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From the Green to the Gene Revolution: A 21st Century Challenge

Norman E. Borlaug

USDA Agricultural Outlook Forum

Arlington, VA

February 24, 2005



FROM THE GREEN TO THE GENE REVOLUTION
Edited Transcript

NORMAN BORLAUG
1970 Nobel Peace Prize Laureate
And Distinguished Professor for
International Agriculture,
Texas A&M University

SECRETARY JOHANNS: Ladies and gentlemen, now I have just a genuine honor and that is to introduce our keynote speaker. I'll invite him up to the podium as I say a word or two. I had an opportunity yesterday to speak to Dr. Norman Borlaug. I told him that growing up on that farm in Northern Iowa I knew of him because he came from a community just down the road and I know he's very familiar to everybody in this room. His humble beginnings like mine were in a little Iowa community called Bresco. Now, many of you probably don't know this, but I will tell you that they always had great wrestling teams and they would come to Osage and whoop on us. But you are known for so much more. Not only has he made his home state proud, but his accomplishments are a source of pride for our nation and a credit to the power of what a single person can do.

Norman Borlaug started his career in the 1930s as a forester with the USDA Forest Service. Back then he was working on the Salmon River and he developed a reputation as the most isolated forest service employee. But if isolation was what he wanted, he went about it the wrong way. Instead, Dr. Borlaug went about proving that science and technology could change the world. He helped to solve some of the most intractable problems like hunger. He is known as the father of the Green Revolution, but in a way titles scarcely describe what he has really done. He won a lot of awards, including the Nobel Peace Prize, but awards don't accurately describe his accomplishments because in the end the most important question is, how many lives has this good man saved? Across the world, there are literally hundreds of millions of people who might never have heard of Norman Borlaug and yet they owe their very lives to him. There are men and women and children who have lived and grown stronger and healthier thanks to the work of this fine man.

We are here today to discuss the ways in which science and technology can change the world. Dr. Borlaug is the textbook case to prove that it can be done. Science and technology are Dr. Borlaug's weapons in the fight against hunger and misery. He has wielded them for virtually his entire life. And today, almost 70 years after he put on a USDA Forest Service uniform, he continues to inspire us with his wisdom, his commitment and most of all his compassion.

Ladies and gentlemen, would you help me give a very warm welcome for a good friend, Dr. Norman Borlaug.

DR. BORLAUG: Thank you. Thank you Secretary Johanns. Ladies and Gentlemen, it is a pleasure to be here. I'm an old fossil from the standpoint of science and technology. When the Secretary was telling about the current yields of corn, for example, I reflect what the yields were when I was a boy; on a good year in Northeast Iowa, 30 bushels an acre. On an average year, 20. Think of the implications of

the yields that were mentioned by our Secretary. This technology has of course changed the world. I'm going to try to give you some insights into how I see the world food problems for the future. I must tell you all that I will reflect what I have seen over these past 60 years in the third world countries. If we want peace and tranquility here at home, a lot of that will depend on what happens in other parts of the world from the standpoint of food production and availability to the masses of people. I'm going to use PowerPoints that my long time colleague Chris Dowswell prepared and go through these rapidly. Some of these outstanding points have influenced third world agriculture and indirectly influenced both our own agriculture from the standpoint of exports and imports of certain kinds of goods.

We will take a look at the first so-called statistics of the Green Revolution. First, let me say that the Green Revolution was a term first used on April 8th, 1968 by the director of USAID, or administrator, William Dowd speaking to a small group here in Washington interested in international agriculture and development. He was the first to use it. What constituted it? What are the components of the Green Revolution? I might say when he used this term he was talking about the changes that were coming forth in the third world. They were not Red Revolutions like happened in the Soviet Union, nor were they White Revolutions like in Iran. It was a Green Revolution based on science and technology. And a year before it happened, he said Pakistan will be self-sufficient in wheat and rice in 1979. He was writing this in '78. India will be moving in that direction, it already is, and in four or five years it will be there, too. He was right. While he was writing this, I was in Pakistan writing a report to their President and Secretary of Agriculture that they had reached self-sufficiency.

Okay. What were the components? On those two columns, you will see there were none of these high-yielding dwarf wheat and rice variety grown in the '60s. By '65, I won't bother about figures, you can see the millions of hectares in the first column and the percentage of the total cultivated area of these crops. In the year 2000, it was 70 million hectares, 84 percent of the total wheat area in the developing country in the wheats and similarly in rice, 100 million hectares, 74 percent of the area. Irrigation, double. Irrigation is important in many of those areas where the winters are mild or short because it lends itself to multiple cropping on the same land. Look what happened to fertilizer nutrients, from 2 million nutrient tons to 70 million nutrient tons.

Remember, all of my work has been on worn out lands in the third world, not beautiful lands like much of our high-producing areas. So fertilizer nutrients are of tremendous importance no matter how good the variety. There is no magic. That house is built in genetic yield potential, but you can't eat that potential until it is converted to grain. That means restoring soil fertility using the proper agronomic practices, including weed control, control of insects and diseases, and finally hooking it all up with economic policies. Availability of those inputs at the farm level six weeks before planting, credit for the little farmer.

Remember in India and Pakistan, especially India, you're dealing with mostly farmers of 6 to 8 acres and they have no cash. So they need credit to buy the input at time of planting, pay for it at harvest. Then you also had to change the whole question of policy on pricing where there are hungry, miserable people in big numbers. With few exceptions, political leaders will say we have so many poor people, we have to keep the prices of food low. They are kept at 60 percent of the international price. That's the way it was. You have to get that ceiling off, permit the reflection of the international prices. You see the technology is one part; developing, demonstrating it in thousands of farms; and then at the right time getting the political leaders to make those economic policy changes that permits this technology to be applied. Look what happened in cereal production. It essentially, in the developing countries of Asia, increased threefold from roughly 300 million to 960 million metric tons and mostly in 30 years.

