



**RECOGNIZING RISK**  
**IN GLOBAL AGRICULTURE**  
FEDERAL RESERVE BANK *of* KANSAS CITY • JULY 19-20, 2011

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**A Symposium Sponsored by  
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**Kansas City, Missouri  
July 19-20, 2011**

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**Session 1:  
Balancing Global Food Production and Consumption**

## **Symposium Introduction**

### **Transcript**

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*Alan Barkema*

*Senior Vice President and Director of Research*

*Federal Reserve Bank of Kansas City*

Good afternoon, ladies and gentlemen. My name is Alan Barkema, and I am senior vice president and director of research here at the Federal Reserve Bank of Kansas City. And I am delighted to welcome you to the Bank's 2011 Agricultural Symposium, "Recognizing Risk in Global Agriculture.

This Bank is one of 12 regional Reserve Banks in the Federal Reserve System, with responsibilities in monetary policy, supervising commercial banks and bank holding companies, and providing payments services to depository institutions. The Bank's region spans seven states: Wyoming, Colorado, Nebraska, Kansas, Oklahoma, the western third of Missouri, and the northern half of New Mexico. Agriculture is a vitally important enterprise in this part of the nation, and research on developments and prospects in the industry has long been an area of particular focus for the Bank.

At this Bank, we have positioned responsibility for research on agricultural and rural issues—including this Symposium—in our branch office in Omaha, Nebraska. The Omaha Branch is led by my good colleague, vice president and branch executive Jason Henderson. Jason, who holds a Ph.D. in agricultural economics from Purdue University, has been with the Federal Reserve Bank of Kansas City for more than 10 years, and he has headed up our Omaha office since 2006.

This is an extraordinary period in agriculture. At our Symposium in this room one year ago, a strong consensus emerged that a surge in global food demand driven by a potent combination of population and income growth in the developing world would stretch agriculture's capacity as it strained to double production by the middle of this century. Today and tomorrow at this year's symposium, we will consider the risks the industry faces as it takes on that challenge.

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Those of us in the room today are not the only ones attune to the risks ahead. Agriculture is in the spotlight, and leaders around the globe and at home are focused on the industry's potential rewards and downside risks. Our diverse audience is ideal for probing these topics. This room is filled with participants from across the country, representing production, agribusiness, finance, academe, and government – including staff members from the offices of Senator Roberts, Senator Moran, and Congressman Yoder. One of those concerned leaders, Kansas Senator Pat Roberts, who is the ranking member of the Senate Committee on Agriculture, Nutrition and Forestry. Senator Roberts is unable to attend the symposium today but he offered to share his thoughts with you in a brief video presentation.

## **Video Message**

## **Transcript**

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*Senator Pat Roberts*

*Kansas*

Hello. I'm Senator Pat Roberts. I really apologize for not being there in person, but I can assure you I am working hard in our nation's capital to help solve some of the very serious issues we face as a nation. And, one of them falls right in line with the very theme of your symposium – Recognizing Risk in Global Agriculture.

Our producers have a very large task at hand. By the year 2050, just a couple of decades, the global population will rise to over 9.3 billion people. That's a lot of mouths to feed.

Now, to meet this challenge, we must double our agriculture production in order to feed this troubled and hungry world. This is no small task. It will take advancements in technology and efficiency, ensuring that new products can be brought to market. Doubling agriculture production will only occur through farmer techniques that combine the use of important conservation practices with the use of improved seed varieties that increase drought and disease resistance while increasing yields.

I think we can all agree that a well-fed world is a much safer and more stable place that, in turn, leads to stability, economic growth, and peace. Hungry people lead to discontent, instability and, yes, even extremism. We must give our farmers and ranchers the tools they need to be successful. Over 9 billion people in a world hungry for nutrition, peace, and stability are depending on it.

Thank you for listening.

