



Africa's Turn
A New Green Revolution for the 21st Century



THE ROCKEFELLER FOUNDATION ■ JULY 2006

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Over the course of nearly four decades, beginning in the 1940s, annual crop yields surged in poor countries around the world. Between 1960 and 1985 cereal yields, total cereal production, and total food production in developing countries all more than doubled. Dubbed the “Green Revolution” by an American foreign-aid official, this historic transformation of traditional farming methods began with a single public-private experiment with Mexican wheat. It quickly spread to corn, beans, and rice, rippling across hundreds of millions of cultivated acres throughout Latin America and Asia. The change was particularly pronounced—life-altering and frequently life-

saving—on the small farms where nearly half a billion of the world's poorest people made their living.

The roots of this achievement were a combination of venturesome philanthropy, astute agricultural research, aggressive recruitment and training of scientists and farmers in the developing world, and determined government agricultural and water policy. The results were as massive as they were unprecedented.

What they were not was universal. The Green Revolution stopped at Africa.

To be sure, hunger and hard, volatile farming aren't limited to any one continent. Nor did the Green Revolution bestow a uniform blessing on all other parts of the world. Even in South Asia, where the Green Revolution years saw so much growth, portions of the region still suffer from widespread hunger and rural poverty. But given the size of sub-Saharan Africa, the predominance of small-scale farming among its main industries, the international attention devoted to the region, and the extent of its poverty and hunger, it is particularly disheartening that little of the benefits from a worldwide upheaval in agriculture took root there. Sub-Saharan Africa, which contains 16 of the 18 most undernourished countries in the world, remains the only region where per-capita food production continues to worsen year by year.



Tororo district, Uganda.

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There are many reasons for this gigantic gap in the benefits of the Green Revolution. But more to the point, there is good reason to imagine closing that gap—reasons that include advances in all the fundamentals that made up the original achievement: science, training of local practitioners, public-private cooperation, and improvements in government policy and practice. It is time for a second Green Revolution, aimed squarely at Africa. But before building a case for a goal of that scale, it is worthwhile to consider how the first Green Revolution got its start, and how its initially modest ambitions grew to become one of the signal peaceful achievements of the 20th century.

An act of leadership

Before all else, the original Green Revolution was a product of philanthropy, in a carefully negotiated partnership with government. The partnership began in Mexico and expanded to Colombia, India, the Philippines, and farther into Latin America and Asia. Its first manifestation was a modest research center outside Mexico City, formally lodged in the Mexican government but managed, staffed, and mostly funded by the Rockefeller Foundation. The idea started with a casual comment in 1941 by Henry Wallace, then Vice-President of the United States, to Rockefeller President Raymond B. Fosdick: Increase the yield per acre of corn and beans in Mexico, and you would do more for the country and its people than by any other means. (The same might now be said, 60 years later, about crops in Africa.)



Norman Borlaug.

Intrigued, Fosdick consulted the Rockefeller Board, hired three eminent agricultural scientists to scope out the possibilities, and organized a research and development operation. After first seeking and receiving an invitation from the Mexican government, the Foundation created the *Oficina de Estudios Especiales* within the Mexican Department of Agriculture, initially staffed by scientists on the Rockefeller payroll. Among the pioneers in this effort was plant pathologist Norman Borlaug, who remained a Rockefeller Foundation officer for the next 39 years. He won the Nobel Peace Prize for his Green Revolution work in 1970.

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By the end of the decade, the Mexican government had supplemented the Foundation's small research team with 79 Mexican scientists and agronomists, many of whom went on to postgraduate study in the United States on Rockefeller scholarships. The Foundation then began drawing Latin American agricultural fellows to the Oficina from universities it was supporting elsewhere in the hemisphere. By the time Fosdick had retired and completed a history of the Rockefeller Foundation in 1952, he was already noting evidence of an international bandwagon:

News of this cooperative undertaking spread rapidly to other countries. It traveled by word of mouth from the returning fellows, visiting professors, and others who

had personal contact with the project, and by the printed word of technical papers and other publications reporting the results of the researches and their application to crop improvement. Eventually, inquiries began to come from other Latin American countries, ...inviting the Rockefeller Foundation to collaborate. ...Reports from Asia indicate that accounts of what was done in Mexico have circulated there.