We move on. The Secretary mentioned land saved. This is for the world cereal production, 1950 to 2000, all cereal. Production in 2000 was a 1 billion, 900 million compared to the 650 million in 1950. Had we tried to produce the harvest of 2000 with the technology of 1950 we would have had to increase the cultivated land area of the same quality of land by 1.1 billion hectares. The third world, especially Asia, didn't have it. The only approach was through yield increase.

We move on. There were indirect things that happened that I never in my fondest dreams would have expected; see what's happening in Punjab and Haryana. All the land that was available was in cereal, yields miserably low. Now there are some very creative farmers, pretty largely on their own, later with support from research, that are growing poplars in an eight and now being reduced to six-year rotation. Poplar is all for wood production, wood is scarce in those countries. They grow the wheat under irrigation intensively until the canopy closes in six years or so and harvest high yields, but a large amount of wood is produced in a small wood-using industries; so a lot of employment has to come into being. Who would have thought this possible during the '50s and '60s when many in our own academia said India, Pakistan are hopeless causes?

We move on to the indirect values. What has happened -- this is in the USA, but I can refer to it, close to where the Secretary grew up, he will remember. He was outside of the drainage of the Turkey River, I was on the Little Turkey River on the farm where I lived. There were no turkeys there. During my dad's lifetime, there were no turkeys. My granddaddy said there were few when I was a boy. Now they are back in large numbers thanks to wildlife. But land has been taken out of production for conservation purposes. The same thing with whitetail deer: there were none around that area. Now there are so many they're a pest. Now we look to the west, the area where I used to be in Idaho. The elk population, especially on the national forest, was overpopulated, eating all the underbrush, and with all the reproduction it was a miserable situation. But who would have ever thought that it would have been possible to reintroduce the wolf to bring in to better balance those populations of elk? These are changes that have come about and there are compensations for sheep, if some of them happen to be killed off by a wolf. But these are changes that I could never visualize could happen.

We move on. What has happened in agriculture in the very intensive cultivation in the last 30, 40 years is happening in forestry. This happens to be a picture of Aracruz cellulose production in Brazil, a very progressive company using high yield production of bleached eucalyptus, but they are also producing seedlings and encouraging the restoration of the rain forest species. This is a company that has long time perspectives, and one of our own U.S. forest product companies is involved now indirectly with them in a new adventure. There will be more of this in the future. Intensive forestry will replace extensive forestry, just as has happened in agriculture. This will leave much more land available for the indirect benefits for wildlife, and for diverse vegetation.

We move on. Africa once was inhabited by a large number of wild species. Today it's mostly confined to national parks and that land you see with the wilde beast and zebras, will be plowed up in the next 40, 50 years unless we can produce food that is needed on land that is not in national parks or reserves.

We look ahead to where is our food coming from. Our food supply by the year 2050, largely 85 percent of it, will come from additional increases in yield per hectare or per acre. There are very few areas in Asia that can be opened to more cultivation. As a matter of fact, in many of those countries their land in cultivation should be taken out, put back in forest or grassland. So the limitations or the places where expansion area can be made in rainfall areas that are adequate is in South America, especially Brazil.

We have many of those types of soils in certain parts of Sub-Saharan Africa, but we can't talk about those at the present time because of lack of infrastructure.

We move on to the Chinese. The tremendous change that has taken place there over the last 30 -- well, actually it's been more like 20, 25 years. I can't believe that change. Part of that change in wheat was Mexican technology that was developed that made the Green Revolution in India, Pakistan, all the Middle East, and it went into China from Pakistan. It got there eight years before I got there to see it growing. I'm talking about spring wheat. The change that they have made, it started a decade later than India and Pakistan. They caught up and passed and in some ways, especially distribution of benefits, distribution of food, they have done a better job than either Pakistan or India.

Now, what else is happening there? Look at how their meat consumption has changed. Notice the imports of soybeans. China is the second largest producer of corn (maize), in the world, but has a big shortage of soybeans. Look at how the soybean imports, millions of tons, have scooted sky high in the last three or four years. These are things that are coming about indicating vast improvement in the diet of Chinese people.

We move on. Where are the places where there can be expanded cultivation? For you, American farmers and officials of the government, this is the Brazilian Cerrados. These are acid soils bleached during geologic time. Some of the oldest landscapes in the world, corresponding to the equivalent in Australia and the land that is under the icecaps in Antarctica. They have never been cultivated. People tried it in colonial times. You would starve to death. But with the new technology, liming, and these are bleached of many things, it wasn't just nitrogen and phosphorus and potash, but many of the other nutrients had to be supplied, plus varieties that had tolerance to soluble aluminum, which is toxic to the roots of most crop plants. After you limed, you change the top layer 20, 30 centimeters but when the roots of the ordinary varieties hit the acid subsoil, if there was a short drought, they would die from drought. With the aluminum tolerant plants, they penetrate more easily, each year the roots are deeper and as the roots decompose they move calcium and magnesium downward, they are changing the pH and they are becoming more and more productive. The green area is the acid soil area that is producing today or will produce much of the soybeans in the future. Let me point out that before they learned how to handle these acid soils, there was invasion of the tropical rain forest and much of it was destroyed in the Amazon region. You can see there (Province,) but as soon as they learned to handle the acid soil -- these soils were essentially worthless before, five dollars an acre, now they are some of the most productive soils and highly valuable. Everything has changed.

