INVESTING IN INTERNATIONAL AGRICULTURAL RESEARCH AND DEVELOPMENT—A PREREQUISITE FOR PEACE

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I am now in my 57th year of continuous involvement in agricultural research and production, working primarily in the low-income, food-deficit developing countries. I have worked with many colleagues, political leaders, and farmers to transform food production systems through the introduction of productivity-enhancing technology. On the production side, there have been both winners and losers, although I submit that winners far outnumber the losers. However, on the consumption side, there mainly have been winners. We ended the 20th Century with world market prices for wheat, maize and rice, adjusted for inflation, at the lowest level they have ever been. While all consumers have benefited from these lower food prices, the poor have benefited relatively more, since they spend a larger portion of their income on food. However, despite all of the successes of the so-called "Green Revolution," the battle to ensure food security for hundreds of millions of miserably poor people is far from won.

Meeting Global Food Demand

By the year 2025, global demand for maize will likely approach one billion metric tons, and wheat and rice about 900 million metric tons. To meet future food and feed demand of 2025, annual production of these three cereal grains—which account for more than 60 percent of the world food supply—will have to increase collectively by more than 600 million metric tons. It is likely that demand for poultry and livestock products will increase more rapidly than the cereals, if income levels in the developing world improve in real terms.

The United States today is the largest producer of food surpluses, with current agricultural exports in excess of $53 billion annually. This pre-eminent position is not accidental, nor is it exclusively due to natural resource endowments. Rather, it is the result of investments in agricultural education, research, and extension; mechanization and transport; fertilizers; irrigation; energy; credit; stimulatory agricultural policies; and lastly, but certainly not least, extremely enterprising farmers and ranchers. The demand

for U.S. agricultural products is likely to be very strong in the coming two decades. Indeed, IFPRI estimates that 60 percent of the food exports to the developing world will be supplied by the United States.

It is important for Americans—and especially decision makers—to understand the critical interdependency between U.S. agriculture and Third World economic development. Indeed, there is a strong correlation between developing countries that have the highest agricultural growth rates and those that increase their grain imports the most. Imports have grown in developing countries with rapid agricultural growth, not because domestic production has failed but because rising incomes have sparked stronger demand for grain and livestock products than expanding domestic production can satisfy, and these countries generally have the foreign exchange to pay for more imports.

Recent Trends in Agricultural Research Funding

During the past two decades, U.S. support to the public sector national research system has slowly declined, while support for international agricultural research has dropped so precipitously to border on the disastrous. If these trends continue, we risk losing the broad continuum of agricultural research organizations—from the more basic to the more applied and practical—needed to keep agriculture moving forward. Strong public sector research programs also are needed to provide dynamic research environments to train new generations of scientists. They also have a role to play, I believe, as "honest scientific brokers" so that farmers and consumers do not become hostages to private sector research monopolies.

One important characteristic of publicly funded research is that the information and products that it produces historically have tended to be quite freely available, not only to U.S. scientists but also to the international scientific community. The benefits of this scientific sharing have been enormous, and have gone both ways. Per Pinstrup-Anderson will report on the benefits to U.S. agriculture from investments at the CGIAR centers. I will not mention the IFPRI data, except to say that the benefits of international cooperation are undoubtedly much greater than the figures IFPRI researchers have calculated.

Permit me to give just two examples. The advent of international germplasm exchange and testing began in the early 1950s in wheat, in response to a devastating stem rust epidemic in North America. At the time, all U.S. and

Canadian wheat germplasm was susceptible to a new race of stem rust, called 15 B. The situation was critical. In search of resistant germplasm, the USDA appealed to other research programs in the Americas for access to possible resistant materials. The Mexican Government-Rockefeller Cooperative Agricultural Program with which I was associated, as well as several national agricultural research programs in South America, responded rapidly, agreeing to exchange a broad range of their best early- and advanced-generation breeding materials, and to test these materials at many locations. Out of this initial effort, new sources of stem rust resistance were identified that have held up to this day. Indeed, no stem rust epidemics have occurred in the Americas in nearly 50 years.

In addition, a new institutional innovation and hallmark of the ***Future Harvest*** **CGIAR centers**—international germplasm exchange and testing—was in the making, which continues to bear fruit today. International germplasm testing broke down the psychological barriers that previously had isolated individual breeders from each other, and led to the introduction of enormous quantities of new and useful genetic diversity. It became accepted policy that individual breeders could use any material from these international nurseries, either for further crossing or for direct commercial release, as long as the original source of the germplasm was recognized. This led to the accelerated development around the world of new high-yielding cultivars, with much higher levels of disease and insect resistance, and ushered in a golden age in plant breeding.

Another major contribution of international agricultural research cooperation, which has benefited not only the United States, but all of humankind, were the germplasm collection efforts of native landraces pioneered by the Mexican Government-Rockefeller Foundation agricultural program during the 1950s, with subsequent assistance from the U.S. National Academies of Science. In maize, for example, extensive germplasm collecting work of the native land races was undertaken in Mexico and Central and South America and deposited in seed banks held at CIMMYT and in several countries of the Americas. These seed banks contain most of the genetic diversity of the maize species in the world. Had this work not been undertaken then, much of the biodiversity in maize would have been lost by now.

