Views

Agriculture in the Third World

Norman E. Borlaug

Norman E. Borlaug, who has been called the father of the green revolution, was awarded the Nobel Peace Prize in 1970 for his work in developing high-yielding varieties of wheat.

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Picture the annual world harvest of cereal grains as a "highway of grain" circling the earth at the equator. This imaginary highway would be 65 feet wide, 8 feet deep, and a little over 25,000 miles long. The world's people consumed this entire amount of grain last year. This year the highway of grain must be reproduced in its entirety and another 650 miles added to its length just to feed the growing world population at the same, and often inadequate, level. More than half of this food and 80 percent of the additional food requirements each year will be consumed in the less developed countries of Asia, Africa, and Latin America, where more than 3.5 billion of the world's 4.7 billion people live.

World food production of all types is today about 4 billion metric tons, representing about 2 billion tons of edible dry matter. Of this total, 99 percent is produced on the land; only slightly more than one percent comes from the oceans and inland waters. Plant products constitute 93 percent of the human diet, with about thirty crop species supplying most of the world's calories and protein. These include eight species of cereals, which collectively supply 52 percent of the total world food supply.

Until the mid-1960s, very little agricultural research was being conducted in most of the developing world on the major food crops. The network of international agricultural research centers, established over the past two decades to work on the major food crops and farming systems of the developing world, has been important in stimulating agricultural research in the Third World. The improved varieties and production practices developed by scientists

In his research with wheat varieties, Borlaug has worked with short-stemmed triticale (center), which has a bigger head than its two parents, rye (left) and wheat (right).

Science Year photo by Ted Streshinsky, © 1983 World Book, Inc. By permission of World Book, Inc at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico and the International Rice Research Institute (IRRI) in the Philippines, in conjunction with researchers in developing countries, did much to avert the spectre of famine for millions of people in the 1960s and 1970s.

The green revolution. The introduction of high yielding wheat and rice varieties, in combination with other improved agronomic practices (especially fertilizer) that permitted these varieties to express their high genetic yield potential, has had a major impact on transforming food production in Asia, the world's most populous continent. Although larger farmers in favorable production environments were the first to benefit from green revolution technologies, they were soon followed by smaller farmers.

Today, both large and small Asian farmers are harvesting nearly twice as much wheat and rice — 250 million extra tons annually — as they did two decades ago. Coined the green revolution, this transformation has few parallels in the history of agriculture, other than perhaps the spread of hybrid corn in the United States during the 1940s and 1950s.

New green revolutions needed. Despite the tremendous food production successes achieved in Asia, the Middle East, and parts of Latin America in recent years, agriculturalists today face even greater production challenges to feed future generations. New green revolutions must occur in the more marginal production areas of Asia, Sub-Sahara Africa, and parts of Latin America. Such areas are generally rain-fed environments with difficult production conditions such as moisture and temperature stresses, soil fertility problems, and diseases and pests.

Some lessons learned. How can we help ensure that these new green revolutions in food production will indeed occur? In reflecting on my forty years of personal experience in attempting to assist developing nations improve the productivity of their agriculture, I have learned certain lessons that bear directly on the challenge ahead:

1. Despite the fact that 50 to 80 percent of the total population in the Third World directly engages in agriculture and animal husbandry, the agricultural sector in virtually all developing nations is the economic "ugly duckling" that is exploited for the benefit of the minority in the urban sector. Relatively low priority is given to investments in crop research, water resource development, rural roads, input delivery systems (for seed, fertilizers, pesticides), credit, and grain storage facilities.

This "exploit-the-agricultural-sector" political tilt is also manifested in cheap-food policies sponsored by many governments of developing nations in order to keep food prices low and, consequently, the better-organized urban sectors quiet. Too often, these policies are reinforced by easy-term food aid and surplus disposal programs sponsored by food-exporting nations. Such policies have time and again retarded agricultural development in food-deficit, developing nations. Obviously, food aid is another matter in times of emergencies caused by natural disasters such as droughts, floods, frosts, and disease epidemics.

