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A Green Revolution, This Time for Africa

By [TINA ROSENBERG](#) April 9, 2014, 12:00 pm

Last month was the 100th anniversary of the birth of Norman Borlaug, the father of the Green Revolution.

In 1944, Borlaug moved to Mexico to work on breeding high-yield, disease-resistant strains of wheat. Mexico adopted them — and in 1970, wheat yields were six times what they had been in 1950.

In 1965, India and Pakistan, then on the brink of widespread famine, began growing the high-yield wheat. Over the next 30 years, wheat yields in India tripled. The same happened with high-yield rice strains that had been developed in the Philippines.

Borlaug, who died in 2009, directed the wheat improvement program of the International Maize and Wheat Improvement Center, which goes by the Spanish acronym Cimmyt. The research headquarters is a 78-hectare spread of land a half-hour drive from Mexico City.

Today Cimmyt researchers grow and test new varieties of corn, or maize, along with the wheat. Their purpose is to contribute to a new green revolution — this time for Africa.

The high-yield wheat and rice of the Green Revolution produced dramatic gains in harvests in Asia and Latin America. But not in Africa. There, the climate was too varied, the soils too degraded. Africa lacked infrastructure such as roads, or India's railway system, that helped farmers to commercialize their grain. It did not have a network of companies to sell farmers the hybrid seeds for the high-yield varieties, nor the fertilizer and pesticides necessary to take full advantage of those seeds.

Asian governments had large programs to provide credit, extension agents to teach new farming methods and subsidized inputs; the Food Corporation of India bought surplus grains at a guaranteed price.

African governments, for the most part, did not do these things. And today Africa's agricultural yields are less than half the global average, and about 25 percent of what they could potentially yield. Agricultural productivity in Africa is growing at about half the rate the population is growing.

Africa has long been a continent of small farmers, half of them women, raising maize with no fertilizer, pesticide or irrigation, on a tiny plot with a hoe. Now the little these farmers have is endangered by drought. Climate change is making Africa's weather more extreme and erratic. Africa loses about a fifth of its maize crop because of drought. In many years, the loss is near-total. A survey of farmers in 12 countries found that in the last decade, they averaged about three wipeout years.

Maize is the natural focus for a Green Revolution in Africa, as it is the poor person's crop, and the most widely planted in Africa.

In 2011, I walked through the fields at CIMMYT with Marianne Bänziger, the center's deputy director general for research and partnerships. She is a Swiss crop physiologist who specializes in developing maize for low-water and low-fertility environments.

CIMMYT began working on drought-tolerant maize in the late 1980s. In 2000, the first seeds for drought-tolerant maize were planted in Malawi and Zimbabwe. Now three million farmers in 13 countries in Africa are using them. (All these strains are conventionally bred, not genetically modified.)

"One drought is something that throws farmers back into poverty," said Bänziger. "They lose everything. During a severe drought, a farmer may harvest 5 percent of the ears of a normal crop. With drought-tolerant maize, the farmer can get 50 percent. We want to get to the point where we can save every plant."

The Green Revolution of the 1960s and 1970s is still debated today. The bumper yields came not only from new strains of wheat, but also from the use of chemical fertilizers and pesticides. Farmers, who had lived for millennia using the seeds they grew, now had to purchase them to get these gains. Buying seeds and fertilizer, of course, was easier for the wealthy than the poor. And vast planting of only a few varieties reduced biodiversity.

But Mark Rosegrant, the director of the environment and production technology division at the International Food Policy Research Institute, said that small farmers did, with some lag, adopt the new technologies — the record yields they saw others achieve convinced them to buy the seeds, fertilizers

and pesticides. They also benefited all along from a newly revitalized rural economy, higher wages and lower food prices.

Pesticides and inorganic fertilizers are bad for the environment. But this is not an argument that anyone who eats in America should be making to African subsistence farmers. In 2006, an African Union Declaration (pdf) on agriculture adopted the goal of 50 kilograms of fertilizer per hectare planted. At the time, Africa was using only eight kilos per hectare; America was using 120. Africa needs vastly more fertilizer use, not less.

But the Green Revolution also produced enormous environmental benefits. Borlaug's research was motivated in part by a desire to save forest from being turned into farmland. And he succeeded — as cereal production doubled in Asia, the area under cultivation increased by only 4 percent.

Most important, the Green Revolution's critics have no good answer to what would have happened to Asia's exploding population, already hungry, absent the doubling of yields. The Green Revolution saved a billion people from starvation. (For a concise summary of the debate see this short paper (pdf)).

What will happen to Africa? It is not only possible to get more maize from every acre planted, it is necessary. Africa cannot feed itself while getting only a quarter of its potential yields.

