

**COMMENTS BY NORMAN E. BORLAUG**  
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I am now in my 58<sup>th</sup> year of continuous involvement in agricultural research and production in the low-income, food-deficit developing countries. I have worked with many colleagues, political leaders, and farmers to transform food production systems.

The breakthrough in wheat and rice production in Asia in the mid-1960s, which came to be known as the 'Green Revolution', symbolized the process of using agricultural science to develop modern production techniques for the Third World. As a consequence, cereal production has tripled over the past 40 years and real grain prices have declined by more than half.

**Hunger Still Haunts Asia**

Despite the successes of smallholder Asian farmers in applying Green Revolution technologies, the battle to ensure food security for millions of miserably poor people is far from won, especially in South Asia.

A comparison of China and India—the world's two most populous countries—which both have achieved remarkable progress in food production—is illustrative of the point that increased food production, while necessary, is not sufficient alone to achieve food security. Huge stocks of grain have accumulated in India, while tens of millions of people need more food but lack the purchasing power to buy it.

**Sub-Saharan Africa—The Region of Greatest Concern**

More than any other region of the world, food production south of the Sahara is in crisis, due to high rates of population growth and little application of improved production technology. While there are some signs during the 1990s of improvement, this recovery is still very fragile.

There are so many conflicting voices today about “appropriate” technology for smallholder agricultural development in sub-Saharan Africa that it must be very difficult for policy makers to know what to do. In particular, confusion about fertilizer remains a major problem. It makes no biological difference to the plant whether the nitrate ion it “eats” comes from a bag of fertilizer or decomposing organic matter. Moreover, given the very low current levels of fertilizer use, and the alarming trends in declining soil fertility, a very strong case can be made that increased fertilizer use in SSA

is one of the most “environmentally friendly” things we can do. Our challenge is to supply adequate plant nutrients to the soil in the most efficient way possible, and bring an end to saddling the African farmers with fertilizer prices two to three times world market prices.

A new array of high-yielding, early-maturity, disease- and insect-resistant varieties and hybrids are becoming available from research institutions, especially for rice, maize, wheat, cassava, and several grain legumes. These materials open possibilities for new cropping patterns, involving food, cash, and green-manure crops. Minimum tillage systems offer great hope to check soil erosion, conserve moisture, and reduce the back-breaking drudgery of hand weeding and land preparation.

Nutritionally superior maize varieties are being enthusiastically adopted by substantial numbers of farmers in a growing number of countries, especially in SSA. In the not too distant future, we should have new rice types available with higher levels of vitamin A and iron to improve nutrition.

We have the knowledge to permit African farmer to prosper, and not just survive. Still lacking is the political, financial and institutional commitment to ensure that science and technology will be put fully to work in the service of the smallholder farmers and poor consumers of this vast continent.

With technology already available, farmers can quite easily double and triple yields in most of their food, feed and fiber crops. They do not adopt this technology largely as a consequence of high transportation costs.

Efficient transport is needed to facilitate production and enable farmers to bring their products to markets. While the condition of the main highways in Africa have improved somewhat, the condition of local roads—both in rural areas and in urban centers—is poor and generally worsening, as the volume and weight of traffic increases.

Not only will improvements in transport systems and other rural infrastructure (especially potable water and electricity) greatly accelerate agricultural production and rural economic growth, it would reduce rural isolation, thus helping to break down tribal animosities and establish rural schools and clinics in areas where teachers and health practitioners are heretofore unwilling to settle.

Finding the way to provide effective and efficient infrastructure in sub-Saharan Africa underpins all other efforts to reduce poverty, improve health and education, and secure peace and prosperity.