## **Outlook for U.S. Agricultural Exports (Remarks)**

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*Joseph Glauber*

*U.S. Department of Agriculture*

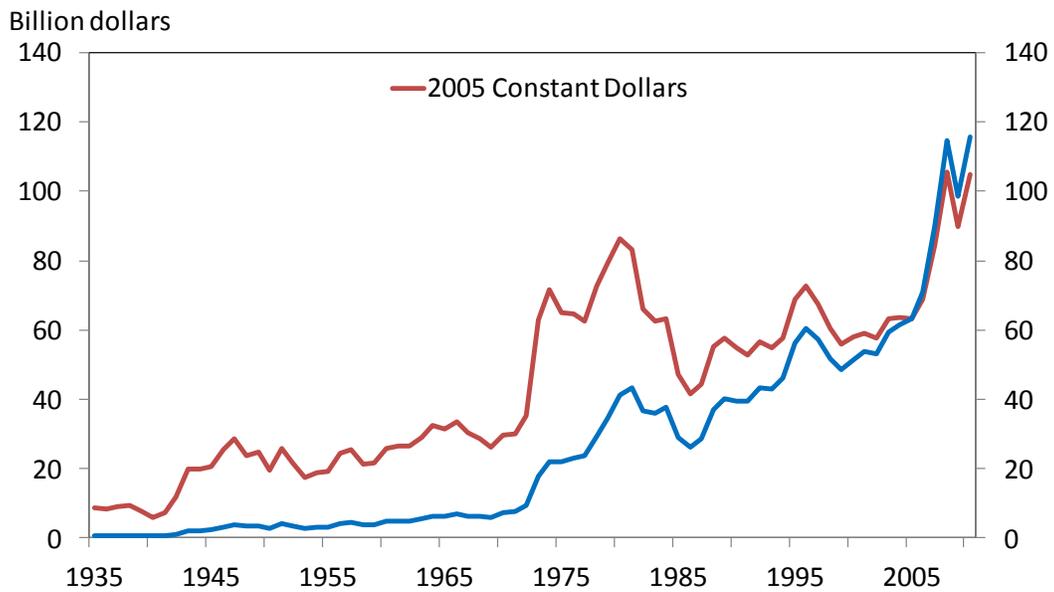
I was asked to talk about the outlook for U.S. agricultural exports and go over some of the trends we've seen over the last few years. It's a little different than what I normally do. We give a lot of outlook speeches, obviously, and talk on a variety of other issues. This was a nice opportunity to climb back into some of the data and look at the longer-term trends we've seen.

As many of you know, the USDA puts out a 10-year baseline every February. My analysts there do this on a regular basis. It was quite useful for me.

For a couple of years, I served as U.S. agricultural negotiator in the Doha Talks. There, too, you get an appreciation for a variety of the markets that could be of interest to the U.S., which has given me a bit of perspective on this.

Let me review some of the trends. The graph shows U.S. agricultural exports by calendar year for the last 75 years, adjusting for inflation and in nominal terms [Chart 1]. U.S. exports have been at record levels over the last two or three years – 2008 now followed by 2010. Agricultural exports in 2010 are both nominal and real records. The U.S. had a big export jump in the early 1970s, when we started selling a lot of grain and oilseeds to the former Soviet Union, followed by the big activity in the late 1970s, both to China and also to the former Soviet Union. In the early 1980s, exports really plummeted, reflecting a strong dollar, weak economic growth, and agricultural policies that maintained U.S. prices above world levels. But since then, we've seen a pretty strong progression, particularly over the last five or six years.

**Chart 1: U.S. Agricultural Exports**



We often like to point out that production from one out of every three acres is exported. But you can see that really varies by commodity. Generally, if you look at the percent of production by decade over the last several years [Table 1], you can see how that has changed. In particular, you can see how some export shares declined for grains. In the 1960s and 1970s we had a lot of concessional sales – things like Food Aid, when a lot of surplus U.S. grain was being dropped on world markets. In the 1970s, that changed as China and the former Soviet Union came into the markets -- but again U.S. export shares generally declined.

