

2006 Norman E. Borlaug/World Food Prize International Symposium
The Green Revolution Redux:
Can We Replicate the Single Greatest Period of Food Production in All Human History?
October 19-20, 2006 - Des Moines, Iowa

SESSION FOUR: Looking to the Future

October 20, 2006 – 9:00 – 11:50 a.m.

Zhangliang Chen

Moderator

Gordon Conway

I persuaded Per Pinstrup Andersen to take over half time. He owes me, so we're just about even now. The other good news is that we've got a tremendous lineup this morning, and I think it's going to be a very lively, very exciting morning of discussion.

And this first session we've got three people. Well, actually we've got two, and one is sort of floating, I guess, but we will find him in time, which is Pedro Sanchez who is somewhere out there. We've got Dr. Zhangliang Chen, Dr. Calestous Juma, and Dr. Pedro Sanchez. These are three people whose roots are in the three corners of the world but whose work is at the cutting edge of the new Green Revolution. And because it's cutting edge, much of what they're doing is controversial. And so you'll find a considerable amount of controversy going forward.

What we're going to do is, each of them is going to get up to about half an hour, 25 minutes, half an hour to speak; there will be a short question and answer session, Per will take over; there will be two more speakers, Hans Herren and Bob Watson; and then at the end of the morning all five will be on the stage as a panel, and they can have a good, lively discussion at the end, which Per will moderate.

Dr. Chen is a world expert on biotechnology. He started out in 1983 working with Roger Beachy, and did his PhD at Washington University in record time. He's been back in China since 1987, was vice president of Beijing University and now is president of Beijing Agricultural University. And in my days at Rockefeller we had a great deal of business that we did with his university. And in his honor I'm wearing a Ferragamo tie, which on it – and you can all come and inspect it afterwards if you like; you can't have it, but you can inspect it – it's got genetically engineered wheat with beautiful blue butterflies all over. It's a Doubly Green Revolution tie.

Dr. Chen.

The Green Revolution in China: Past and Future

Zhangliang Chen

President, Chinese Agricultural University

Director, Chinese National Laboratory of Protein Engineering and Plant Genetic Engineering

Thank you very much, Gordon, and this is indeed a great meeting and wonderful ceremony last night. I'd like to congratulate the three Laureates and thank you for your great contribution to your country, Brazil. But also I'd like to thank you for your great contribution to China; because of your work, soybeans have helped the Chinese a lot. Last year we imported 5 million tons of soybeans from your country, so actually your work (has really made) a significant contribution to China. In the whole country, we produce no more than 16 million tons, but we import 5 million tons of soybeans from Brazil.

It was a wonderful speech by President Gates during breakfast. It crossed my mind that a couple years ago, I was visiting Texas A&M, and President Bush Senior invited me to visit his library. And in November of last year he was in Beijing, and I was called to have dinner with him. And the joke was very interesting, so I'd like to share with you; it's very simple. During the dinner with Bush Senior, he said that he was very young when he was like ambassador to China; he was in Beijing. And he was called by our great leader, Deng Xiaoping, to meet Deng Xiaoping in the great People's Hall. And Bush Senior said he never ever forgot the first time he met Deng Xiaoping. The first words that Deng Xiaoping asked him were, "I heard that you spied on me every day, including breakfast, lunch and dinner, and my telephone. Is this true or not?" And so for President Gates, I say that was a really big contribution by CIA.

I'd like to go over some of my thoughts and the data about the Green Revolution at the present time, the achievements, and in the future, the challenges. But first I'd like to show you that, as you all know, China is one of oldest (countries) for agricultural practice. And this is one (picture) that you can see that, about six thousand years ago, Chinese already know how to grow rice. This was discovered from a cemetery in southern part of China – the rice seeds.

