The Year Changes Over But Climate Changes Us

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Introduction

In India as in the rest of the world, climate change has become not just a cause for concern but also a call to urgent and specific action. It's increasingly likely that our descendants will face a less stable, more violent climate. They will have to become *resilient* against extreme droughts, floods, storms and heat. Resilience is especially important in the rainfed drylands, where highly variable rainfall flips agriculture from boom to bust over short time periods.

Following Hurricane Sandy's recent devastation, Andrew Zolli summed up resilience strategy thus: "Where sustainability aims to put the world back into balance, resilience looks for ways to manage in an imbalanced world." He used the metaphor of "rolling with the waves, instead of trying to stop the ocean."

1. Vulnerable drylands

But the poor are least likely to stay afloat, because they have the fewest resources to draw upon in times of crisis. They are the most *vulnerable*. For example while New York will recover relatively quickly from Hurricane Sandy, the storm delivered a knockout punch to poor Haitian farmers.

Studies by our sister CGIAR institutes confirm that the drylands are especially at risk. IWMI illustrated the high drought vulnerability of the African and Asian drylands. IFPRI's 2012 Global Hunger Index flags these dry areas as highly vulnerable to malnutrition.

2. Building resilience

The definition of resilience used by the European Commission, the Montpellier Panel and others is "the ability to withstand, adapt to, and quickly recover from stress and shocks." How can these three dynamics of resilience – withstand, adapt, recover – be enhanced? We made resilience a pillar of our institutional strategy of inclusive market-oriented development (IMOD). The IMOD conceptual diagram illustrates that a portion of the economic gains from markets should be re-invested in building resilience, gradually replacing the need for emergency aid assistance. We also incorporated DFID's livelihood capital concept into IMOD. With larger stocks of social, human, natural, physical and financial capital, smallholders would be better able to roll with the waves.

3. Withstand

Rainfed farmers' ability to withstand climatic stresses can be increased in many ways. For example, models being developed by the CGIAR Research Program on Climate Change attempt to predict seasonal rainfall patterns, to help farmers choose appropriate crop varieties and planting dates. Drought can be moderated through rainwater harvesting. Harvested water is stored in simple reservoirs, in wells, or in the soil profile for later use. Conservation agriculture reduces the evaporation of water from the soil surface and concentrates soil water and nutrients in the root zone, increasing water use efficiency. Small doses of the right fertilizers deliver big gains in resilience.

4. Adapt

More climate-hardy crops are being bred. Chickpea is being adapted to hotter climates by increasing heat tolerance at flowering stage. Drought adaptation in sorghum is being enhanced through stay-green traits. Climate change may cause shifts in disease and pest prevalence; crops bred for tolerance/resistance to these stresses become more resilient. Biological nitrogen fixation (BNF) by grain legumes is relatively sensitive to drought; breeding for drought-adapted BNF holds considerable potential.

5. Recover

Diversification at many levels – livelihoods, cropping systems, and crops – helps farmers recover. Supplementary off-farm employment provides income when the rains fail. Social networks such as self-help groups and farmer cooperatives replenish lost livelihood capital. Research-for-development networks such as APAARI, ASARECA and CORAF help member countries rebuild human capacities and restore lost seeds. Emergency food reserves and crop insurance also help a farmer diversify her bets.

At the farm level, diversification by adding grain legumes can rescue the family's food supply when drought derails cereals. Grain legumes also diversify human diets, combating protein deficiency in children of poor households who cannot afford enough milk or meat. Healthier children are more resilient against illnesses.

6. Land Rejuvenation

At the 18th Conference of Parties (COP-18) of the UN Framework Convention on Climate Change that concluded in Doha on December 8, 2012, the CGIAR Research Program on Climate Change highlighted the need for greater attention to agriculture and forestry. These two sectors contribute about 30% of all greenhouse gas emissions, yet they also hold massive potential to remove carbon from the atmosphere

and store it safely and productively in soils and biomass. Agriculture is part of the problem; but it's also part of the solution.