**Table 1: Share of U.S. Crop Production that is Exported**

Period	Wheat	Corn	Rice	Soybeans	Cotton
1960-69	53.8%	12.3%	51.0%	37.9%	34.4%
1970-79	57.8%	24.6%	58.9%	38.0%	44.1%
1980-89	58.9%	26.2%	52.5%	38.8%	47.6%
1990-99	48.7%	20.8%	46.0%	34.4%	39.8%
2000-2010	49.5%	17.6%	49.3%	38.9%	70.3%
2011-2020 <sup>1</sup>	46.0%	14.9%	53.0%	47.3%	81.3%

<sup>1</sup> USDA Long-Term Agricultural Projections, Feb. 2011

The last row shows projections [Table 1], based on USDA’s 10-year baselines. These values show how much our analysts believe will be exported as a percent of production. The decline in corn exports as a percent of production reflects the fact that an increasing portion of the corn crop now goes for ethanol production. What has happened is that, while the export numbers haven’t changed much – in fact, USDA projects increasing corn exports over the 10-year period – corn production is increasing even more to accommodate growth of bio-fuels production.

Over the last several years, we have seen the increase in soybean exports, primarily to Asian markets – especially China – which USDA expects to continue over the next 10 years.

For cotton, the large increase in exports as a percent of production is due to a variety of factors – both with the phase out of the multi-fiber agreement and also just the general competitiveness of the U.S. textile industry. Most of the textile industry has now moved offshore. Cotton exports, which formerly would account for about 40-45 percent of the U.S. crop, now accounts for 70-80 percent of the crop in any given year.

For livestock, the importance of trade has grown particularly over the past 15 years [Table 2]. Prior to the early 1990s, U.S. livestock, dairy and poultry markets were insular, with few commercial exports and imports controlled by quotas. Over the past

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15 years, the U.S. has become a significant exporter of pork and poultry, export more than 15 percent of production. While this past decade saw the growth in beef exports stagnate due to the discovery of BSE, exports have rebounded in recent years. This year USDA anticipates U.S. beef exports to exceed is exporting much, much higher quality beef despite the discovery of BSE, which in the pre-BSE levels and USDA forecasts that beef exports will account for about 10 percent of production over the next 10 years.

**Table 2: Share of U.S. Livestock Production that is Exported**

<b>Period</b>	<b>Beef</b>	<b>Pork</b>	<b>Broilers</b>
1960-69	0.2%	0.7%	2.0%
1970-79	0.4%	1.5%	2.3%
1980-89	1.8%	1.3%	4.3%
1990-99	6.9%	4.2%	3.1%
2000-2010	6.8%	13.1%	16.5%
2011-2020 <sup>1</sup>	10.3%	22.0%	16.9%

<sup>1</sup> USDA Long-Term Agricultural Projections, Feb. 2011

While the table does not include dairy, dairy exports have grown in recent years and could see further growth as Asian consumers demand more dairy products. The U.S. is already a significant exporter of nonfat dry milk. If you look at the U.S. share of world exports [Table 3], the U.S. share has seen a decline for most commodities over the years, largely because of increased competitiveness abroad. World demand has increased significantly. And, as I mentioned, if you look back to the 1960s and 1970s, the U.S. dominated a lot of those markets by virtue of surplus disposal through food aid and concessional sales.

**Table 3: U.S. Share of World Crop Exports**

Period	Wheat	Corn	Rice	Soybeans	Cotton
1960-69	42.3%	52.4%	19.0%	87.6%	24.7%
1970-79	43.2%	67.8%	21.5%	87.8%	19.7%
1980-89	37.4%	67.4%	20.1%	74.7%	20.4%
1990-99	30.1%	67.2%	13.8%	62.8%	25.0%
2000-2010	24.2%	59.5%	11.6%	44.6%	37.9%
2011-2020 <sup>1</sup>	17.9%	52.8%	10.9%	39.3%	35.1%

<sup>1</sup> USDA Long-Term Agricultural Projections, Feb. 2011

In the world wheat market, the U.S. faces competition from developed markets like Canada, the European Union, Australia, but also emerging markets like the Black Sea region, India, Argentina, and some other developing countries.