Also, you can see from this slide, a published cover story in *Science* by Chinese scientists who (were) the first to sequence the rice genome. So you can see a picture here. I want to show you this terrace. Last year I went to this place because I wanted to see a cover story in *Science*, this building. It's an amazing terrace. And so I went there. It's in the western part of China, near Yunnan. And indeed this is a picture I took – and it was made 1,200 years ago. This guy, this person, wrote about it in a book (written) in the Ming Dynasty – I'm talking about the terrace in the western part of China. So this is a beautiful one. I'll show you another picture I took; it looks like a horse, but this is also terraced fields that the local people used it for 1,200 years to grow rice. And it is still being used; it's been wonderful.

Now, on significant achievements of grain production in China with technology of Green Revolution. You all know that (since) 1949, when a new China was established, as you can see the total production in agriculture increased dramatically from 1949 to 1989 to 1990, (during) this period. It's a great contribution made by the Green Revolution. And today we are using 7 percent of our arable land to feed 22 percent of the world population, and we believe this is a big contribution to the world.

Now, certainly your whole country knows that we have to acknowledge a couple people. Obviously, this person, the father of the Green Revolution, Norman Borlaug – I chose a very young picture. This is Norman Borlaug, very handsome, very young. Many people (have) not seen this picture, so I decided to use this picture to show the young and handsome Norman Borlaug. He made a great contribution. And during his speech in our university two years ago, he said that the Green Revolution in China had to be attributed to three persons. (These were the three persons who were named by Norman Borlaug.

First one is Deng Xiaoping, because he's the one that really made a big contribution to agricultural production. And second is He Kang. Mr. He Kang was a minister in agriculture for many years, and that is a critical period in China. He made Chinese agriculture so successful during the period that he was minister in the Ministry of Agriculture. The second one is Mr. Yuan Longping, Professor Longping. He has been named as the "father of hybrid rice." Fortunately, both of them (are) laureates of the World Food Prize. And Mr. He Kang is in this meeting with his wife; he was the president of the university (where) I was studying as an undergraduate student.

Now, we know that there are many determinants for agricultural production, including agriculture policy, technology, (inputs), and also arable land. Now, I want to show you the critical period in China, right after the Cultural Revolution – so this was another revolution, not the Green Revolution but the Cultural Revolution. And right after that was a very critical period. And Mr. He Kang at that time was chairman, or minister, in the Ministry of Agriculture.

So one thing that Deng Xiaoping did to reform agriculture policy was to divide the land to each family from a commune. And so this is the situation. Here now is the small family-based farming system – about 4.4 people per household with 2.8 laborers working on .6 hectares of land. And this is the case today in most families. However, we know the challenge today: Because of small families, and so much competition after China entered the WTO, we have a problem with high cost and low productivity. In the case of the soybean, I will show you – that's a challenge.

Now, the Green Revolution helped China tremendously. You can see that the grain production increased dramatically from 1949 to about 1982 or 1985. Now this is a critical period because our population increased dramatically from 400 million to 1.3 billion. And without Green Revolution, (there would have been) no way that we can feed a population of 1.3 billion. So you can see that correlation to nitrogen input of the Green Revolution – not only the policy in agriculture, but also you can see it's very correlated to nitrogen inputs from 1952 to 1996. It continually increased in fertilizer application, (even until) now. Now we have some problems because of overuse of fertilizer. Some provinces use over 60 percent extra (than necessary).

And obviously the number three determinant is breeding. The hybrid rice made by Yuan Longping and colleagues and also other scientists contributed a lot to increase production, at least 20 percent a year. And here I like, we really would like to acknowledge Dr. Khush and IRRI colleagues; their contributions to hybrid rice and to the rice in China (were) tremendous.

Now, because of the successes in agriculture in production, we (can) feed our population of 1.3 billion. Now you can see the changes. You can see the shares of urban and rural

population (since 1978): how the rural population decreased, and urban population increased. However, the incomes of the rural residents increased from 1978 to up to last year, continually increased.

