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Opinion

Benin agriculture in front of climate change: challenges and implications: Kandi case

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Kandi commune has been for several years one of Benin regions where there is climate change damage on agricultural production. The situation has become increasingly important over the years, with serious threats to the food security of the population. The rains are rarified, and dramatically retarded with a tendency unfavorable to the growth of the crops until maturation. A better understanding of the climatic basis for the decline in crop yields of maize, cassava and sorghum crops in Kandi commune, and to predict future trends on the horizon is the subject of this study. The interest of such an approach is linked to the preventive diagnostic approach to help the actors of the agricultural sector in effective decision-making. Weather data for the historical phase covers the period 1972 to 2014 and are official and complete daily data collected at the Agency for the Safety of Air Navigation in Africa and Madagascar of Cotonou. As for the predicted weather data, they have been regenerated thanks to the CARAIB dynamic model developed at the University of Liège. The Aqua Crop model is used in the work to predict agricultural yields. After calibration of the model and validation of the theoretical data of regenerated yields for the historical phase (1975-2014) in comparison with the observed data (collected at the National Directorate of Agricultural Statistics), future forecasts are developed using data Weather forecast. The whole process was based on an appropriate statistical approach supported by previous work on the subject. Diagnosis and monitoring of the rainy season length trend was an important step in guiding planting and harvest dates. The significant decline in this indicator is one of the reasons for the early senescence of crops in Kandi in relation to climate change. Consideration should be given to the contraction of agricultural seasons to define seeding dates and to promote efficient management of rain fed resources for agriculture. Agro-climatic constraints impose a preventive policy on the choice of short-cycle crop varieties and on curative mitigation measures, including climate insurance. It is recommended to sensitize the various factors involved in the agricultural sector and to protect agricultural land from any degradation in order to limit the implications of other factors to the decline in agricultural yields. The State must adopt an agricultural policy incentive to minimize the change of activities of the actors and the random rotation of crops induced by climate change.

Climate change is threatening the agricultural sector on a global scale and, as such, is causing enormous damage to agricultural yields. In recent years, we have been experiencing a critical phase of food insecurity in developing countries as a result of climate change. Africa in general and particularly the countries of Africa south of the Sahara are the most vulnerable to agro-climatic disasters. The rainfall character of agricultural policy in West Africa exposes farmers to a significant decline in agricultural yields. The rains are rarified, extreme and not continuous, with a bad distribution. The extremes of rainfall are becoming more and more imposing with a length of agricultural season in full decline. The random selection of sowing dates by farmers and actors of the agricultural system in these countries is the fundamental cause of the early maturation of crops. Poorly selected crop varieties, particularly those that require a longer growing phase, are causing significant declines in agricultural yields in the face of climate disruption. In Benin, the situation is critical at different spatial scales. Kandi finds itself in a Sudano-Sahelian region of Benin where a unimodal climate regime imposes itself under the dominance of a dry season and a rainy season. Since the 1970s, North Benin has been marked by an important rainfall increase that is disrupting agricultural activities. Rain fed agriculture and livestock are the main activities of the populations of the North in general and of Kandi in particular. The commune of Kandi is one of the regions of Benin most exposed to rainfall and climatic extremes. Water resources useful for agriculture and livestock rearing seasonally, leading to early senescence of crops and agro-pastoral conflicts. This situation leads to a shift of the working population from villages to cities in order to make money more easily. Some farmers change crops to produce cotton, a cash crop subsidized by the state. The impoverishment of agricultural land and the poor management of surface water resources in Kandi combine with climate change to drastically reduce the agro-climatic potential of the municipality. Information on soil typology and the agricultural vocation of the land is unimportant in the planning policies of the agricultural area of North Benin and Kandi. The Kandi commune, on the other hand, lacks an agro-climatic policy that is effective in dealing with new climate changes. The coming years are hypothetical for agricultural production in this commune, where the actors of the agricultural sector vegetate in absolute uncertainty. It is therefore of interest to scientists to take a closer look at the issue, to anticipate what is expected as an agro-climatic catastrophe and to propose appropriate recommendations. It is in this vision that this study is initiated which concerns the forecasting of maize, manioc and sorghum crops in the commune of Kandi in the context of climate change by 2050. The FAO Aqua Crop model was used to make this forecast using weather-historical and weather-forecast data detailed in the methodological approach. An evaluation of the evolution of the potentially useful rainy season is carried out and supported by a suitable statistical approach. Climate change and crop response are at the center of the analyzes for the sole purpose of estimating current and future agro-climatic constraints in Kandi commune in northern Benin. Does the decline in agricultural yields (of maize, cassava and sorghum) in Kandi commune have a link with climate change? Will

the coming years be catastrophic for the production of maize, cassava and sorghum in Kandi commune? Is the duration of the rainy season potentially useful lower than in the historical weather phase (1974-2014) and forecast weather forecast for 2050 in Kandi commune? Responding to these three research questions is the subject of this study.

The present work focused on assessing the implications of climate change for the declining agricultural yields of maize, cassava and sorghum in Kandi commune in Benin. The climatic diagnosis confirms that the length of the season of potentially useful rainfall has evolved mostly downward since the years 1972 in the commune of Kandi. This situation is accompanied by a significant change in the agricultural calendar in the said commune. Cereals whose maize and sorghum are the most threatened due to poor selection of sowing dates that do not favor continuous irrigation for canopy growth until senescence. Climatic extremes in general, and especially rainfall decline, lead to early maturation of the crops according to the present results. Integrating agro-climatic diagnosis into agricultural policy planning becomes a requirement for the effective and sustainable minimization of agro-climatic disasters. It is expected that in the coming years, grain production in Kandi will become increasingly low, due to poorly managed climate constraints. Cultivation of tubers in general and especially of cassava is little threatened by climate change because their growth phase is in a favorable period of the agricultural season to the progressive senescence of the canopy. Indeed, between the last dekad of June and the first dekad of September, the deregulation of rainfall is not very restrictive. It is during this period that the farmers produce cassava in Kandi. Thus, the cassava canopy is weakly affected by cyclic effects of rainfall shock. Cultivation of cassava is therefore very poorly maturing at an early stage and its yield is little threatened. Hence the interest of reviewing the agricultural calendar for cereals which are crops very sensitive to the said disruption. The actors of the agricultural sector must review the sowing dates and sensitize the farmers while collaborating with the scientists on the question. A thorough research policy on short-cycle crop varieties will be required to meet the water requirement of growing crops. Land degradation and impoverishment are important explanatory variables, as is the sustainable management of water resources for agriculture. Hydro-agricultural development is recommended in areas of high climatic constraints to compensate for imbalances and if possible to make production off-season. By 2050, there is a risk that there will be a massive displacement of the active rural populations from Kandi to the cities if no adequate measures are taken to accompany the producers. The "climate insurance" resource is desired to mitigate and offset the financial capital of farmers in unexpected disaster situations. The ultimate objective is to promote agricultural yields, care should be taken to monitor soil fertility and to promote sustainable management of the resources necessary for the equilibrium of crops. Benin must establish a "National Observatory on the Monitoring of Agro-climatic Risks" to better support and guide the players in the agricultural sector.

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Conflict of interest

Author declares that there is no conflict of interest.

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