We move on. As we look ahead to increasing more of that production through improved technology, irrigation, although it's only 17 percent of the total land area cultivated, represents 40 percent of the total food production, fiber production of the world, and there's only about 270 million hectares of irrigated land. A good share of it is in the third world. There are still opportunities for more, but the things that are beginning to happen now with bed planting, you can cut down by 25 to 30 percent the amount of irrigation and in a similar way increase the efficiency of fertilizer utilization by 20 or 30 percent. The next slide shows conservation tillage, zero tillage. This is particularly important for African countries because of the animal diseases. Vast parts of Africa have no animal power. They never had oxen, they didn't have horses or mules because they died also. And so it was a hoe and the machete. With zero tillage, weed killers and crops with tolerance to a broad-spectrum herbicide, it changes everything, the increase of water uptake reduces erosion, improves soil texture and nutrient fertility.

We move on. For the last 17 years I have worked with a little extension program, Sasakawa Global, financed by a Japanese foundation, the Nippon Foundation. President Carter has been involved. Before we started the program, we saw a lot of research being done, but nobody was putting all the pieces together, the variety changes, the soil fertility, the weeds and the diseases. So this little program has done extension, not research. We are a small organization, the countries we worked in you see indicated on the map. Sasakawa was the family that started that. Africa has lots of problems. Look at the soil fertility. In the foreground, the yellowish corn plants, the same variety in the background with fertilizer. The national average in those bar graphs is orange and those brown graphs represent probably 300,000 demonstration plots, a third of a hectare to a half of a hectare on farmers' fields. Look at the response. But how do you convert this into reality? Soil fertility has to be changed. Look at what has happened on fertilizer consumption in the third world. Look where Vietnam is today, right up pushing Holland or the Dutch Netherlands. China is the world's expert at handling organic fertilizer. I've always said there should be no confusion and discussion or debate between the use of organic and chemical fertilizer. Use all the organic that is available, but for God's sake don't try to tell the world that we can produce the food that is needed without chemical nitrogen or other chemical fertilizer. This is nonsense and yet we hear lots of that over television and radio and in debates, debates of ignorance.

So look where China is today. It's pushing the United Kingdom. Look where India is, it's about like the USA in nutrient supply. Had that graph been drawn 30 years ago, look where the African countries are. You can barely see them on the map. That's where Vietnam, that's where China, that's where India were 25 years ago. So let's not forget that soil fertility is a leading role.

Moving on. Africa is in deep trouble because of lack of infrastructure. Most of the product is moved on people's heads a short distance. Without that the cost of bringing in fertilizer, then if you increase production you will have surpluses in one area, and 200 miles away in the same country people starving. You can't move it, no roads, no railroads.

We move on. We need a Marshall Plan for Africa. Roads do wonderful things, not just for agriculture, bringing in inputs, distributing surplus to deficit areas, but where there's a road there's soon a school, a primary school. Not one, but a whole series of them and soon after there's a school there's a public health official, an M.D. But more important, there's a beat up old bus or truck moving people. That's tearing down ethnic cultural barriers, linguistic barriers, reducing fear. Until we have roads and these other offshoots from the roads, Africa will change painfully slowly and be sort of a cancer for the rest of the world for decades to come. I hope that this will seep through so that the infrastructure can be improved.

Asia was different than Africa. In colonial times, the railroads in India and Pakistan were built into the best agricultural areas. Why? Because cotton was the most important commodity imported into Britain. When the railroads were built in, the local governments and farmers organizations built the roads to the rail pit and that changed everything. In Africa, the railroads went to the mines; agriculture was not important. So we have to contend with that.

Just a word about biotechnology. I'm a firm believer in this. We need to utilize this new technology. It is being used already in several crops, especially soybeans with broad-spectrum herbicide tolerance and cotton and corn that carry the B+ insect toxin. Their introduction has made a big change in improving insect control, and at the same time reducing the amount of insecticide. For example in cotton, at least 24,000 tons of cotton insecticides have been reduced. We should never forget those indirect values. There will be many more new developments coming from biotechnology. We need it. I don't

understand why all of the dreadful fear has come into the situation. There is no good scientific evidence to indicate that it will have any disastrous impact. It's the resistance to change. And I think that we forget about our heritage, the good ol' days. I remember them as a boy. They weren't very good, Mr. Secretary. They were pretty miserable. I'm a product of horse-drawn equipment before we had the tractor, a one-room country school for eight years. Summer complaint which was nothing but diarrhea because we didn't have refrigeration. All of those goods things weren't so good. That's the way it is.

Are we in danger of being poisoned out of existence? I don't think so. The life expectancy in 1900 for a boy baby on average was 46 years, for a girl 47 years. By the year 2000, it was 75 years for a boy baby, 80 for a girl baby. The girls are gaining on us, double their life. So treat those young ladies with care.

Then, you know, from the time I was a graduate student, I had a dream. The rust fungi attacked all the cereal grains except one. Wheat. Three species of hundreds of types attacking different varieties. I spent 65 percent of my total life battling these things and yet I noticed even as a graduate student, and I didn't work on the wheat and rust, I worked on the unimportant secondary crop, flax. But what has happened? Rice from the time it split off from all the other cereal closed the trapdoor on all of the rust. It's immune. With the new biotechnology, some day some young girl or boy is going to solve that and maybe the people working on oats or wheat will have enough time to go fishing for three or four days rather than running on that treadmill of trying to keep up with the changes of microorganisms.

So we have got problems on the frontier. For 52 years there has been no rust epidemic with stem rust anywhere in the world. Now we have a strain in East Africa. If it gets loose into Asia or into North America or South America or Australia, the chances are that half of all the varieties are susceptible. The stage is set. Just like in soybeans, as you all know about, we have new ferocious animals that we have to contend with. That calls for ongoing research, but there is complacency when you haven't had an epidemic for 52 years, and many of the young scientists think that you can't find anything in the computer database, anything about stem rust epidemic. You have to go to the library. But we are likely to learn some bad lessons unless we move very rapidly.