Now another dramatic change that a previous speaker mentioned about China is the changes to our diet. The diet changed from rice, solely, to more meat. You can see the crop from 1970 to year 2000 – it dropped from 82 percent to 26 percent (of total agricultural output). But livestock increased from 14 percent to 30 percent. Also, among the crops, cereal production decreased from 80 percent to 65 percent. However, cash crops increased from 19 percent to 34 percent. Those are the changes happening today. And since 1990, Chinese agriculture has gone from shortages to basic equilibrium and also surplus in some years. The incomes to the farmers increased; however, consumption decreased and demand changed from quantitative to qualitative, as at this moment. The contribution of agriculture to national GDP continued to decrease. I will show you the data on the decrease, especially (since China has) entered WTO.

Now, George Bush Junior, George W. Bush, in November of last year was in Beijing also with his father. They were there in different weeks. But (he was there) negotiating with Chinese leaders for two things, three things: one, for trade balance, because it's a higher deficit for Americans to trade (with) China. Second was to ask to increase the value of Chinese money. And three was IPR, intelligent property rights.

Now, for trade deficit, the biggest deficit (in) U.S. trade (is) with China. However, that's in industry, in textiles and stuff. In the agricultural products, this is the only (are) in trade where it's a surplus for U.S. You can see the two countries trade, between China and United States, year 2000 and year 2004 – (there is an) increase in the trade import and export. However, the deficit is to China's side, and the surplus is to the U.S. side. And gross value, import and export. And the deficit for Chinese agriculture the year before last reached to \$5.5 billion. But the industrial goods, we're in a surplus situation.

The biggest one is soybeans. Now, soybeans are a big story at this moment, even in China. In America, in Brazil, in Argentina, in the world market, and also in Iowa, because Iowa has a lots of things to do in Chinese soybeans market.

You can see that since 1996 China started to import soybeans from United States and then increased dramatically to year 2001, decreased in year 2002 because of transgenic soybean – a big story in China, the consideration of GM soybeans – but it recovered quickly in the year 2003 and reached to the highest (level) last year. Last year, China imported 26 million tons of soybeans, and domestic production was only 16 million tons. So we imported 26 million tons – from America 11 million tons, Brazil about 6 million tons, and Argentina 5 million tons. So it's a lot of agriculture goods.

Now, this is consumption and imports from year 2005. I'll leave those data (for you) to organize if you want to have it. I don't need to read through those things, but those are the data we have.

The second import is cotton. As you know, the Chinese textile industry is very prosperous, and so is cotton production. We are starting to import cotton. In 2005, last year, our

imports of cotton reached to 38.63 percent of total cotton (consumption in China), and that was the highest import of last year. This year we are looking, we are actually seeking to have a higher proportion in cotton. Now those are the projections, grain projections, by different organizations, including the World Bank and USDA. And you can see that they project Chinese production and demand and also imports. So this is projection to year 2020, to be sure that we can produce enough food for Chinese to (consume). However, we certainly need to have some more imports because there are certain limitations to our arable land, and our population will continue to grow. You know that we are going to reach to 1.6 billion by year 2020.

So obviously, people are concerned very much. As you all know, the Doha negotiation and WTO conference – this is last year's WTO meeting in Hong Kong, the biggest demonstration in WTO that's related to agriculture. So agriculture is a high concern in Doha and also in WTO summit and the conference. They are big issues.

Chinese government, from the year 2003 – this was the year that was kind of scary because the total production dropped in four years continually to reach to the lowest (level) in the year 2003. So then strong action was (planned) by the Chinese government in the year 2004. Number one – that's the biggest one – was to cut tax. You know, as a previous speaker said, OECD countries are subsidized each day at least \$100 million, but Chinese government (has) no subsidies. However, (farmers have been taxed) since the Ming Dynasty, so every farmer had to pay money to the government in order to grow crops. And in the year 2004, the Chinese government decided to cut taxes next year for farmers in every province; they are no longer to pay tax to government. So that's good news for farmer.