The U.S. has long been the dominant player in the corn market, though its market share has declined with competition from Argentina, South Africa and more recently, from Russia. Russia has increased production dramatically over the last five or six years, apart from last year's drought. While the U.S. exports about half of what it produces, U.S. rice exports are a small part of the world market, accounting for about one-fifth of what is traded. Most of the competition coming from, not surprisingly, the Southeast Asian markets like Vietnam and Thailand.

Finally, cotton – where the U.S. has become a much bigger player by virtue of the fact we [the U.S.] are now exporting a large portion of our crop – you can see the U.S. increased its market share to around 30-40 percent of the world market, with significant competition from India, who in the last five or so years has increased productivity through the adaption of Bt cotton and now has become a major cotton exporter. Brazil, with similar adoption of Bt cotton, has increased exports, as have other areas like central Asia and sub-Saharan Africa.

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If you look at the meat markets, 20 years ago, you would have seen a market dominated by Europe, at least for beef and pork (Table 4). Now the U.S. has become a much bigger player in those markets. With broilers, we face a lot of competition from Brazil since they have increased their market share as other countries have dropped off.

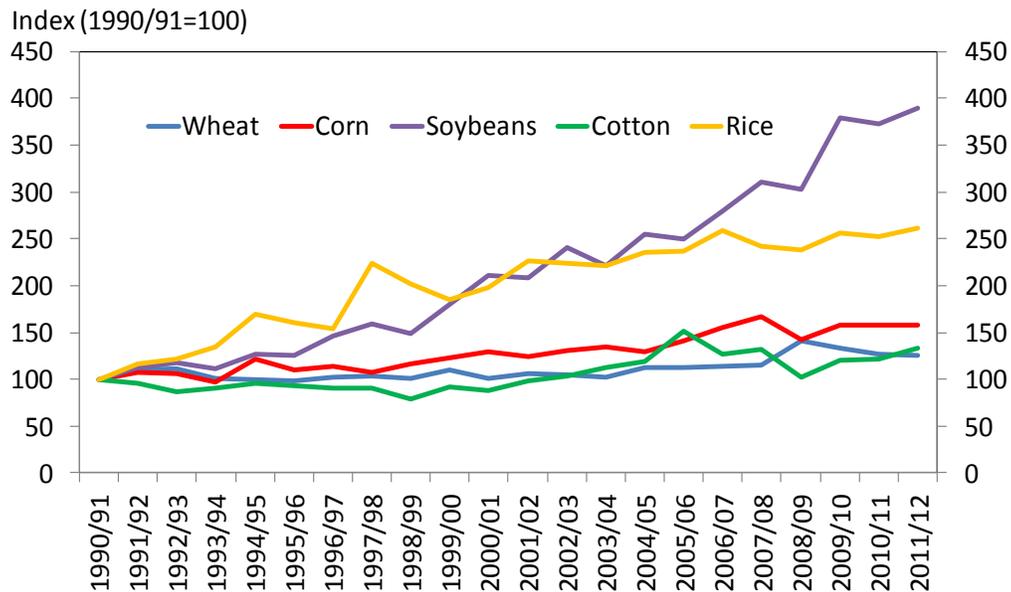
**Table 4: U.S. Share of World Livestock Exports**

<b>Period</b>	<b>Beef</b>	<b>Pork</b>	<b>Broilers</b>
1960-69	1.0%	3.3%	16.4%
1970-79	1.2%	4.3%	12.4%
1980-89	3.6%	2.4%	16.5%
1990-99	12.6%	10.1%	40.0%
2000-2010	11.8%	29.1%	37.7%
2011-2020 <sup>1</sup>	18.1%	37.6%	36.6%

<sup>1</sup> USDA Long-Term Agricultural Projections, Feb. 2011

Chart 2 shows growth in world trade. Here I normalized trade in terms of comparing growth rates since 1990-91 levels. Growth rates for wheat, corn, and cotton have averaged between 1 to 2 percent per year.