2. A low-yield, stagnant, traditional agriculture cannot be transformed into a high-yield, productive agriculture without the development and widespread application of a package of improved technology. An aggressive, interdisciplinary research effort is essential for developing such packages. The new technological practices must have the potential, when properly applied, of increasing yields

Borlaug, pictured here at CIMMYT, the International Maize and Wheat Improvement Center in Mexico. An important part of Borlaug's work focuses on teaching young scientists his techniques. He is also a strong advocate of transferring research findings to farmers through extension activities.
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on farmers' fields by at least 50 percent (often yields can be increased several fold) over that of the traditional methods. Moreover, this increased yield must be achievable within acceptable levels of risk for the farmer. Appropriate economic policies are also essential in stimulating the farmer to shift to improved technologies.

3. Effective research programs, capable of developing useful methods and materials for revolutionizing crop production, require continuity both of scientific personnel and program objectives. Generally it takes a minimum of six to eight years of creative, dedicated, and adequately supported research work in various disciplines to produce the information and improved varieties from which a package of improved production practices can be formulated.

The refinement and transfer of appropriate production technologies requires the skill of agricultural scientists — integrators — who are also interested in increasing agricultural production to serve human needs. Once developed, the production package must be tested on many farms and modified as necessary to reduce farmers' risk as much as possible.

Research integrators must also be able to anticipate and sense when political leaders are willing — often because of serious, pending food shortages — to make important changes in agricultural development strategies. Often at such moments a scientist can best convince national leaders to put into place the three economic pieces of the jig-saw puzzle, namely, the availability at reasonable prices of the necessary production inputs (especially fertilizers), credit for the small farmer before the sowing season, and adequate output prices at harvest that are announced before the planting season. With these pieces in place, an aggressive, well-publicized national production campaign can be launched with support from the agricultural extension service staff.

4. Agricultural extension programs in developing nations have often been accused of not transferring improved technology from experiment stations to farms, thereby contributing to the perpetuation of low yields and in turn to worsening food shortages. In most cases, the so-called new technology emerging from experiment stations has been economically nonviable, incapable of increasing yields adequately within acceptable levels of risk to the farmer. The result is agricultural stagnation and, in fact, often a reduction in per capita food production.

Clearly, the development of an agricultural extension service that is not closely linked to a dynamic research system has little to offer farmers in the way of improved technology. With the development of national research and production systems, however, I am confident that agricultural extension systems in developing countries can become more effective in the years ahead. Also encouraging is the growing trend for at least part of the technology to be generated on the fields of farmers who are representative of those for whom the technology is being developed.

What the United States can do. The United States can and must play a critical role in solving the food-poverty dilemma in the Third World. First, as the largest food exporter, the United States will continue to serve as the world's breadbasket. While there is an oversupply in the international grain markets today, U.S. farmers face long-term prospects of considerably greater world demand for their agricultural products. Second, the United States has done more than any other country to transform its agriculture into a dynamic, highly efficient production system. Through scientific institutions like the University of Illinois and our foreign aid program, we have an even larger role to play in future years to help assure the agricultural development of the poor, food-deficit nations of the world.

The lack of continuity in many U.S. technical assistance programs has seriously affected the payoffs from past efforts. One of the main reasons is that the turnover of expatriate scientific staff is too rapid. Assignments of two to three years are of little value to the host country. It takes a minimum of three to five years for visiting scientists to familiarize themselves with the order of importance of the agricultural problems, language, and culture of a new country and to contribute productively to agricultural development.

The motivation for U.S. technical assistance has self-interest as well as humanitarian elements to it. In this increasingly interdependent world, no country, however rich and abundant in resources, can exist as an island unto itself. International trade is essential today to the economic well-being of every nation; history has proven that chronically food-deficit, low-income countries don't make dynamic trading partners.

Further, peace on earth will never be achieved as long as a fourth to a third of mankind lacks the basics of life: adequate diets, shelter, health care, education, and employment opportunities. As we should know by now, overpopulation, poverty, and hunger are the breeding grounds for revolution.

Cautious optimism. In summary, I believe that, if proper emphasis is given to agriculture and if sound financial policies are established and implemented, the line can be held on the food production front during the time of the next doubling of the world population. If this is to be achieved, it will require far fewer words and sensationalized reports and much more research action and production. Moreover, it must be remembered that producing more food and fiber and protecting the environment can, at best, be only a holding operation while the "population monster" is being tamed.

The attitudes of scientists, political leaders, and the general public will be decisive in determining whether we reach — or fail to reach — the food production targets needed to sustain world civilization. If we fail in this endeavor, it will only prove the irrelevance and folly of whatever feats we accomplish in all other walks of life.

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