Rice production becoming more resilient to climate change

How climate change will affect rice production in Africa is a fundamental question that should perhaps be underlying all of AfricaRice's research for development.

Before we can answer this question, we first have to know what the projections are for climate parameters that affect rice production in Africa. AfricaRice remote sensing and GIS unit, under the umbrella of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), conducted a "first analysis of climate changes in Africa" in relation to rice production zones and growing seasons.

Remote sensing and GIS specialist Sander Zwart summarizes the work: "We combined spatial data sets on the growing seasons and the location of rice with climate change scenarios presenting minimum and maximum temperatures and precipitation for different time slices and climate projections. It gives an insight of where temperature and precipitation will change during the growing season and with which magnitude."

Climate change is affecting key parameters for rice production such as maximum and minimum temperatures, rainfall amounts and patterns, relative humidity, and salinity. The analysis focused on temperatures and rainfall. When the maximum temperature is too high, rice suffers heat-induced spikelet sterility, which severely limits yield. The Sahel, for example, already has maximum temperatures close to the threshold for spikelet sterility, so any increase could shift or shorten the rice-growing season, or even make production of existing rice varieties impossible. Meanwhile, high minimum (night) temperatures can reduce assimilation of nutrients, thus hampering crop growth and grain production. Low total rainfall and high-intensity rainfall events may lead to longer drought spells and an increase in the number and severity of floods in inland valleys and lowlands.

Zwart modeled total seasonal rainfall (precipitation), and average minimum and maximum temperatures for both main and 'off' seasons. The outputs were maps of predicted changes per season, predicted changes per Representative Concentration Pathway (RCP), and reports of expected changes per country.

For the Sahel, the assessment predicts slight increases in overall precipitation across the region in both seasons, massive increases in southern Niger, northern Nigeria and southern Chad in the main season, and massive increases in southwest Niger and neighboring northwest Nigeria, and part of southwest Chad in the off-season. Meanwhile, temperatures will increase across the region (*see figure opposite*), with Mali showing the biggest changes in maximum temperature across all scenarios in both seasons. Northern Mali and central-south Niger, and southwest Niger are predicted to be the worst affected areas in terms of increases in minimum temperature in the main season and in the off-season, respectively.

The ORYZA2000 crop model[1] will use the temperature data to determine the impact of the modeled changes on rice yields.

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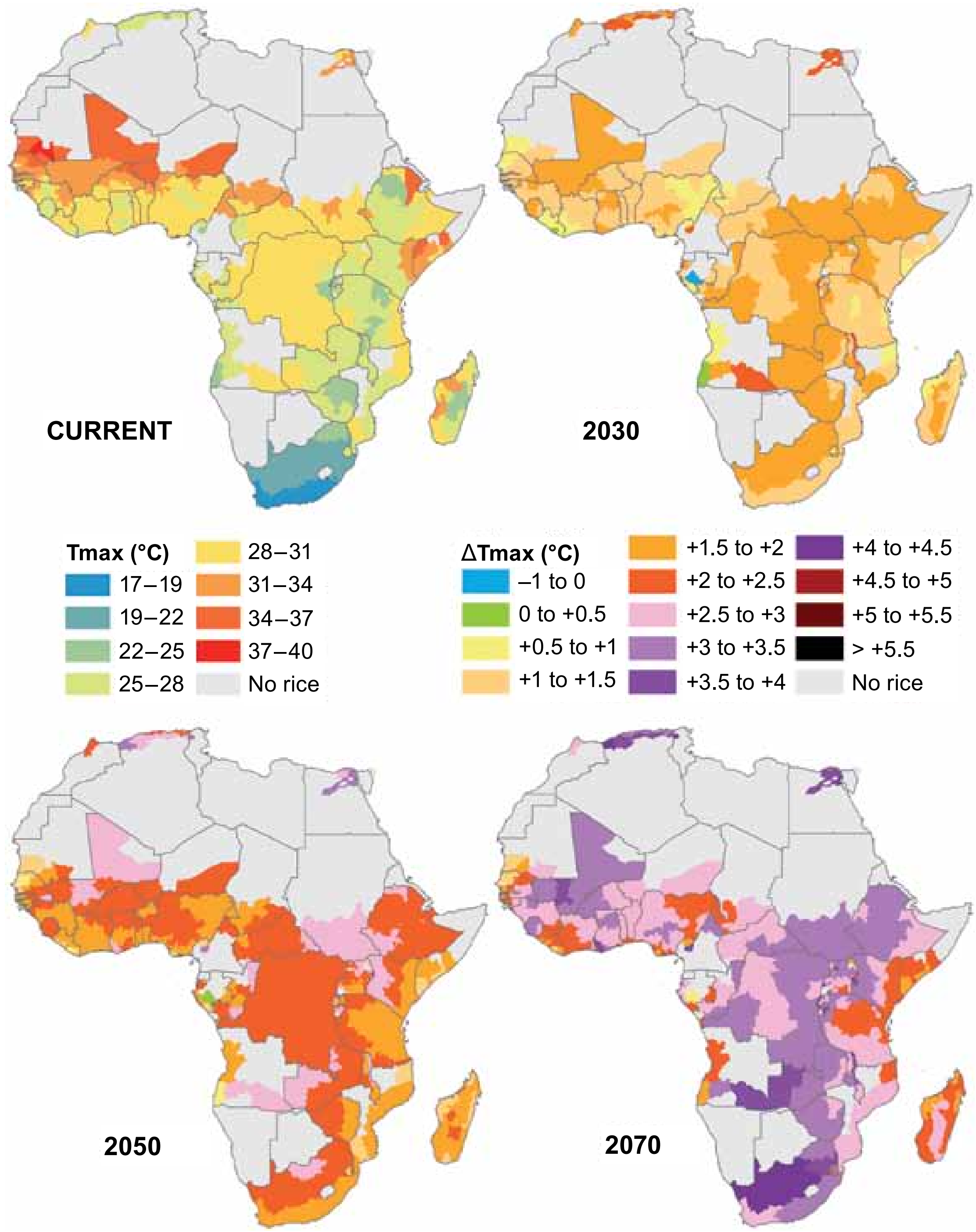
[1] *See* 'Improving climate-risk simulation for arid areas', *AfricaRice annual report 2013*, pages 27–29.