Chart 2: World Crop Trade

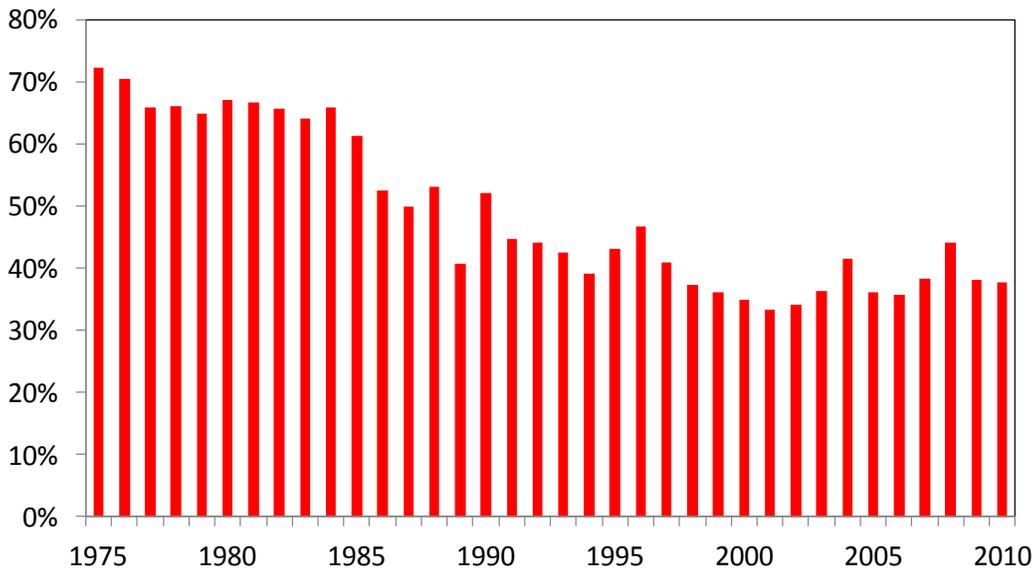


The real growth we've seen certainly has been in the soybean market. I'll show that again as we look at consumption a little later on. There has been a steady progression. If we break that out by country, you'll see how important countries like China are to world trade.

In general, the picture for U.S. agriculture, those record levels I was talking about, the composition of trade has changed a lot from the mid-1970s when we were exporting a lot of wheat and coarse feed grains and soybeans. That has now declined, whereas we've seen a shift toward growth in high-value products, such as fruits, vegetables, and meats, and to a lesser degree in some of the intermediate meat and soybean meal and soybean oil products.