In 1957, the Rockefeller Foundation started a similar country program in India and three years later the Rockefeller and Ford Foundations jointly created the International Rice Research Institute at Los Baños in the Philippines. These two steps opened an Asian front in the spreading revolution, which continued accelerating for decades.



Borlaug with students in wheat field, Mexico, 1964.

Africa is a more complex challenge from those faced by earlier revolutionaries.

The point of this story is not to relive a distant chapter of foundation history. The point is that the Green Revolution was not solely a triumph of unfettered science, Western largesse, or the free market—three of the favorite solutions in much of the popular debate over Africa today. It was, at its origins, a strategic act of philanthropy, enlisting experts, government, and ultimately local scholars and farmers in a carefully wrought partnership that grew geometrically—and deliberately—over many years. Science, donations, and market forces all played an indispensable part; but all were guided, in the first instance, by a philanthropic plan.

A similarly decisive initiative from philanthropy—perhaps even more challenging than the first Green Revolution, but surely within the means of today's foundation community—could well spark a new Green Revolution, this time for Africa. As in the first instance, success is far from assured. Africa is a more complex challenge from those faced by the earlier revolutionaries. Still, the basic elements of the first Green Revolution still apply, at least in broad strokes, to the needs of African farmers today: scientific development of more productive crops and fertilizers; cultivation of local talent in plant science, farming, agricultural policy, and business; strong commitment from national governments; and public-private collaboration on infrastructure, water and irrigation, the environment, and building markets for the inputs and outputs of a revolutionized farm sector.



Maize field, Uganda.

Where the next revolution begins

Consider a typical African smallholder farmer, one of 180 million across the sub-Saharan region. She (many are women, virtually all are heads of individual families) farms one hectare of land, the size of an American city block. The farm is largely a subsistence operation. In good years, a small surplus might be bartered or sold locally, but there are likely no warehouses or processing companies to preserve excess crops for later sale, and transportation to city markets over poor roadways is difficult, costly, time-consuming, and sometimes dangerous. There is no irrigation and probably little or no chemical fertilizer; the farm depends on nature for water and fertility. In a bad year, due to any combination of pestilence, disease, environmental degradation, drought, or other hostile weather, the farmer and her family will go hungry. This precarious existence is neither rare nor extreme by sub-Saharan standards: 60 percent of all Africans work in agriculture,

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and three-fifths of their farms are small, run mainly for subsistence. Half the population of sub-Saharan Africa earns the equivalent of 65 cents a day on average.

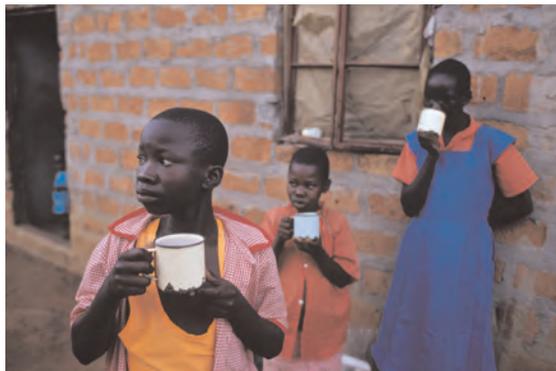
On this typical farm, the children are an essential part of the workforce. If they are lucky, they may go to school for a few hours a day, but most family farms require all hands. Long days of stoop labor, meager nutrition, and rampant disease, including tuberculosis, malaria, and AIDS, make life expectancies short and pose a constant threat to the farm's operation and the family's survival. With few skills and no disposable resources, children have scant hope of migrating to cities and finding non-farm employment. If they survive to adulthood, most will have to start new farms—either on a small piece of land they receive from their family or by expanding the cultivation of land farther and more often, inefficiently and unsustainably.

A main reason for the inefficiency is that the crops on the great majority of small farms are not the high-yielding varieties in common use on other continents. A small African farm

is less than one-third as likely to use such crops as one of its Asian counterparts. Thus the only way to grow more and support more families is to cultivate more land. Yet that stringent arithmetic suggests a latent opportunity: If better seeds could reach this farmer, along with techniques for using them effectively, the inefficiency and risk of food shortages could be reduced or eliminated. In time, the farm could be converted from subsistence to surplus, with the additional harvest available for sale, locally or regionally. Still greater yields would come from improved fertilizer, given the right combination of seeds, soil, and added nutrients.