Second, increase the price for grain in year 2004 and control the price of fertilizer. And then also to get rid of farmers' children's education costs, including tuition and books fee. This year and next year, there will be free education for all farmers' kids. And so farmers' incomes increased about 6.8 percent, agricultural production increased in year 2004, it continued to increase in year 2005, last year, and we expect it to increase year 2006, this year.

Many strategic actions are being taken. One is there is public policy for investment and also to restructure the farming system. Second – slowly with the policy, carefully – to allow farmers to have small companies in towns and then also in cities. In the past five years, each year on average about a million farmers have been moving to the city and working in the city. In Beijing, in Shanghai, in many cities, you can see many farmers. And transforming on the employee system (within agriculture).

The last point; there are new technology applications. Again it's related to the Green Revolution. And the most important technology there is biotechnology. So I will talk quickly about technology development in China. The government spends a quite good amount of money for R&D – this is the second-largest country now today in the world for government investment, after the United States. The amount of money doubled each year almost. And you can see area for biotech crops in the fields. Number one, the United States; number two, Argentina; Brazil, Canada. China is number five, because we still are not allowed to have the rice, only cotton. We are in number five position in the world (according to) ISAAA's statistic.

And this technology – Gordon just mentioned that in 1986, 1987 I was with Roger Beachy in St. Louis at Washington University, and so this is Roger and myself in 1986; we were working in the first field trial in Illinois. That's a transgenic tomato, and no one knew at that minute in that year – I'm sure Roger did not know, and myself – we did not expect such important technology today in agriculture, related to Green Revolution. And we did not know also that it (would be) such a controversy in 1983, 1984 when we started earlier, trying to do GM research. So then in 1986 I returned back to China, established national center or National Laboratory for Biotechnology. Chinese has set up a regulation since 1986 to year 2002 with very strict regulation and basically very similar to U.S. but then again a little bit similar to EU – we are in the middle of the United States and EU countries for technology regulations for approval.

We had 192 organizations apply (for GMO approval) – all together, 1,525 applications. And we have approved 456 for trial, 211 for environmental release, and 181 for pre-production trial. Now, we issued 424 licenses for GM crops for production and issued 18 licenses for international companies to import raw materials of GM products. And those are the crops so far approved by government for production – cotton, the tomato, sweet pepper, petunia, and this year, papaya was just approved for field release and production.

Many crops – over 30 different species – are allowed to do field tests and releases. However, more are allowed to do production. You can see the biggest one obviously is cotton. And cotton is very important in China, and so far over 60 percent of fields in China, cotton fields, are transgenic, and they make a very significant difference in controlling the insects.

Now, then the second always leads to rice, corn, soybean. For cotton – over 200 million farmers involved in transgenic. So it's very important for Chinese economy. You can see that (cotton) occupies 15 percent of the country's total exports. This is a chart to show you the increase in growing area for cotton plants in China since 1996. However, because of debates in European countries starting in 1996, 1997, Chinese GM crops slowed down a lot. Otherwise I'm sure China (would be) number two next to United States today, (in terms of) overall yield.

And the controversy came to China, a big argument; it's a very confusing situation. We are in the middle between United States and Europe. So you can see the case – rice. And rice is the most important crop. So far we are still waiting for final approval by government. And I'm on the committee of biosafety, National Biosafety Committee, and we try to push hard to get (GM rice) into field production. And so far there are many transgenic rice being received by Chinese scientists, including (varieties for) insect, bacterial, stress and nutrition. And you can see this is Xa-21, a disease-resistant rice. This is insect-resistant – field tests are very significant in many provinces – herbicide-resistant and salt-resistant.

Now, two years ago, the year 2004, in November, we almost got approval. In November our safety committee approved it to go into production. Unfortunately, Greenpeace very quickly took action, and in April of the year 2005, they collaborated with a German company and announced that they discovered some transgenic rice in a Chinese market. And it scared the Japanese, and South Korea quickly made sanction not to import our rice. And so that got into the government office and again they slowed down, saying, "Slowly, let's go slow." So it's not in action. However – Iran approved, for the first time in the world in the year 2005, the commercialization of (GM) rice.