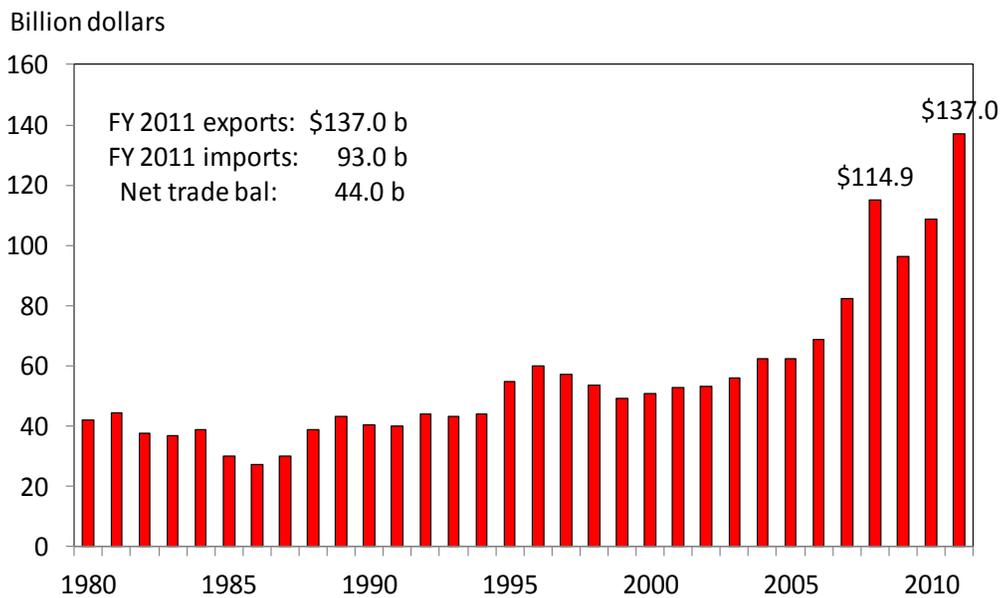
As you remember from Chart 1, trade has increased dramatically over the last five years and almost doubled over the last ten years with bulk exports holding at about 35-40 percent [Chart 3]. Even though the overall percent in terms of total exports has remained flat, obviously in value they too are doubling and not losing ground to the other commodities.

**Chart 3: Bulk Exports as a Percent of Total U.S. Agricultural Trade**



Let's look now at the current picture. USDA just put out revised numbers in May and are now forecasting for fiscal year 2011 total U.S. agricultural exports of \$137 billion. Again, this is a record high, both in nominal terms and after adjusting for inflation.

**Chart 4: U.S. Agricultural Exports – Fiscal Year**

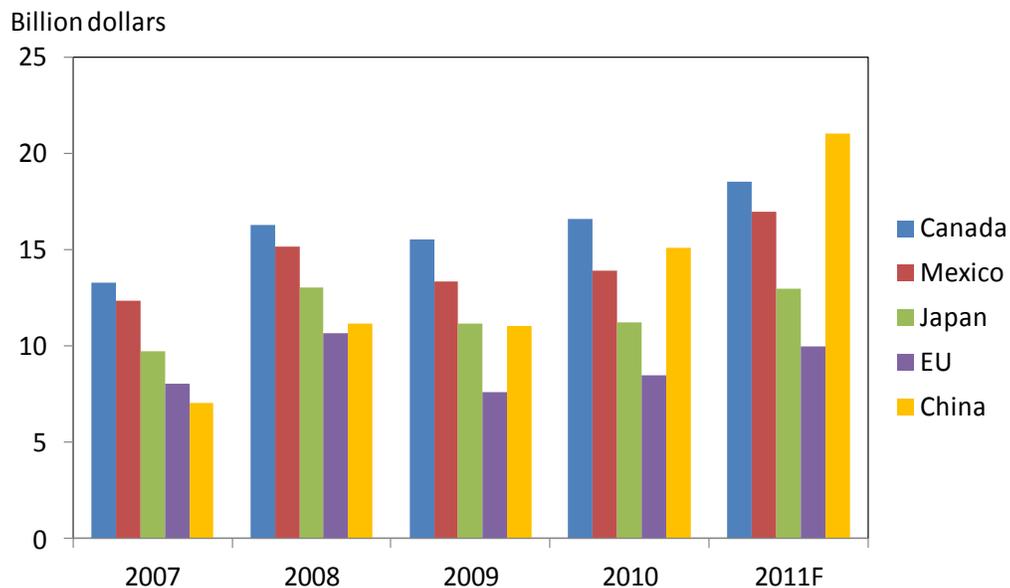


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Imports are projected at \$93 billion, also a record. The U.S. imports a lot of counter-seasonal fruits and vegetables and a lot of tropical products not produced in very large quantities here in the U.S., such as bananas, sugar, and beverages like coffee. The U.S. net trade balance for agriculture is \$44 billion, a nominal record and second largest net trade balance, adjusting for inflation. It is often heard this is one bright spot in the overall U.S. trade picture. Agriculture has been not only just increasing exports, but also increasing the net trade balance.

