table 1.

Table 1: Test of significance of the trend and constant.

	Model with trend and constant		***Model with trend and no constant***	
Variable	***t-stat***	***Critic Value tabulated by Dickey-Fuller***	***t-stat***	***Critic Value tabulated by Dickey-Fuller***
Ltemp	*1,99*	*2,79*	*1,11*	*2,54*
Lpre	*1,59*	*2,79*	*0,46*	*2,79*
Lland	*2,19*	*2,79*	*0,7*	*2,79*
Llabour	*1,72*	*2,79*	*2,92*	*2,79*

Source: Our Calculations

Note that the constant is not significantly different from zero for the variable Llabour. For this variable is performed in unit root test on the model with no constant trend for other variables, for which the constant is not significantly different from zero, we estimate the model without constant and without trend. And the unit root test is performed. The results of these tests are focused in the following table.

Table 2: Test results of the unit root.

	Order of integration	ADF	Critique value in 5%
Lrev	*Difference 1*	*-3,96*	*-2,94*
Ltemp	*Difference 1*	*-4,85*	*-2,94*
Lpre	*Difference 1*	*-5,31*	*-2,98*
Lland	*Difference 1*	*-3,70*	*-2,92*
Llabour	*Difference 1*	*-4,29*	*-2,94*

Source: Our Calculations

From these results, we can say that all the variables are integrated of order 1. These results let us predict the presence of cointegration. It invites us to look for the presence of at least one cointegrating relationship. Since our sample size is not large enough, we adopt here the two-step method of Engle and Granger.

3.2. Estimated model error correction

Table3: Result of the estimated MCE.

Variables	Coefficient	Standard Error	P-value
D(Ltemp)	*-0,033*	*0,003*	*0,0001*
D(Lpre)	*0,0006*	*0,000069*	*0,001*
D(Lland)	*0,832*	*0,057*	*0,047*
D(Llabour)	*0,481*	*0,036*	*0,003*

Source: Our Calculations

The results of our estimation of the model error correction, it can be concluded that the increase in temperature causes a decrease in the income of farmers. By cons increased rainfall pushing up the income of the latter *(Table3).* Indeed, because the unit increase of precipitation *(1 mm of rain)* increase agricultural value added 0.06%. Conversely, a unit increase in temperature leads to a decrease of the value of 0.3%. This situation can be explained by natural geographical position of the African continent. Indeed, the continent is located in the where the temperatures are very high compared to all other tropical continents. It is therefore logical that a further increase is detrimental to their wealth. Similarly, in this area the rains are rare. It is therefore logical that increasing precipitation silk profitable to farmers in Cameroon, especially as irrigation agriculture is little or not at all practiced. These results also show through said control a proportional increase in agricultural inputs increase the added value of Cameroonian farmer's variables. This result is similar to that obtained by *Fontan (2008)* in his study of the sources of inefficiency of farms in West Africa.

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Recommendations

In light of the results of this study, policy makers should:

- Continue their programs to improve agricultural production, including the development of more land for farmers and increased lending to the agricultural sector. Our study shows that the search for the increase of agricultural production also led to the improvement of agricultural value added.

- Respect the agreements they have signed to reduce global warming.

- Helping farmers to adapt and to cope better with the negative effects of climate change.
- For organizations that collect-data such as the FAO, to provide researchers with more detailed data and reduced as much as possible the same units should enable finer and conduct specific studies.

4. Conclusions

The objective of this paper is to evaluate the impact of changes in temperature and precipitation on agricultural value added in Cameroon to propose actions to the government. In this context, we use data from the database of development indicators in 2011 the *World Bank and the FAO*. Using the proposed by *Engle and Granger (1987)* method of analysis, we estimate the error correction model, which allowed us to show that an increase of one degree Celsius causes a decrease of about 0.3% of the agricultural value added in Cameroon and an increase of one millimeter of rain increases in agricultural value added *0.06%*.

These results show that the actions of the Cameroonian authorities and farmers should be oriented adaptive methods such as the use of irrigation and access to extension can serve as viable options to mitigate the impacts of climate change.

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