Now then this is announcement by Greenpeace and they said that 19 samples, out of 25 samples, discovered GM rice in the Chinese market and (called it a) “scandal.” It’s a big story, so we slowed down. Now, this year we tried to push again to allow it to get into production. And then what happened? Just last month EU announced finding GM rice imported from United States. It was long-grain rice contaminated by LL601, and it’s, again, a big story in China.

Last month, September 5, Greenpeace announced they discovered a GM component in imported rice noodles in France, imported from China. And they say the rice noodle contained GM, and the French government immediately took action by searching the largest noodle company called TangFreres Company in Paris, and blocking (all sales) until that investigation. And so that story was in the news in China and then the official government said, “What’s happening? Why is the French government so scared about GM? There must be some problem there.” So it’s just delayed again and again.

So August 26 our committee again had a meeting and examined seven different varieties, including insect-resistant and bacteria-resistant, and we made a proposal to the government last month. And we are hoping that next month or so, then, the government will carefully examine the application from the National Biosafety Committee. Hopefully, we can get approval in the next year or so. If so, then it will help farmers a lot. You can see the same data that really helps.

(There are) many debates, and one debate is safety. And so far you know that (there are) only two major genes: insect resistant or herbicide resistant. And many people use that gene, actually that bacteria, Bt toxin, from the Bt bacteria that has been used in China since 1960s for biological control. No one said it was toxic until the day when we moved the gene. Then people said, “Well, it could be toxic.” But we (had) used it for many years.

And as you know, China imports soybeans from America. And they contain GM (soybeans). We have been using that for over ten years, and no case has been reported of toxic. Over 2 billion people, including the United States, Argentina, Brazil, Canada and China – we have been using the GM (crops) for six to ten years. (There’s) no case to show that it’s toxic (for) human beings. But then again and again, a European country or some NGO or some politician just wants to make a story big, and says, “It’s not safe” or “How do you know it’s safe?” And then that makes the government of many countries, including in Africa, (delay) making a decision whether to use it.

Second, (there are) the debates (of) environmental safety. They always say that pollen has dispersed, but no one shows any evidence. However, in China in our experiments, the data published in *Science*, if you check, are very clear-cut: that if you plant transgenic cotton, or rice, you get more diversity for the insects because you spread less – over 60 percent less – pesticide in rice fields. You get more insects because you use less pesticides. You get more diversity. And then they say, “You will pollute those wild species,” for example, soybeans or else species of rice. However, when we planted the cultivar rice, no one said anything about our contaminating the wild rice. So when we plant the GM, then they say we are contaminating the wild rice? What’s the difference?

And so the situation is just getting more and more complicated. You can see that (reduced) pesticide use in transgenic fields, and you can see less field farmers get poisoned in

those transgenic fields. Each year 40,000 to 50,000 people in China are poisoned because of pesticides, because, you know, it's a family-based, small land; the people use pesticide (out of) a bag and then spread the pesticide. Many people are poisoned – over 40 to 50,000 people are poisoned each year, and people are killed – 400 to 500 people are killed because of poison. That's the true data. Then many people say, "Are you sure it's safe?" And they're not allowed to use it. But many people killed because of poison and the pesticides.

The benefits to farmers are significant. I don't need to go through the data.

And last one, there is a labeling controversy. (There is a) good system in the United States. You have a very good system. (Because) I'm in the congress, I visited Washington, DC; I stayed four days in Washington, DC, to learn about your system, USDA and FDA and EPA. And after careful study, I really respect your system – your labeling system. And Chinese enforced labeling in 2002; 17 products are required to be labeled in 2002, including soybean seeds, soybean, soybean flour, corn seeds, corn, corn oil, corn flour and rape seeds, cotton seeds, tomato. And after this requirement in 2002, for about six months or a year the market in China did not see any labels. And then the government got very angry and decided to take strong measures – to force companies, international companies, to label – this is the label today in the market. You can see, they put a small tag on the label. This is a new one they put on, and if you are good in Chinese you can see it says, "This product made from transgenic soybean." However, this oil did not contain any GM component. So this is a very confusing label. No one understands what it's labeling for.