But the challenge of bringing higher-yielding seeds to Africa's small farms is more complicated than it was in the earlier Green Revolution. Among other factors, Africa's climate, soil, and range of suitable crops are all far more diverse than in Asia or Latin America. In addition, irrigation was far more widespread in Asia than it is in Africa, and there are fewer teams of trained scientists available to work in large breeding programs.

Yet it is possible to develop higher-yielding crops suitable to Africa's various regions, particularly if the region's farmers are part of the breeding, testing, and selection process. It is possible to deliver these superior seeds to farmers, and to help them use the seeds effectively. In fact, all of these things are already being done, at least in select regions. The process is necessarily more decentralized than in the first Green Revolution, with many breeding programs working on many more niche environments, in close collaboration with local



Children at daybreak, Kenya.

farmers. Extending this enterprise across all of sub-Saharan Africa would take time, significant investment, and particular effort to recruit and train generations of African scientists. Africa's version of a Green Revolution may not be as immediate and sweeping as the earlier one, but it could be just as profound, with consequences every bit as life-saving.

Early milestones in raising yields

The idea is neither hypothetical nor farfetched. The Rockefeller Foundation's six-year-old program on improved crop varieties for Africa has helped establish a credible, promising beachhead on all these fronts, at least in parts of the continent, primarily in the east and south. Relying on grants to African and multinational organizations, for projects led primarily by African scientists, the Foundation has supported the development and release of more than 100 new crop varieties, dozens of which are already in use. One example among many is the breeding of a breakthrough rice variety that stands up to the particular challenges facing rice farmers in Africa's upland regions—including weeds, drought, pests, and diseases that have hindered African rice cultivation for centuries. Since the new varieties reached the market in the late 1990s, they have proven both popular and successful. Known as New Rice for Africa, or Nerica, the various strains are now cultivated on more than 300,000 acres across the continent. Besides the benefits for the food supply and farm incomes, the spread of Nerica has had a measurable, far-reaching social effect: The rice's shorter growth cycle and strength against weeds has boosted school attendance among children who are now less needed in the fields.

Given the need for local specificity in developing seeds, a critical element of crop-breeding programs is the recruitment and training of African scientists familiar with the circumstances of the particular areas where they work. Many of the scientists working on the Rockefeller-sponsored projects grew up on farms similar to the ones with which they are now working. The Foundation is supporting some 25 crop-breeding teams working within various national agricultural research institutes, as well as the training of about 50 students pursuing doctoral degrees in plant breeding and another 30 to 40 completing master's degrees. Though this is barely a start on the total number of scientists needed for a full-scale Green Revolution in Africa, the influx of new talent will make it possible to triple or even quadruple the number of national breeding programs over the next several years.



Biotech lab, National Agricultural Research Organization, Uganda.

In addition to better seeds, another essential element of the first Green Revolution was the widespread use of better fertilizers.

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Farmer examining harvested beans, Kenya.

In addition to better seeds, another essential element of the first Green Revolution was the widespread use of better fertilizers. But this, too, is an area in which the challenges of a second Green Revolution will be steeper than in the first. In Africa, where roads are poor and rail and waterways scarce, by the time fertilizer reaches a small farm, transportation costs alone will have driven its price to more than twice the world market level—far beyond the means of most subsistence farmers. Government trade policies, taxes, and other factors often push the price even higher. Fortunately, the attention of public and private organizations to this issue has lately grown much more intense, as evidenced by the Africa Fertilizer Summit in June 2006 in Abuja, Nigeria. One significant outcome of the Summit: More than 40 national governments agreed to lift all cross-border taxes and tariffs on fertilizer. Various pledges and agreements sought to strengthen the nascent

industry of “agro-dealers”—village retailers who sell seeds, fertilizer, and farm tools—to build market mechanisms for helping farmers buy better inputs and learn how to use them. Participants in Abuja also agreed to establish an African fertilizer-financing mechanism within the African Development Bank, starting with a \$10 million pledge from Nigeria, to finance the various efforts that the Summit set in motion.