We will move on. I've done the soybean rust thing. I predicted this was going to be here in short order. It is here. We have to contend with it. We don't know a lot about it that we should have known.

We move on to these points. We need to restore public funding. Remember that all of the research, or virtually all, before World War II was in the public sector, universities, land grant colleges, Department of Agriculture, state departments of agriculture. After World War II the private sector took over, good and well, but in the third world we can't rely on this. We had established a network in transferring the Mexican wheat technology and rice technology from the Philippines through young trained scientists made that big transfer and change possible. We didn't continue training those people. It has broken down and now we have got to do this over again and start all over.

How do we spend our money? You go through the African countries, you see this old military gear broken down, standing around, the cold war took a bigger toll on African countries irrespective of whether they signed up for the Soviet eastern block or the western mantle. Instead of investing in roads and schools and hospitals, too much of it went into military. And I'm a firm believer in order. We can't have chaos in progress, but look at the amounts we spent.

Finally, we still have bad problems in education: nearly 900 million people that are illiterate. The number of illiterate women is more than two times the number of illiterate adult men and women play a key role in the whole family's development. Unless that changes we are going to have more and more trouble. Remember, that in those poverty stricken areas with illiteracy, emotions can play a big role in planting seed in these seed beds that are very fertile for all kinds of isms, including terrorism.

Remember as Lloyd Boyd Orr said, the first director of the FAO, the Food and Agriculture Organization of the U.N., you can't build peace on empty stomachs. Thank you all very much.

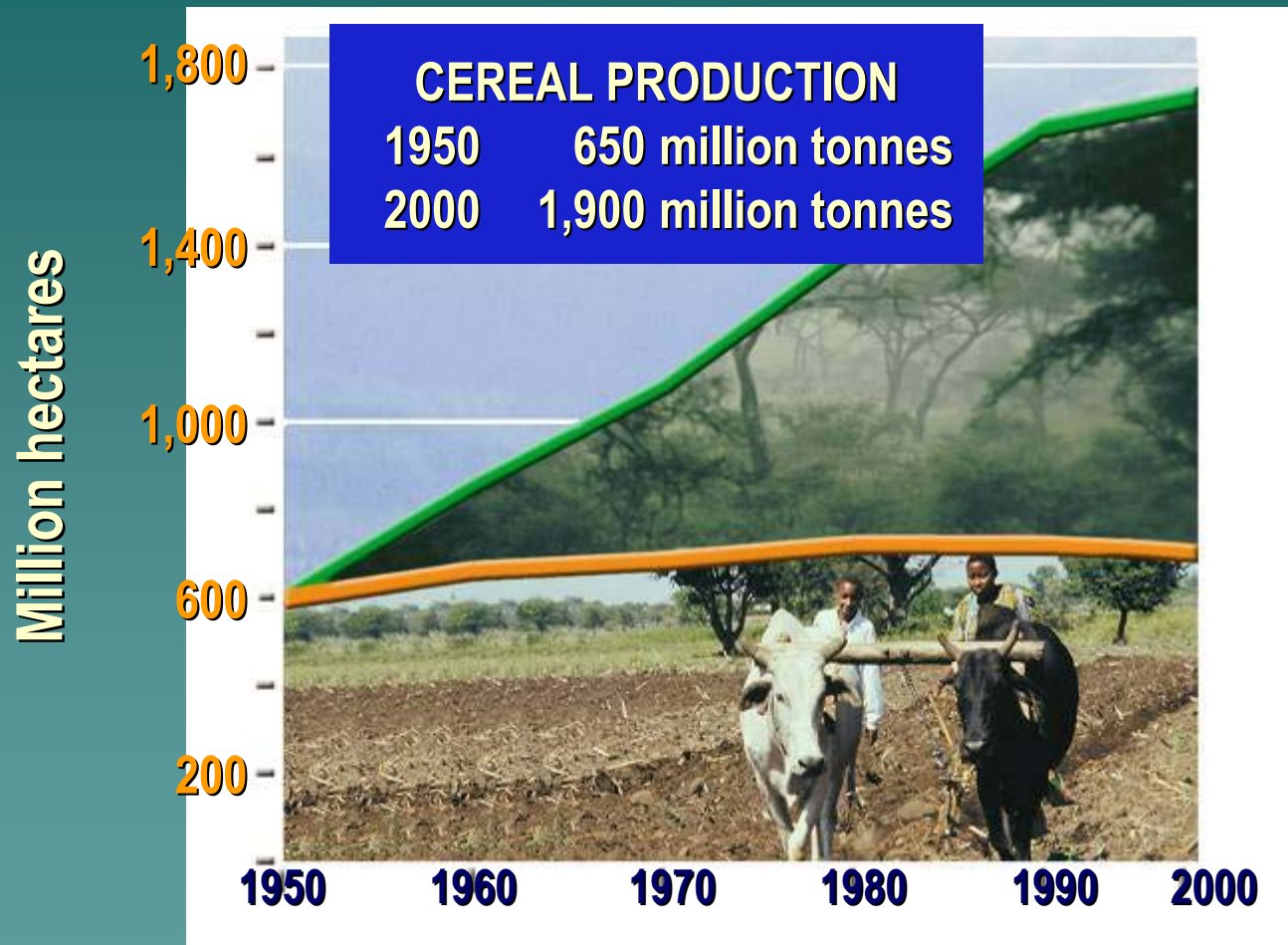
Green Revolution:

Changes in Factors of Production in Developing Countries of Asia

	Adoption of Modern varieties		Irrigation million ha	Fertilizer Nutrient Use million t	Tractors millions	Cereal Production million t
	Wheat M ha / % area	Rice M ha / % area				
1961	0 / 0%	0 / 0%	87	2	0.2	309
1970	14 / 20%	15 / 20%	106	10	0.5	463
1980	39 / 49%	55 / 43%	129	29	2.0	618
1990	60 / 70%	85 / 65%	158	54	3.4	858
2000	70 / 84%	100 / 74%	175	70	4.8	962

Source: FAOSTAT, July 2002 and author's estimated on modern variety adoption, based on CIMMYT and IRRI data.