And what's interesting is that, after labeling, no one cares. Citizens still buy it; it's been announced, but citizens believe that, if the government says it's safe, then it's safe. So somehow the market was not affected at all. However, because of labeling from production to processing, we have to spend at least 20 or 30 percent more in terms of cost.

Now, the last point. There is discrimination against biotech crops, which I argue a lot. I'm being heavily attacked by Greenpeace. If you'll check the Greenpeace website, my name was the first one being attacked. And I don't understand why I'm being attacked, because I believe transgenic is organic, because we transfer genes, and genes are organic. The products are protein. Protein is organic. And if we are not organic, then cultivar is not organic. (There is) no reason for any organization in the world to discriminate GM crops from organic. And they say that organic is safe, organic is the future.

And I don't know what the future (will be). You know that since 1949 to 1985 the biggest production period was the Green Revolution, because of breeding and fertilizer and pesticides. Before that we were farming organically. If we really return to organic agriculture, that means production (will be) 100 million tons – so how can we feed 1.3 billion population? I don't know that it's the future or not, but I don't think that we can get rid of fertilizer or pesticides.

So final slide is for your consideration. Consider – the world has spent too much money because of those political debates on the safety, environment, safe to human beings, organic or blah-blah-blah. We spend too much money on that, and it blocks Africa, blocks China, block Asia and many countries from using this technology. I believe this technology is just a (continuation) of the Green Revolution. This is not new. It's just a new technology, technique to

move genes, not much different from traditional breeding. It's just a molecule away. I believe it's just a (continuation) of our great father, Norman Borlaug, discovering the Green Revolution. So this is just a (continuation). It's very important, however, because of some reasons – some countries' interest, some politicians' personal interest or whatever – (and they) block (it). And people repeat and repeat, again and again, tests for safety. How much money today is spent in United States, in Europe, in China? Even in China, hundreds of millions are being spent just for testing safety. And people repeat tests on the same two genes again and again, on the same crops, in order to know it's safe – which we've eaten for many years already.

And then the lesson we should learn is from recombinant DNA drugs, from recombinant interferon, from recombinant EPO, from recombinant insulin: people in Europe who are doing transgenics have no problems transferring genes or injecting the protein into our human being – no problem with that. So what's the problem when we eat it? And then they say, "How do you know if it's safe or not?" So we need to really learn the lesson from biotechnology in those arenas, pharmaceutical. And I hope, I know that EU is a key reason for application of biotech crops in the world.

I hope this "Luxury Syndrome" could be changed. I guess it's because people are stuffed – they don't know the hungry people's feeling. And this is a very important meeting because I've been so happy so many years because I was involved very early with GM research. And I'm so happy, when I see Norman Borlaug's articles, when I see Khush, Swaminathan, and all those top guys, big guys; their papers say GM is good, technology is good, everyone should use (it) – I was so happy.

I hope that – today's meeting, many of you are very VIP. I hope you can really stand up and heavily criticize the people who just have their own benefits. And please help, because if you do so, the more people saved from the poison and the pesticides, and (you can) save human life.

And I have a friend, he's the (speaker of the house) from Bangladesh. He visited China, and I'm a member in the congress, I receive him, and he wanted to feed our fish in a pond, and he put a feed to the fish. And then he discovered so many fish. So that's true because fish need food also. And I'm so happy that I have a chance to visit Des Moines to join this important meeting. I'd like to thank Ambassador Quinn and also thank the Foundation for invitation. Thank you very much.

Gordon Conway

Thank you, Zhangliang. That was a terrific presentation. You talk about the VIPs, but you're the VIP when it comes to biotechnology in China.