Fig 1

CLIMATE & AGRICULTURE IN WEST AFRICA

BENJAMIN SULTAN AND SERGE JANICOT EXPLAIN HOW CLIMATE IMPACTS RELATE TO AGRICULTURE THROUGHOUT WEST AFRICA.

Climate has a strong influence on agricultural production, considered as the most weather-dependent of all human activities, with socio-economical impacts whose severity varies from one region to another.

Background

These impacts are particularly strong in developing countries in the tropics that in many cases are exposed to high variability in climate, and where poverty increases the risk and the impact of natural disasters. This is especially true in the Sahel where rainfed crop production is the main source of food and income and where means to control the crop environment are largely unavailable to farmers: irrigation is rarely an option and use of mechanization, fertilizers, and other off-farm inputs is low.

In addition, the Sahel is currently affected by a food deficit crisis resulting from a rapidly growing population combined with stagnant yields of pearl millet, the main source of food and income of the Sahelian people, over the last few decades leading to a decrease of food production per capita. Staple crop production thus occupies an important place in government policies, and one of the top priorities has become the stabilization of crop yields in the context of the long-term drought of the last decades over the Sahel and the uncertainties of the global climate change.

Considering the potential benefits of climate predictions to agriculture and the impacts of anthropogenic climate change on the Sahel, it appears crucial to orient the research efforts to the linkage between the two fields of research: meteorology and agriculture.

VARTROP is a team of French researchers focused on tropical climate variability and its impact on human activities (agriculture, water resources) and health. It belongs to the LOCEAN (Laboratory of Ocean and Climate through Experimental and Numerical Analyses), a laboratory being administrated both by CNRS, IRD, MNHN and UPMC. The main goal of the team is to build bridges between climate science and human processes such as agriculture in West Africa (Fig.1).

Achieving the goal

To achieve this goal, climate researchers work together with researchers in agronomy mainly from CIRAD (International Institute of Research in Agriculture and Development). This inter-disciplinary collaboration gave several very new results.

Recent studies indicated that the "true" rainy season in terms of the summer monsoon, which is associated with a sudden northward jump of the inter-tropical convergence zone (ITCZ), begins at a very constant date (around 24 June). The irregular rainstorms occurring prior to the onset of the monsoon can be called a pre-rainy season, constituting only 10% of total seasonal rainfall on average in Sahelian regions.

Fig 2

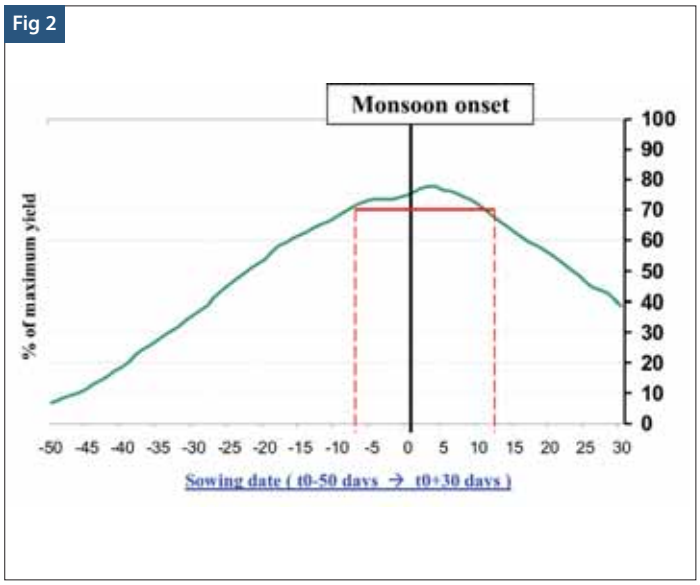

FIG. 1: (Credit ESA: The Bijagos Archipelago is located off the Guinea-Bissau coast. These islands were declared a Biosphere Reserve in April 1996 and are inhabited by the Bijagos people, who have maintained a traditional and ancestral way of life - hunting and agriculture. The green colour of the sea around the islands is the result of sediments which are transported and deposited by the River Ge'ba.)

FIG. 2: Relationship between relative, attainable yield simulated for 19 years with the crop model SARRAH for a 90-day millet crop at Niamey, Republic of Niger, and the sowing date (expressed relative to the onset data of monsoon rains, typically around 24 June). 100% = mean of simulated, attainable yield for optimal sowing dates calculated individually for each year.

According to climate and soil hydrology-driven crop simulations for a 90-day millet crop, the highest and most stable yields can be expected for sowing dates around the onset of the summer monsoon, whereas erratic results are obtained with earlier sowing dates during the 'pre-rainy' season (Fig.2).

Global circulation models

Another recently studied issue is the spatial scale gap between climate models (General Circulation Models; GCM) and the crop growth processes. Indeed, while GCM are increasingly capable of making relevant predictions of seasonal and long-term climate variability, GCM outputs come at different spatial resolutions (or levels of aggregation), and may thus be quite different from the weather experienced by the crop at the plot level.

Translating GCM outputs into attainable crop yields is difficult because GCM grid boxes are of larger scale than the processes governing yield, involving partitioning of rain among runoff, evaporation, transpiration, drainage and storage at plot scale. It thus introduces a bias to crop simulation when climatic input is aggregated spatially or in time, resulting in loss of relevant variation. Recent results indicate that forcing a crop model with spatially aggregated rainfall causes yield over-estimations of 10% to 50% in dry latitudes, but nearly none in humid zones, due to a biased fraction of rainfall available for crop transpiration.

Aggregation of solar radiation data caused significant bias in wetter zones where radiation was limiting yield. Where climatic gradients are steep, these two situations can occur within the same GCM grid cell. Integrated climate-crop modelling systems therefore need to handle appropriately the loss of variability caused by aggregation. This can potentially be achieved in two different ways: (i) by a scaling up of crop modelling as other scientists have done and who designed a crop model able to run at a spatial scale comparable to the resolution of GCMs, or (ii) by scaling down of GCM outputs by various dynamic, empirical or statistic-dynamic methods.

The VARTROP team is strongly involved in the African Monsoon Multi-disciplinary Analysis (AMMA) project, which is a coordinated international project whose objective is to improve our knowledge of the West African Monsoon (WAM). This project involves scientists from more than 25 countries, representing more than 140 national and pan-national agencies and institutions. AMMA is motivated by an interest in fundamental scientific issues and by the societal need for improved prediction of the WAM and its impacts on West African nations. The objectives are:

To improve our understanding of the WAM and its influence on the physical, chemical and biological environment regionally and globally,

To provide the underpinning science that relates variability of the WAM to issues of health, water resources, food security and demography for West African nations and defining and implementing relevant monitoring and prediction strategies,

To ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision making activity.

AMMA is promoting international coordination of ongoing activities, basic research and a multi-year field campaign over West Africa and the tropical Atlantic. AMMA is developing close partnerships between those involved in basic research of the WAM, operational forecasting and decision making, and it is establishing blended training and education activities for African technical institutions and schools.

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For more informaton : AMMA - http://amma.mediasfrance.org
Note :Full references for this article are online at www.geoconnexion.com