Educating Affluent Urbanites about Agriculture

The current backlash against agricultural science and technology evident in some industrialized countries is hard for me to comprehend. How quickly urbanites become detached from the soil and agriculture, and how quick some environmentalists are to brand farmers and ranchers as natural resource plunderers rather than the stewards that they really are!

Through the application of science and technology, American farmers and ranchers have been able to increase agricultural production many-fold, and I contend, in ways that have helped protect the environment, not destroy it. For example, had the U.S. agricultural technology of 1940—when relatively little chemical fertilizer and agricultural chemicals were used—still persisted today we would have needed an additional 575 million acres of agricultural lands—of the same quality—to equal the aggregate production of 700 million metric tons for the 17 main food and fiber crops produced in the United States in the 1996-97.

Put another way, a land area equal to the total area of all of the 25 states located east of the Mississippi River has been spared for other uses, thanks to the productivity increases achieved through agricultural intensification. Imagine the environmental disaster that would have occurred if hundreds of millions of acres of environmentally fragile lands not suited to farming had been ploughed up and brought into production! Think of the soil erosion, loss of forests, grasslands and biodiversity, and extinction of wildlife species that would have ensued!

To be sure, we all owe a debt of gratitude to environmental movement in the industrialized nations, which has lobbied to create legislation over the past 35 years to improve air and water quality, protect wildlife, control the disposal of toxic wastes, protect the soils, and reduce the loss of biodiversity. However, I agree with the environmental writer, Gregg Easterbrook, who argues in his book, ***A Moment on the Earth***, that "In the Western world the Age of Pollution is nearly over…Aside from weapons, technology is not growing more dangerous and wasteful but cleaner and more resource-efficient. Clean technology will be the successor to high technology."

However, Easterbrook goes on to warn that, "As positive as trends are in the First World, they are negative in the Third World. One reason why the West must shake off its instant-doomsday thinking about the United States and

Western Europe is so that resources can be diverted to ecological protection in the developing world."

I know that the environmental theme belongs to Ian Johnson, but I hope he will allow me to make a few more comments. In order to spare more land for non-agricultural uses in the developing world, the productivity of the land actually being cultivated must be increased in environmentally sustainable ways. The first condition for such improvements are the adoption of soil management strategies that restore and maintain soil fertility, in combination with the adoption of modern varieties and improved crop management practices. Sadly, soils are being mined in many parts of the developing world today at alarming rates, and especially in Africa where it is estimated by ICRAF that 1,250 kg/ha of NPK nutrients have been lost in about 100 million hectares of cultivated land over the past 30 years. In contrast, soil nutrient levels on farms in North American and Europe have increased over this same time period, sometimes resulting in groundwater and stream pollution.

Successful agricultural intensification requires other developments beyond science and technology, per se. In particular, efficient transport and marketing systems are needed to deliver inputs to the farm and take surpluses to markets, and at prices profitable for farmers. While the United States, Europe and other industrialized countries have developed efficient agricultural transport and marketing systems, this is not the case in many developing countries, and especially in sub-Saharan Africa. I am always struck by a figure given by Dr. Graeme Donovan, a World Bank agricultural specialist, which illustrates this point. It costs about US$ 45 to transport a metric ton of maize (corn) from a farm in Iowa to Mombassa, Kenya, 15,000 miles away, while it costs about US$ 100 to transport that same ton of maize from Mombassa to Kampala, Uganda, about 600 miles away. Now you can see why undeveloped transport systems in Africa continue to hobble efforts to get agricultural moving, and will continue to do so until the requisite infrastructure and institutions are put into place.

Peace and Agricultural Development

Almost certainly, the first essential component of social justice is adequate food. And yet there are upwards of one billion people who go to bed every night hungry. Particularly disheartening are the 200 million young children who go hungry each day, with this undernourishment leading to often-irreversible damage to their bodies and minds.

Thirty-one years ago in my Nobel Peace Prize lecture I quoted another Laureate, Lord John Boyd Orr, the first director general of FAO, who said, "you cannot build peace on empty stomachs." The recent 1999 FAO report, ***Assessment of the World Food Security Situation***, strongly substantiates his statement. Of the developing countries with the lowest undernourishment, only 8 percent were mired in conflict. In contrast, of those countries where more than half of the population was underfed, 56 percent were experiencing civil conflict.

A ***Future Harvest*** study commissioned through the Norwegian-based International Peace Research Institute in Oslo, also found that conflicts around the world are increasingly the result of poverty, rather than ideology or politics: "The new conflicts can be traced to the loss of livelihood and the hopelessness of surviving at the margins, which are driving many to pursue lives of crime and banditry and are reflected in the viciousness of the new armed conflicts."

Since the agricultural sector provides most of the employment in low-income, developing countries, it is not surprising that when this sector is allowed to falter, armed conflict often ensues. We cannot lose sight of the enormous job before us to feed 9-10 billion people projected to be living on the planet Earth by 2050, 90 percent of whom will begin life in a developing country and, sadly, probably in poverty. Increased investments in agriculture—research, education, production, and rural infrastructure—are the means to change this dismal projection. The United States Congress has the power to help make it happen.