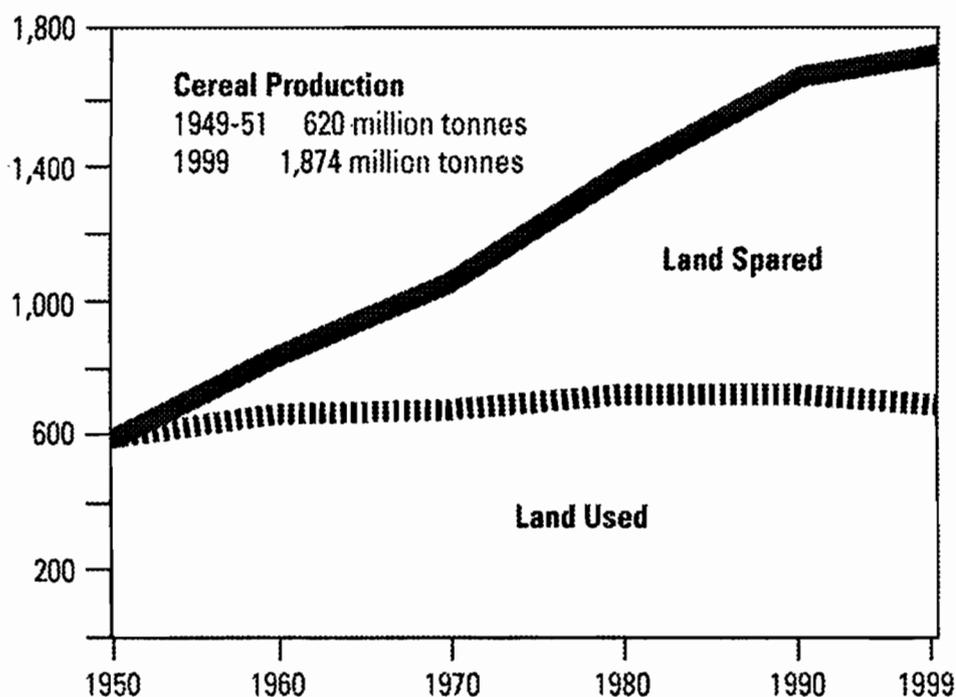
### **Technology and the Environment**

I often ask the critics of modern agricultural technology what the world would have been like without the technological advances that have occurred, largely during the past 50 years? For those whose main concern is protecting the “environment,” let’s look at the positive impact that the application of science-based technology has had on land use.

Had the global cereal yields of 1950 still prevailed in 1999 we would have needed nearly 1.8 billion ha of additional land of the same quality—instead of the 600 million that was used—to equal the current global harvest. Obviously, such a surplus of land was not available, and certainly not in populous Asia, where the population has increased from 1.2 to 3.8 billion over this time period. Moreover, if more environmentally fragile land had been brought into agricultural production, think of the impact on soil erosion, loss of forests and grasslands, biodiversity and extinction of wildlife species that would have ensued.

### **The land world farmers spared in cereal production by raising yields**

Million of hectares



### Closing Comments

Thirty-two years ago, in my acceptance speech for the Nobel Peace Prize, I said that the Green Revolution had won a temporary success in man's war against hunger, which if fully implemented, could provide sufficient food for humankind through the end of the 20th century. But I warned that unless the frightening power of human reproduction was curbed, the success of the Green Revolution would only be ephemeral.

I now say that the world has the technology—either available or well advanced in the research pipeline—to feed on a sustainable basis a population of 10 billion people. Improvements in crop management productivity will have to be made all along the line—in tillage, water use, fertilization, weed and pest control, and harvesting.

In crop improvement, we will need to apply both conventional breeding and biotechnology methodologies. The new tools of genetic engineering—if scientists are permitted to use them—can permit accelerated development of food crop varieties with greater tolerance to drought, heat, cold, and soil mineral toxicities; greater resistance to menacing insects and diseases; and higher nutritional quality levels. African governments should take care not to let these research products pass them by.

Of course, governments must prepare themselves with the necessary legislation and regulations to ensure proper testing of genetically modified crops. But they also must ensure that farmers have adequate access to the new technologies that come from these scientific developments.

The more pertinent question today is whether farmers and ranchers will be permitted to use the new technology? While the affluent nations can certainly afford to adopt ultra low-risk positions, and pay more for food produced by the so-called “organic” methods, the one billion chronically undernourished people of the low-income, food-deficit nations cannot.

It took some 10,000 years to expand food production to the current level of about 5 billion gross tonnes per year. Within 25-30 years, we will have to nearly double current production again. This cannot be done unless farmers across the world have access to current high-yielding crop-production methods as well as new biotechnological breakthroughs that can increase the yields, dependability, and nutritional quality of our basic food crops.