Not only have we seen much growth in agricultural exports, U.S. markets have changed over time. If we were to look at the top five destinations by value back in the 1960s and 1970s, our top markets would have been in the European Union and Japan. Those markets, while important today, have declined relative to our North American neighbors, Canada and Mexico, due to passage of the Canadian-U.S. Free Trade Agreement and then NAFTA. Canada and Mexico became our first and second-largest partner respectively over the past 15 years. You can see that in the relative position of our top five markets in Chart 5. The real story here has been the growth in exports to China which has gone from fifth largest market in FY 2007 to projected number one market in FY 2011.

**Chart 5: U.S. Agricultural Exports by Top 5 Destinations**



It is instructive to look at the composition of exports to these five countries [Table 5]. The bottom line shows the overall composition for total U.S. exports. As I mentioned, bulk exports – grains, cotton, soybeans – comprise about 41 percent. Next you move into the intermediate products – soybean oil, soybean meal. Then you move into the consumer-oriented products, like fruits and vegetables.

**Table 5: Composition of U.S. Agricultural Exports: 2010**

Country	Consumer-oriented	Intermediate	Bulk
China	6.6%	15.9%	77.4%
Canada	77.3%	17.4%	5.4%
Mexico	38.5%	24.1%	37.4%
Japan	42.9%	11.1%	46.0%
EU	46.0%	27.7%	26.3%
Total US	39.2%	20.0%	40.8%

You can see how the mix changes among countries. Canada is dominated by fruit and vegetable exports and processed products.

Look at China, which was dominated by bulk commodities – primarily soybeans and, to a lesser degree, cotton. Even with intermediate products, we have things like cattle hides, which are quite important products to China. But consumer-oriented products – fruits and vegetables – are less important. Obviously, there is a lot of potential. That is the good news.

The vulnerability is that exports to China are dominated by just a handful of products. The other markets show a bit more diversity if you look at the first 5 or 10 products. With China, the first 2 or 3 products account for about 80 percent of their trade, but of course they are very important and show very little sign of letting up. Certainly, soybeans have shown a bit of a lag in shipments lately, but I don't think anyone is thinking China will stop importing soybeans or that soybean exports will decline in the future. China has decided to get their protein requirements from the world market.

In the USDA monthly WASDE reports, most of the attention is given to the bulk product trade or perhaps a little bit to trade in intermediate products. Little attention is given in the monthly forecasts to the more consumer-oriented products or fruits and vegetables.

It is instructive to look at the role China plays in many important markets. Almost 60 percent of soybeans in the world go to China right now [Table 6]. Most long-term forecasts – and that would include USDA or Food and Agricultural Policy Research Institute (FAPRI) -- are maintaining that level if not increasing a bit. For soybean oil, I haven't listed India here, but between China and India, they import about one-third of world trade in soybean oil. They are very important emerging markets.

**Table 6: China's Imports as Percent of Total World Trade**

	<b>2009/10</b>	<b>2010/11</b>	<b>2011/12</b>
Soybeans	58.0%	57.9%	59.6%
Soybean oil	17.3%	17.3%	19.4%
Corn	1.4%	1.6%	2.2%
Cotton	30.1%	33.5%	39.8%