World Cereal* Production—Areas Saved Through Improved Technology, 1950-2000



**LAND
SPARED
1.1 billion ha**

**LAND USED
660 million ha**

* Uses milled rice equivalents

Source: FAO Production Yearbooks and AGROSTAT

Hara Farms, Haryana



Poplar, 50 t/ha/year, 10-year cycle



Poplar, mangoes, wheat

Locally, 15,000 tons of timber logs a day are converted into ply, wood board, flush doors, etc, in 400 processing facilities over the last 15 years worth US\$ 500 million a year

Wildlife Coming Back in the USA



High-Yield Forestry

Aracruz Cellulose, Brazil

World's leading producer of bleached eucalyptus pulp



- 2.1 million tons, 31% of global supply in 2003
- Cutting cycle has been reduced from 8 to 6 years
- Pulp yield per ha has nearly doubled since the 1970s

High-yield agriculture & forestry will protect African wildlife

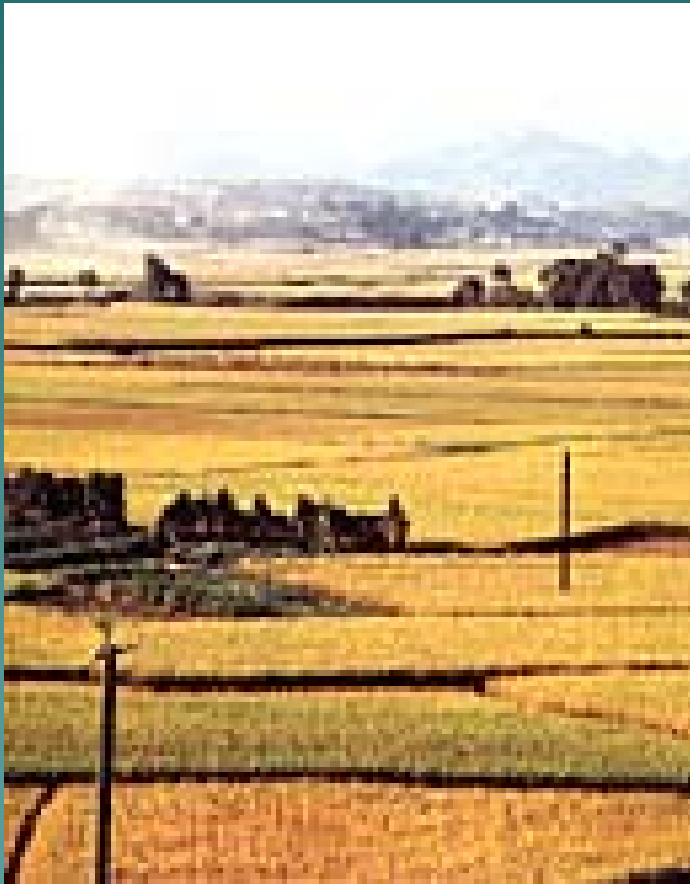


We will have to double the World Food Supply by 2050



- 85% of future growth in food production must come from lands already in production
- Limited potential for land expansions, except in the Americas and Sub-Saharan Africa
- Irrigation will remain crucial to meeting food demand

Chinese Agriculture in 2030



- ◆ 1.6 billion people
- ◆ 200 million fewer rural dwellers
- ◆ Arable land is likely to fall by 20%
- ◆ New science & technology will be critical to food security
- ◆ Far-reaching policy changes are needed in tax policy, land tenure, and farmer education
- ◆ Greater conservation of natural resources will be needed

Major Soybean Importers

(million metric tons)

	1998	2001	2002	2003
China	5.1	16.4	13.9	23.2
Netherlands	5.5	6.2	5.6	5.4
Japan	4.8	4.8	5.0	5.2
Germany	3.5	4.6	4.3	4.5
Mexico	3.5	4.5	4.4	4.2
Spain	3.2	3.4	3.4	3.1

Brazilian *Cerrados*



Source: Top Producer, Farm Journal Media, 2001

Improving Efficiency of Irrigated Agriculture



- 70% of global water withdrawals
- 17% of cultivated land
(275 million ha, 200 million in developing countries)
- 40% of world food harvest
(57% of cereal production)
- By 2030, FAO expects world's irrigated area to increase by 50 million ha.
- Planting on raised beds reduces water and fertilizer use by 20-25%

