Climate change adaptation: Moving forward with hope for the "poorest of the poor" in the semi-arid tropics

Climate change predictions point to a warmer world within the next 50 years, a trend that is increasingly being supported by 'on-the-ground' measurements. However, the impact of rising temperatures on rainfall distribution patterns in the semi-arid tropics of Africa and Asia remains far less certain.

ICRISAT has always been aware of the need to situate our research in the context of seasonally variable rainfall and the impact it has on rural welfare as well as on the performance of the innovations that we were researching and promoting. Within the last 5 years, however, this work has received a new focus as a result of the increased global concern over the impacts of both the rainfall variability associated with current climates as well as future climate changes.

A Board Approved Operational Research Plan for 2008-2015

In March 2008, ICRISAT's Governing Board approved an Operational Research Plan entitled "*Adaptations to Climate Change in the Semi-Arid Tropics*." The plan provides a focused description of the climate change development challenge in the semi-arid tropics; the rational for ICRISAT's involvement; what we aim to achieve through our research and the outcomes we will achieve by 2015. A Summary Flyer has been produced and is available electronically in PDF format for download from ICRISAT website (www.icrisat.org).

The ORP is structured around two key strategic considerations.

1. First, we are convinced that unless risk averse and vulnerable farming communities in the semi-arid tropics are empowered to cope better with *current* season-to-season rainfall variability through improved climate risk management, adapting to *future* climate change will be a daunting challenge for most and perhaps impossible for many.
2. Second, given the lead time required to produce 'finished products' of adapted germplasm, we are combining *ex ante* assessments of the impacts from climate change scenarios on the performance of our mandate crops with investigations into the required plant characteristics that will both mitigate the negative and exploit the positive impacts of climate change. The outputs of this work will help shape our future crop adaptation strategy.

Developing a Climate Change 'Hypothesis of Hope' for the Semi-Arid Tropics

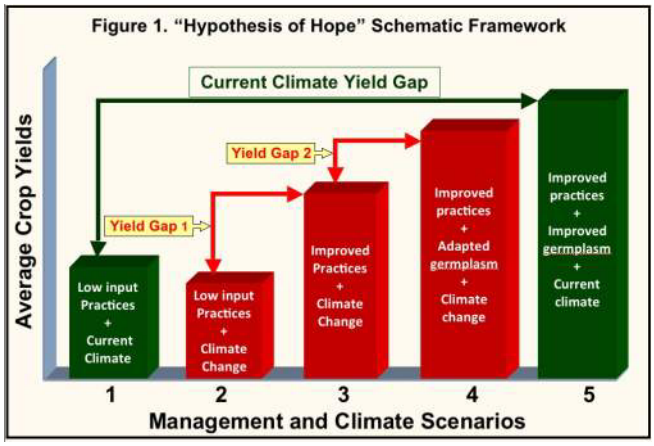
During May 2008, ICRISAT's crop modelers, GIS experts, crop physiologists and plant breeders met in Hyderabad, India for one week. Using a range of weather data driven tools, they initiated research to test the hypothesis that *"in the medium term (2010-2050), ICRISAT is well placed to help farmers mitigate the challenges and exploit the opportunities that are posed by climate change through: (i) the application of existing knowledge on crop, soil and water management innovations, and (ii) the re-deployment and re-targeting of the existing germplasm of its mandate crops.* While much work initiated during this week remains to be completed, early outputs support the hypothesis.

Specifically, the *ex ante* analyses indicate the following.

- Climate change will modify the length of the growing period across the regions of interest, but that this can in large part be mitigated by the re-targeting and re-deployment of existing germplasm.
- Predicted temperature increases, through their effect of increasing the rate of crop development, have greater negative impacts on crop production than relatively small (+/- 10%) changes in rainfall.
- Yield gap analyses show that the negative impacts of climate change can be largely mitigated through a dual strategy of (a) greater application by farmers of improved crop, soil and water management innovations and (b) better targeted crop improvement approaches, more explicitly focused on climate change adaptation.

A schematic framework for testing our hypothesis

We present the schematic framework in Figure 1. The framework identifies three Yield Gaps that ICRISAT must address in seeking solutions to both current and future climate-induced production risks.



Current Climate Yield Gap. Column 1 in the schematic represents yields that farmers are getting under their current and relatively low input management. Column 5 represents the yields that farmers could get through the adoption of current simple and affordable recommendations for improvements in variety choice and crop, soil and water management practices. This is the yield gap that ICRISAT is currently addressing.

Yield Gap 1. Column 2 represents the marginally decreased yields that farmers would get under climate change if they were to continue using the same low input system. We have shown that under such low input systems, other factors continue to provide the overriding constraint. Column 3 represents the yields that farmers could get, even under climate change, if they adopted current improved practice recommendations. This is the yield gap that ICRISAT is and will continue to address through our work to develop, scale up and scale out enhanced crop, soil and water management options for farmers in the semi-arid tropics.

Yield Gap 2. Column 4 represents the yields that farmers could get under climate change if they were to adopt current improved practice recommendations ***together with*** germplasm better adapted to a warmer world. Within the scope of the *ex ante* analyses that we have done so far, we consider better adaptation to solely constitute varieties whose maturity length is better suited to growing in a warmer world. We recognize that other factors such possible changes in rainfall patterns and in the distribution of pests and diseases will also have to be considered. This is the yield gap that ICRISAT will be addressing through our work to develop and deliver improved crop varieties with enhanced performance under high CO_2 concentrations, high temperatures and erratic rainfall conditions for farmers in the semi-arid tropics.

The Schematic Framework highlights three important points.

1. The impact of climate change on the yields under low input agriculture is likely to be minimal as other factors will continue to provide the overriding constraints to crop growth and yield.
2. The adoption of currently recommended improved crop, soil and water management practices, even under climate change, will result in substantially higher yields than farmers are currently obtaining in their low input systems.
3. The adaptation of better 'temperature-adapted' varieties could result in the almost complete mitigation of climate change effects that result from temperature increases.

Such a hypothesis, if proven true, suggests that policy makers should take notice of the following.

Better formulated and targeted policies that facilitate and support the adoption of agricultural innovation today assume even greater urgency. Not only will they improve the welfare of rural population today but will do a great deal to mitigate the impacts of future climate change.