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Climate Change Impacts on Agriculture – Implications for Food Production in Tamil Nadu, India

Policy makers in India need to pay careful attention to the potential impacts of climate change on food production. Research in Tamil Nadu suggests that rice and sorghum yields are likely to decline because of changes in rainfall and temperature even under a 'moderate' climate change scenario. More importantly, rainfall and temperature may have threshold effects with yields increasing and then decreasing. This calls for the use of climate-resilient seed varieties and examining options such as altering crop sowing periods in order to maintain yields.

Background

Changes in global temperatures and rainfall patterns in the 20th century signal the impact that climate change is already having. In India, mean temperatures have increased by 0.4°C over the last 100-year period. According to Intergovernmental Panel on Climate Change by the end of the 21st century, rainfall in India will increase by 10-12 percent, while mean annual temperature will rise by 3-6°C. These deviations will have an adverse impact on agricultural productivity and people's livelihoods.

Approach

To assess the likely impact of climate change on Indian Agriculture, V. Saravanakumar from the Department of Agricultural Economics, Tamil Nadu Agricultural University, assembled climate and agricultural data covering 39 years (1971 to 2009) and 13 districts in Tamil Nadu, India. This data were used to estimate climate change effects on the yields of major food crops (rice, sorghum and maize). This was done by first examining how crop yields had been affected by climatic change in the past and then by using climate change projections to estimate how yields would change in the future. The regional climate model RegCM4 was used to predict how climate would behave in Tamil Nadu up until the year 2100, under a "moderate" CO2 emissions scenario.

Findings

The study finds that rice and sorghum are sensitive to changes in rainfall and temperature. Up to specific threshold levels, increases in rainfall and

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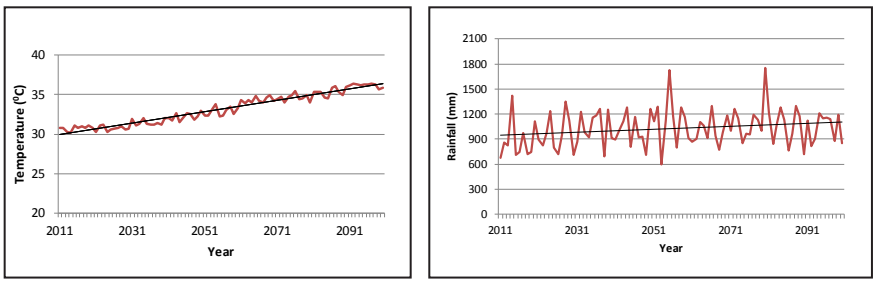
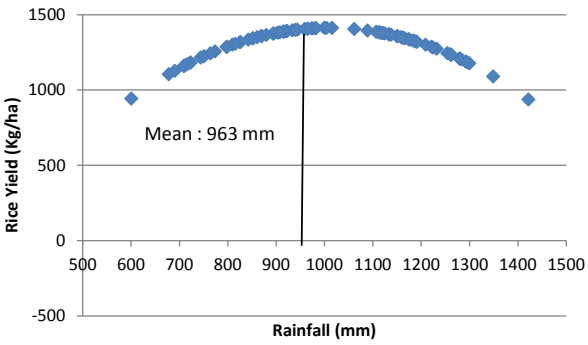
Figures 1 and 2: Projected Mean Annual Temperature and Rainfall in Tamil Nadu (under a moderate climate change scenario with RegCM4 Outputs)



temperature both have a positive effect on the yields of these crops. Beyond these thresholds, further increases have negative impacts. For example, higher rainfall increases rice yield up to a threshold level (1057 mm per annum), after which yields fall. Overall, there is an inverted U-shaped relationship between crop yields and climate variables.

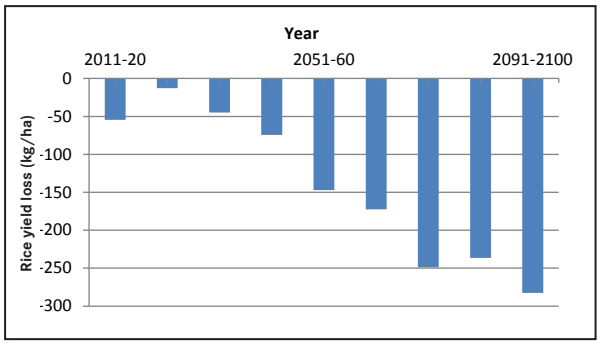
Figure 3: Predicted impact of rainfall on rice yield



During 1971 to 2009, mean annual rainfall in Tamil Nadu exceeded the simulated threshold level (1057 mm) in Figure 2 ten times. Thus, weather events are already resulting in losses in rice productivity.

Projections suggest that by 2100 climate change will cause a reduction of rice yields of 283 kg per ha per decade and a reduction in sorghum yields of 88 kg per ha per decade. Thus, it is expected that there will be 10 percent decline in rice yield and a 9 percent decline in sorghum yield by the end of the 21st century, relative to average yields during the base period 1971–2009.

Figure 4: Rice yield loss projections with climate change in Tamil Nadu relative to the base period (1971–2009)



Recommendations

The study highlights the importance of *threshold effects* of climate change. Given that climate change is likely to result in greater variation in rainfall and temperature patterns, understanding threshold effects on crop yields is clearly important for growth and food security.

Agriculture needs to become more climate-resilient. For this, we need investments in research and farm demonstrations related to adaptation. In response to climate change, farmers will need to use robust seed varieties. The implications of changing sowing times will need to be further understood.

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