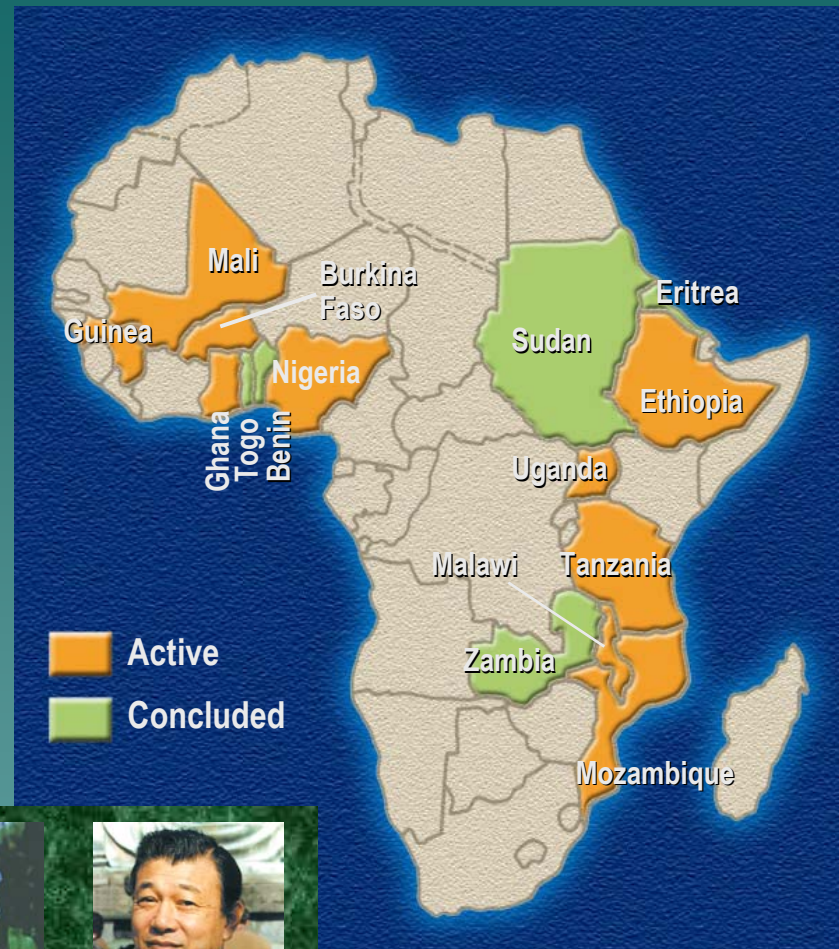
Conservation Tillage



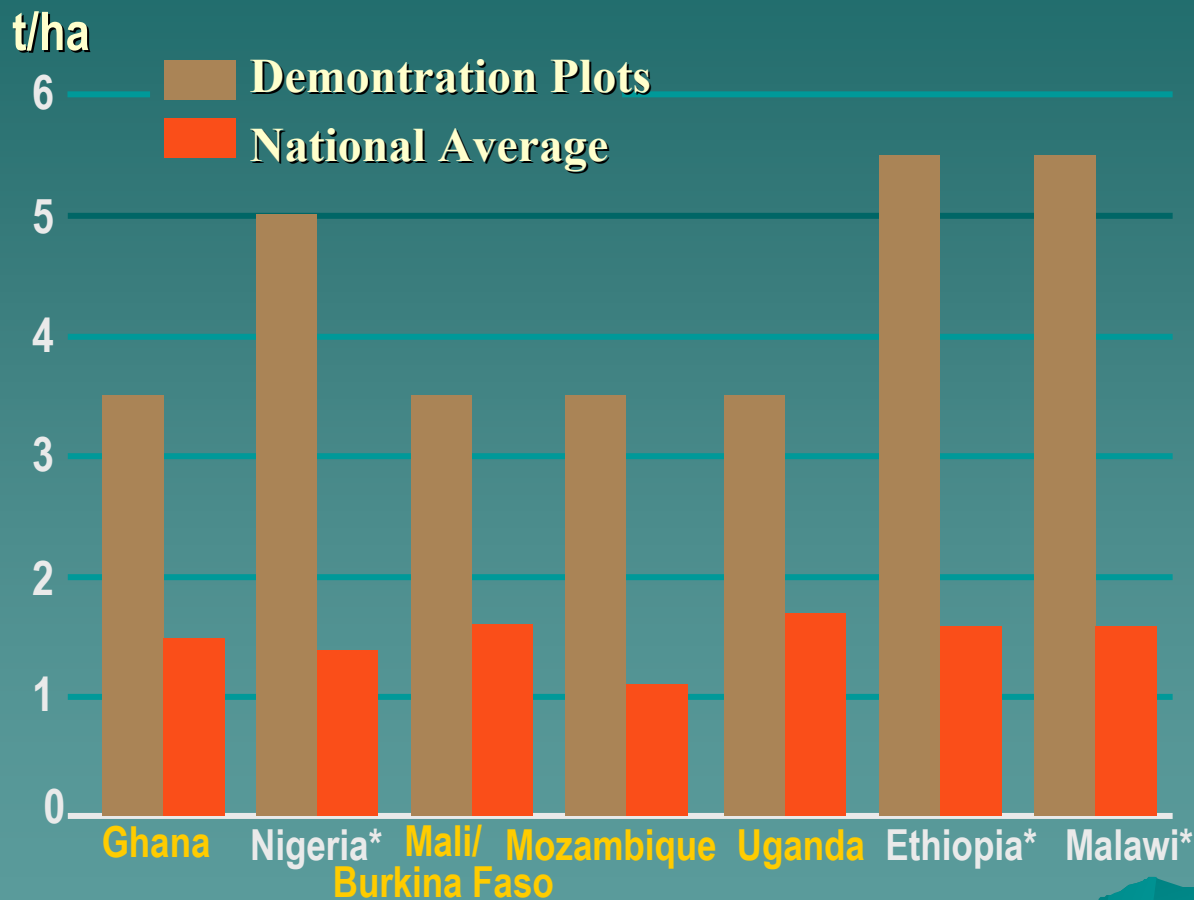
- Saves labor and fuel
- Restores organic matter
- Controls weed
- Reduces erosion
- Conserves moisture