7. Finding common ground

The Climate Change Program (in which we participate with many others) conceptualizes this dilemma by illustrating three overlapping interests: the need to increase food production, the need to adapt to climate change, and the need to mitigate (reduce) climate change. On first glance, these goals might appear in conflict with each other. For example, increased fertilizer use is needed to boost food production, but that also boosts greenhouse gas emissions.

Yet these three interests share some common ground where we can find win-win-win opportunities. For example the conceptualization flags the restoration of degraded lands including correction of soil nutrient deficiencies to increase food production while simultaneously increasing carbon storage in soils.

8. Proof of concept

I'd like to describe one case in point: the Bhoochetana initiative that is changing lives and food production across Karnataka state, India, the second-largest area of dryland/rainfed cropping in the country. The expression 'Bhoochetana' derives from the ancient Sanskrit language, meaning 'land rejuvenation.' It is a collaborative project involving the government at state, district and local levels; agricultural research institutions (including ourselves), universities, community organizations, and lead farmers.

In just three years, Bhoochetana has raised crop yields by an average of 30% across three million hectares, benefiting 2.2 million smallholder farmers — an enormous and rapid impact. In the 2011 rainy season alone, Bhoochetana increased the production of cereals, grain legumes and oilseeds by 5,50,000 tons, worth US$119 million. Our scientists estimate that Karnataka gains 14 dollars for every dollar that it invests in Bhoochetana.

A major factor behind Bhoochetana's phenomenal success has been a large-scale soil testing and amendment program. Across 4,700 villages in 30 districts, 92,864 soil samples were analyzed and used to map soil nutrient deficiencies down to the sub-district village cluster (*taluk*) level of resolution (see graphic). Deficiencies of the micronutrients boron, sulfur and zinc were particularly widespread. Fertilizers were then targeted to correct local deficiencies. They were made more accessible to farmers through a 50% price subsidy, information campaigns and local action committees.

9. Micro-nutrients, macro benefits

An interesting observation is that crops that were provided with deficiency-correcting fertilizers were better at withstanding drought. These more resilient crops enabled poor families to continue to earn a living from their land rather than having to migrate to cities in search of meager income. By promoting crop growth, the correction of micro-nutrient deficiencies likely also increases carbon storage in the soil, which helps to combat global warming (although this has not been measured in Bhoochetana yet). Healthier crops are also leafier, so they better protect the carbon-rich upper layer of soil from wind and water erosion.

Bhoochetana is not the only success story in rejuvenating degraded drylands. Across dryland Africa, we've observed large increases in biomass and yield from small doses of fertilizer that correct specific deficiencies. We've also seen major gains achieved from simple water harvesting structures such as rock bunds and pits that trigger improved soil-water-nutrient interactions.

10. Climate changes us

The Green Revolution of the 1960s/70s established crop yield increases as the foremost goal of agricultural research-for-development. Large quantities of external inputs (required for maximum yields) were assumed to be abundant and obtainable, particularly irrigation water and agrochemicals. However those resources became more costly and less assured with each passing decade – especially when their environmental costs are accounted for, as they should be.

To prepare for wilder weather, we must move beyond the singular objective of maximizing yield. We must equally appreciate gains in resilience from diversified livelihoods and farming systems, increased stocks of livelihood capital, stronger networks and safety nets, climate-adapted crops, and other innovations.

Conclusion

Resilience may be more difficult to measure than yield alone, but new scientific tools and methods can meet this challenge. For example, Erenstein and colleagues from CIMMYT measured and mapped livelihood capital in the Indo-Gangetic Plains. We're studying how farmers are adapting to climatic risk in the People's Republic of China, Sri Lanka, Bangladesh, Pakistan, Thailand, Vietnam and, of course, India.

If we cannot stop the ocean, we'd better learn how to ride the waves.