The strains of maize bred at CIMMYT in Mexico are spread throughout Africa by the Drought Tolerant Maize for Africa project, or D.T.M.A., with headquarters in Nairobi, which is run by CIMMYT and the International Institute of Tropical Agriculture. The project has released 140 new varieties of maize so far.

But a key lesson of the Green Revolution is that getting a new strain of maize out of the research station is not the same as getting it into the fields. Bänziger spent nine years in Zimbabwe and five years in Kenya, working with local governments, farmers, seed company officials and agricultural extension agents who train farmers.

Her career — a combination of scientific research and on-the-ground cajoling, politicking and marketing — reflects both parts of the job. The science, she said, is the easy part. "So far, it's a success story," she said. "And we can further increase tolerance to drought." The more difficult challenge is on the ground — farmers don't know about the seed, or they know about but can't get it, or they can't afford the initial investment, or they are afraid to try it. CIMMYT's job is to pollinate not just a plant, but a practice.

Drought-resistant maize is now providing a better livelihood for some 20 million people. The organization aims to double that reach by the end of next year. The drought-tolerant varieties do as well as or better than traditional maize when the rains are good, and when they are bad they will save a farmer from ruin. Overall, said Tsegede Abate, an Ethiopian agricultural biologist who directs D.T.M.A., they improve yields by 20 to 30 percent.

One setback came two years ago with the emergence of Maize Lethal Necrosis, a new disease that destroyed maize crops in Kenya and Tanzania. Kenya is a major producer of drought-tolerant maize seed — and none of it could be used, for fear of spreading the disease. CIMMYT is testing its strains to see which are most resistant to the disease, and rapidly breeding new ones.

The impact of the disease on the drought-tolerant maize program underscores a basic lesson: farmers can't plant the seed if they can't get it. Maize Lethal Necrosis has not been the only obstacle to seed production, and Abate is now traveling around Africa encouraging seed companies to produce their own foundation seed — the first generation after the breeder seed.

Until recently, there were very few seed companies in Africa, most of them state-run. In many countries, a farmer could look at her neighbor's high yields with envy — but have no place to buy the seed herself.

As with many products in Africa, creating a distribution chain is a bigger challenge than inventing the product itself. Seeds have to be grown — of high quality and in large amounts. Agro-dealers — especially those in remote places — have to get them and stock them. Government extension agents or seed company employees have to plant demonstration plots; seeing the plots of traditional and high-yield maize side by side is persuasive. Farmers have to find out about these marketing efforts. They need credit to buy the seeds and the fertilizers.

D.T.M.A. doesn't do any of this directly. It works with national programs and seed companies, often alongside the Program for Africa's Seed Systems, which is part of a group called AGRA — an acronym for A Green Revolution for Africa. (Two giant foundations — Rockefeller and Ford — financed much of the original Green Revolution, and two giant foundations — Rockefeller, again, and Gates — are financing much of the Green Revolution today.) These groups have successfully midwived dozens of new seed companies and distributors — private sector, government and community-run.

The Seed Systems program also provides fellowships for African seed scientists, another crucial need. Abate said that in the 13 countries where D.T.M.A. works, which account for about three-quarters of Africa's maize, there are only about 65 full-time maize researchers. "Just imagine — a crop that's the

most important source of income on the continent,” he said. “To have less than 70 researchers is really obscene.”

The Green Revolution failed in Africa for reasons that remain major obstacles today. Absent research, roads, storage, extension capacity, credit and subsidies — high-yield maize will produce little, or its gains will go only to wealthier farmers. But when governments invest in agriculture, dramatic gains are possible. (The book “Millions Fed” details some of the success stories.)

One example — not in the book — is Malawi. In the 2004-05 growing season, drought produced a catastrophic maize harvest, and five million people — more than a third of the country — needed emergency food aid. Malawi then started a program that heavily subsidized fertilizer and instituted smaller subsidies for seeds. The effect was immediate: Yields reached double the traditional levels, and remain there. Malawi became a food exporter, selling maize to the World Food Program and to other countries. Inside Malawi, hunger dropped sharply and poverty has declined significantly (pdf).

Abate’s own country, Ethiopia, has also doubled yields. In 2001, he said, Ethiopia had a very good harvest — but it had no storage facilities for grain. “So the bag that contained the grain to transport it to the market was worth more than the grain itself,” Abate said. Ethiopia has since invested heavily in infrastructure, extension agents and marketing; maize is traded, for example, on Ethiopia’s new commodity exchange. Ethiopia is now second to South Africa among African countries in production per hectare.

“Successful countries have invested in agriculture and they are now benefiting from that investment,” said Abate. “Lessons should be drawn from their experiences. This is what the future of African agriculture should look like.”



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