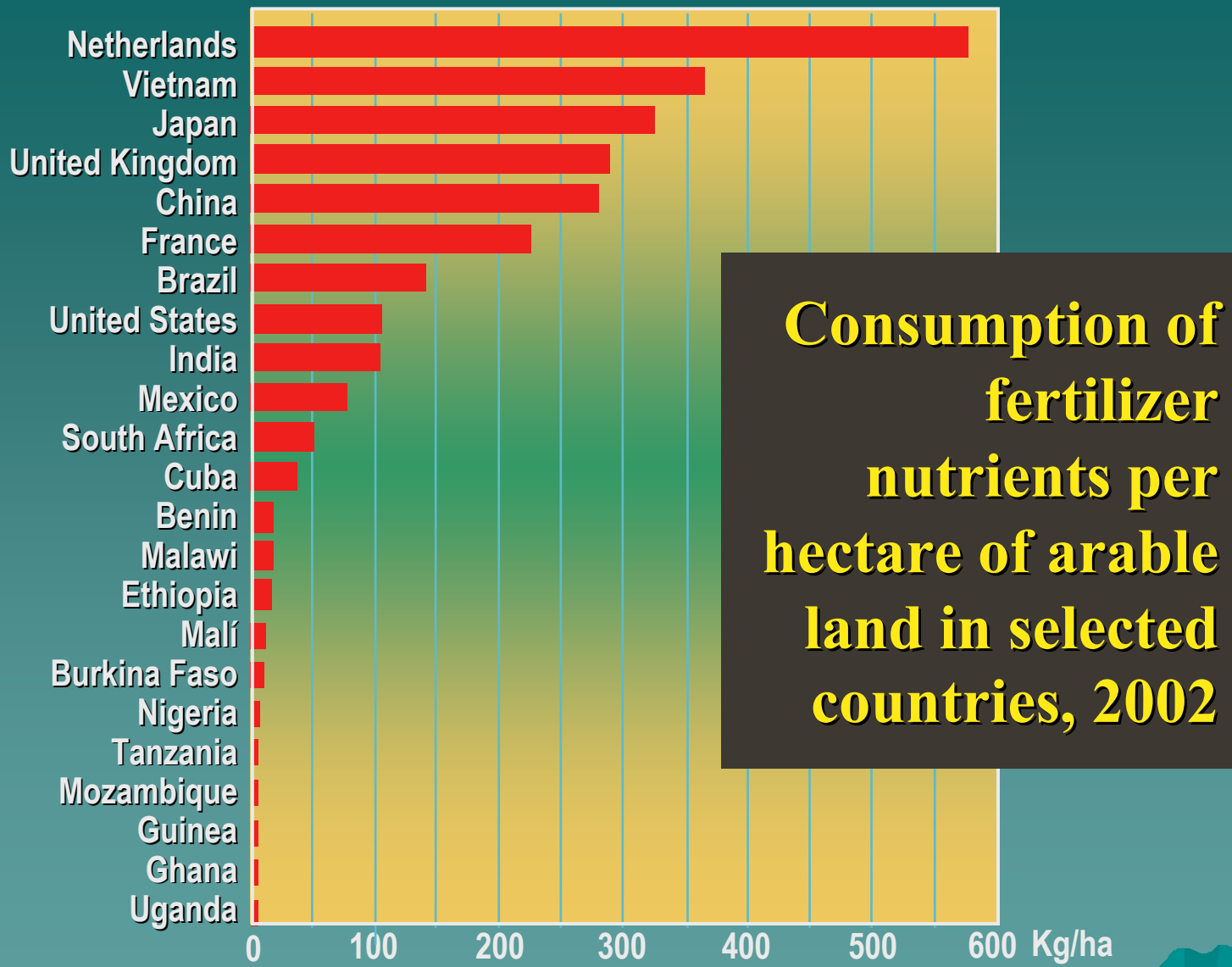
Sub-Saharan Africa is Our Greatest Challenge

Sasakawa-Global
2000 Program
Started in 1996



Sasakawa-Global 2000 Maize Demonstration Yields





Source: FAOSTAT, July 2003

Lack of Infrastructure Is Killing Africa

Kilometers of paved roads per million people in selected countries



	Km		Km
USA	20,987	Guinea	637
France	12,673	Ghana	494
Japan	9,102	Nigeria	230
Zimbabwe	1,586	Mozambique	141
South Africa	1,402	Tanzania	114
Brazil	1,064	Uganda	94
India	1,004	Ethiopia	66
China	803	Congo, DR	59

Source: Encyclopedia Britannica, 2002

“Marshall Plan” for Africa



2004 Global GMO Crop Coverage

Area Million ha	Crops Million ha
--------------------	---------------------

USA	47.6	GM Soybean	48.4
Argentina	16.2	GM Maize	19.3
Canada	5.4	GM Cotton	9.0
Brazil	5.0	GM Canola	4.3
China	3.7		
Paraguay	1.2		
South Africa	0.5		
India	0.5		
9 other countries	0.9		

Total: 81 million ha (200 million acres)

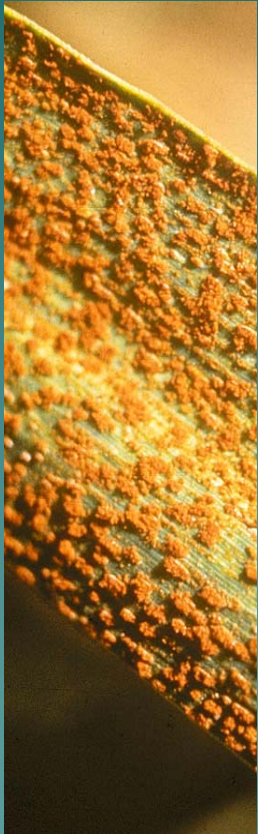
Source: ISAAA, 2005

Bt Cotton

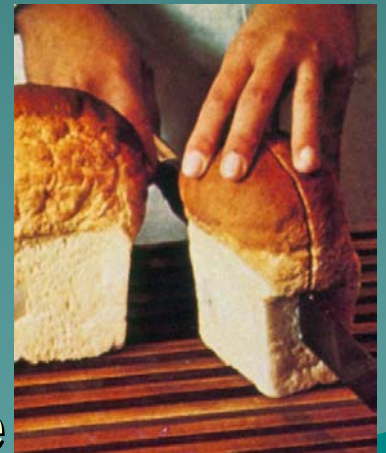


- ◆ 9 million ha around the world;
6 million small farmers
- ◆ Excellent control of boll worms
- ◆ 25,000 mt reduction in insecticide use
- ◆ Substantial reduction in poisoning of farmers
- ◆ Significant increases in farmer profits