Current and projected changes in maximum temperature for rice-growing regions of Africa using Intergovernmental Panel on Climate Change (IPCC) scenario RCP 6.0 (main rice season)

A crop model to optimize resource use and farm income

Under the umbrella of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), AfricaRice crop modeler Pepijn van Oort used computer simulation model ORYZA2000[1] to predict the timings and yields of different rice and vegetable crop combinations to determine which would optimize resource use and output in the Senegal River valley.

According to van Oort, one key in making crop models usable for the real world is “the lessons learned in the process of moving from poor prediction to more accurate prediction.” Early simulations were performed to maximize yield and “optimum sowing dates differed completely from what farmers were doing.” The decision was then made to bring agronomists, breeders, economists and farmers into the discussions. “This led to the incorporation of vegetables and optimizing yield–crop duration and considering flexibility.”

[1] *See also* ‘Improving climate-risk simulation for arid areas’, *AfricaRice annual report 2013*, pages 27–29.

Double cropping medium-duration rice varieties proved the best option in the simulation, with the combined yield of the two crops being almost double that of a single crop. This simulation also provided plenty of flexibility in planting dates, which means that it is feasible for smallholders who often cannot plant on the ‘optimum’ date.

At the end of the day, the simulation backed up what progressive farmers in the valley are already doing: double cropping, either rice–rice or rice–vegetable, to optimize the use of land for family food and income.

“The nice thing about this model is that, once it is finished, it can easily be used for scenarios in other locations,” says van Oort. “We will extend it to all the rice hubs that have an irrigated component, and also build in climate change predictions. Then we will have an idea whether farmers are currently optimizing their incomes and of what the future might hold.”

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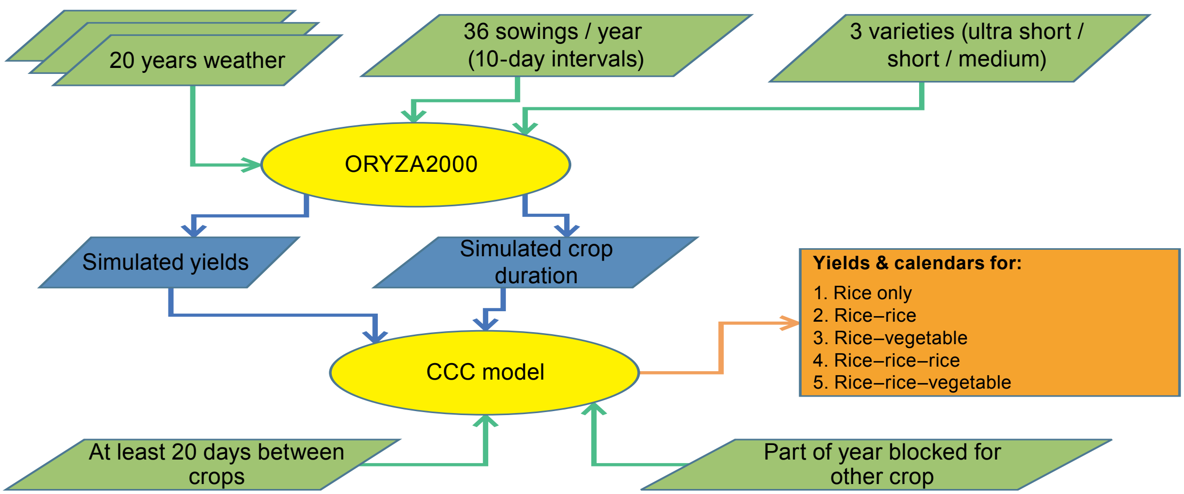

Illustration of how the modeling works

Green: input data and assumptions; yellow: models; blue: ORYZA2000 outputs fed into crop calendar construction (CCC) model; orange: outputs