The growth of the “agro-dealer” industry is worth a particular note. Across a vast, sparsely populated landscape, the distribution of farm inputs and the knowledge of how to use them can be prohibitively difficult. Agricultural extension, a mainstay of farmer education and technology transfer in the West, is still a rudimentary system, at best, in most of Africa. But by training village merchants in the basics of retailing farm supplies—including how to help farmers understand and use the products—and by helping them finance their businesses with loan guarantees and other credit support, Rockefeller Foundation grantees have cultivated a new market sector that strengthens both small retailers and small farmers.

[8] *Imagine that an eventual increase in harvests...results in regular surpluses. How would the additional crops get to market?*



Bugoma Cereal Bank, Kenya.

Beyond the farm

It would be a significant achievement, well worth pursuing on its own, just to reduce the hardships of subsistence farming and improve yields enough to lower the chronic risk of shortages and starvation. But a real Green Revolution would embrace a more expansive vision. Imagine that an eventual increase in harvests, due to superior seeds and nutrients, along with generally better farming practices, eventually results in regular surpluses. How would the additional crops get to market? How could they be stored and preserved in the meantime; who would process and otherwise add value to them? A successful revolution in African agriculture would depend on the growth of stronger market systems, better

infrastructure, and the technology to make the various transactions efficient. In most of Africa, all these essentials are still rudimentary at best.

Yet it is possible to imagine, over time, breaching most of these later-stage obstacles. As with crop breeding, the Rockefeller Foundation's early experience in supporting markets, cooperatives, and small enterprise in rural Africa suggests an opportunity to do a great deal more. Foundation grants have met with some success in helping farmers form cooperatives to store, transport, and market their produce. Microfinance and agricultural lending programs have grown in recent years, also with help from foundations and other

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donor agencies, though the need is still mostly unmet. A few public and international development programs have contributed to improvements in infrastructure, though this remains a huge challenge. Business-friendly policies to encourage the formation of processing, trucking, and equipment enterprises, among many other market essentials, are still less common in Africa than they need to be, though they have shown progress where they have been pursued.

These are all areas in which partnerships with African governments, involving philanthropy, other international donor and finance organizations, and private industry, could be powerfully influential. Although the first Green Revolution did not confront quite so broad a mix of variables, it did rest on precisely the kind of public-private partnership through which many of Africa's current problems could be effectively addressed. The Fertilizer Summit is an example of just such an undertaking: It was convened by an African development organization under the leadership of a head of state, and sponsored by a broad partnership including the Rockefeller Foundation, the British Department for International Development, four prominent international agricultural development organizations, and two international fertilizer trade groups. And it drew participation from roughly two-thirds of Africa's national governments.

The challenge in brief

The vision of a new Green Revolution for Africa is a single challenge in several layers. At the most fundamental level is **improved seed varieties** for larger, more diverse, and more reliable harvests. That requires not only an astute application of science, but the development of new generations of **trained African agricultural scientists**.

A second tier involves **better inputs and practices**, including the use of fertilizer and other soil and water management techniques. Part of this challenge is the development of a more robust market for bringing new products to farmers in a manner—likely through “**agro-dealers**”—that enables the farmers to put the innovations to use.

Next up the ladder is the development of stronger **off-farm systems and markets**, from storage to transportation to processing and final sale. Though this is a more complex and wider-ranging task than the others (and more demanding than anything directly pursued in the first Green Revolution), it represents perhaps the greatest opportunity for a fundamental transformation in Africa's agricultural economy and the future livelihoods of poor farmers.



Tororo District, Uganda.

Also beyond the farm would be the great capital challenges of better **infrastructure** and, where possible, larger **irrigation** systems. Although these are not areas in which the Rockefeller Foundation has made significant investments, both are subjects of increasing inquiry and investment by others. Supportive national policy reforms can also play an important role.

Most of all, underlying all of this, is the essential challenge of forging strong and expanding **partnerships**, with a decisive leadership from institutions and governments, both in Africa and elsewhere, that are willing to get started and pursue the vision. That was the indispensable beginning of the first Green Revolution. There will likely be no second one without an exertion of similar determination and path-breaking investment. That process seems to be starting. Drawing the current, promising efforts into a coherent whole, supplementing them with further investment and a wider circle of partnerships, and pursuing them determinedly over a long term could spark the first great peaceful revolution of the 21st century.



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