My “Biotechnology Dreams”



- Transfer rice's immunity to the rusts (*Puccinia* spp.) to other cereals—wheat, maize, sorghum, barley, etc
- Transfer bread wheat's proteins—gliadin and glutenin—for making superior dough for leavened bread to other cereals, especially rice and maize



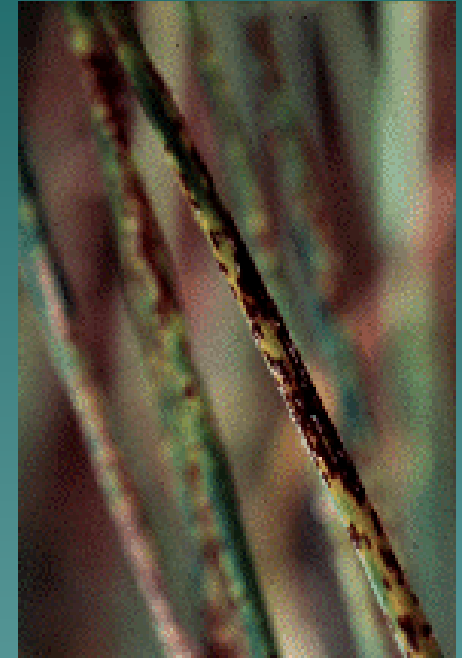
Dark Clouds Gathering in World Wheat Economy



Per capita
production
declining
since 1997



International
germplasm
exchange &
testing declining



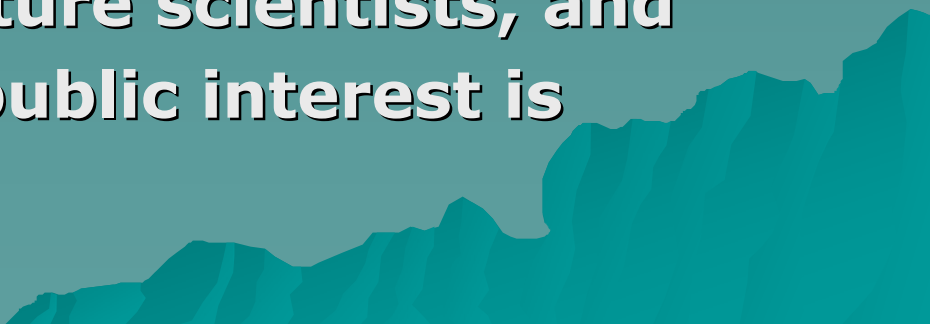
New disease
threats
emerging,
e.g. stem rust

Soybean Rust Epidemic



- ◆ Two species; Asian type most aggressive
- ◆ 2001—Only small area in South America infected
- ◆ 2003—Brazilian producers lost US\$ 1.3 billion (lost yield and fungicides)
- ◆ 2004—Reached southeast USA
- ◆ 2005-06 Expected to spread in USA
- ◆ Could cause US\$ 4.5 billion in damage to U.S. soybean crop

Need to Restore Public Research Funding

- ◆ **Green Revolution was the result of “public goods” research and investment**
 - ◆ **Biotechnology is primarily driven by the private sector**
 - ◆ **Maintaining a balance between public and private research is essential and healthy**
 - ◆ **Public institutions focus on problems of the poor, help prepare future scientists, and help assure that the public interest is protected.**
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the bottom edge of the text area.

Agriculture and Peace

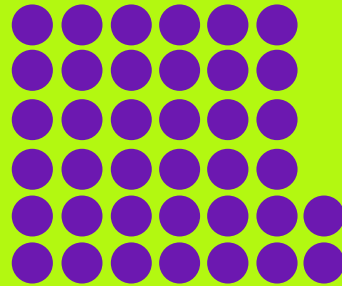


“Our policy...should be the revival of a working economy in the world, so as to permit the emergence of political and social conditions in which free institutions can exit.”

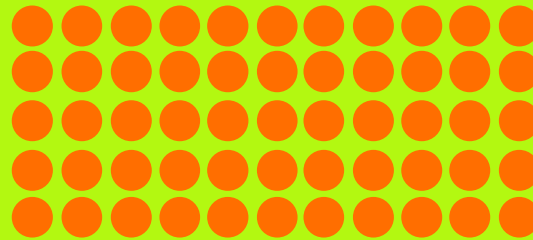
George C. Marshall
June 7, 1947

- Only 8% of countries with the lowest levels of hunger are mired in conflict
- 56% of countries with highest levels of hunger have civil conflict
- World military budgets in 2004 exceed US\$ 900 billion annually (USA accounts for 56% of total)
- In 2000, international support to agriculture reached lowest level in history and has only improved modestly since then

CUTTING ADULT ILLITERACY



Male
320 million



Female
550 million

TOTAL = 870 million people
+ 120 million primary school age
children not in school

**“You Cannot
Build Peace
on Empty
Stomachs.”**

**John Boyd Orr
Nobel Peace Laureate
First FAO Director General**