*Source: WASDE, Jul 2011*

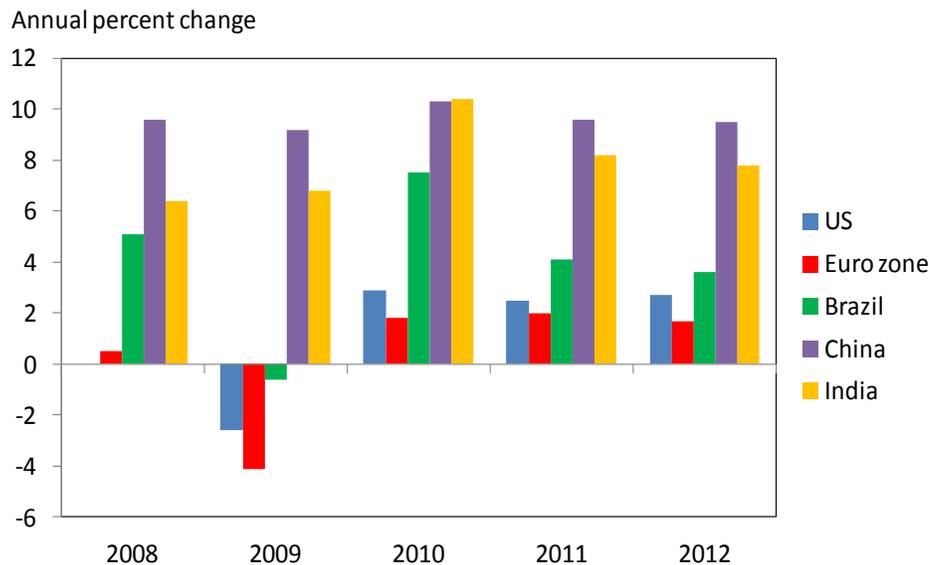
For cotton, 40 percent of the world's cotton goes to the textile trade in China, if you include some of the other Asian markets, you are talking about almost 80 percent of cotton going to those markets. That is up over the last 10 years when it was closer to 50 to 60 percent, which shows a dramatic change in that the world textile industry is centered in Asia right now. As a consequence, world raw cotton fiber is flowing there.

I put corn in here only because corn has received a lot of attention. Certainly, for many years, China has been a large exporter of corn at times. There has been a lot of recent speculation about when China would start moving to become a much larger importer of corn. China has seen a very rapid increase in industrial use of corn – much like what we've seen here in the U.S. – so there has been a lot of corn-based fuel production as well as increases in starch production and other nonfood and nonfeed uses of corn in China. With China's rapid industrialization of meat production, particularly

poultry and pork, we are seeing a much more rational feed use. We have seen the consequences of that rationalization in terms of increased soybean imports. Many analysts speculate that we will see similar future growth on the caloric front, implying more corn imports. The U.S. upped its most recent estimate of corn imports to China this past month. The Grains Council and others have been speculating these numbers will increase a lot more over the next few years. The USDA's baseline shows an increase. Again, given the activity we've seen over the last few weeks, China could become a very regular participant and importer of corn.

If you look at some of the growth factors that affect U.S. trade, you have to look at world output – that is, gross domestic product (GDP) growth [Chart 6]. It is important for low- and middle income countries as they obviously have a much higher propensity to consume with some small increases in income, as diets change and households move to more diversified diets, which include moving to more meat products which then have an effect in terms of meat consumption. Where that meat is produced can have an impact on grains and oilseeds.

**Chart 6: World Gross Domestic Product**



While most of the developed world was going through a serious recession in 2009, we still were seeing pretty large growth in China and India, less so in Brazil, but

their growth rates rebounded far better than the U.S. and the EU, but still not nearly as high as what we've projected in China and India.

Competitiveness of U.S. products is another factor affecting U.S. agricultural trade. One aspect of a weakened U.S. economy has shown up in the value of the dollar [Chart 7]. What this index represents is the value of the dollar versus the currencies of those countries that import U.S. agricultural products. USDA weights it by the imports by country. The dollar has fallen a lot over the past several years, particularly after the recession in 2009 where the low value of the dollar made the U.S. product very competitive. I could put up a similar chart that would compare the value of the dollar vis-à-vis U.S. competitors in agricultural markets. It would look much like this chart, I might add, which is not surprising. If you think of the EU, Australia, Canada, and Brazil, all of their currencies have had strong appreciation vis-à-vis the dollar. When countries are looking at importing a commodity, obviously the weaker dollar gives some advantage to the U.S.

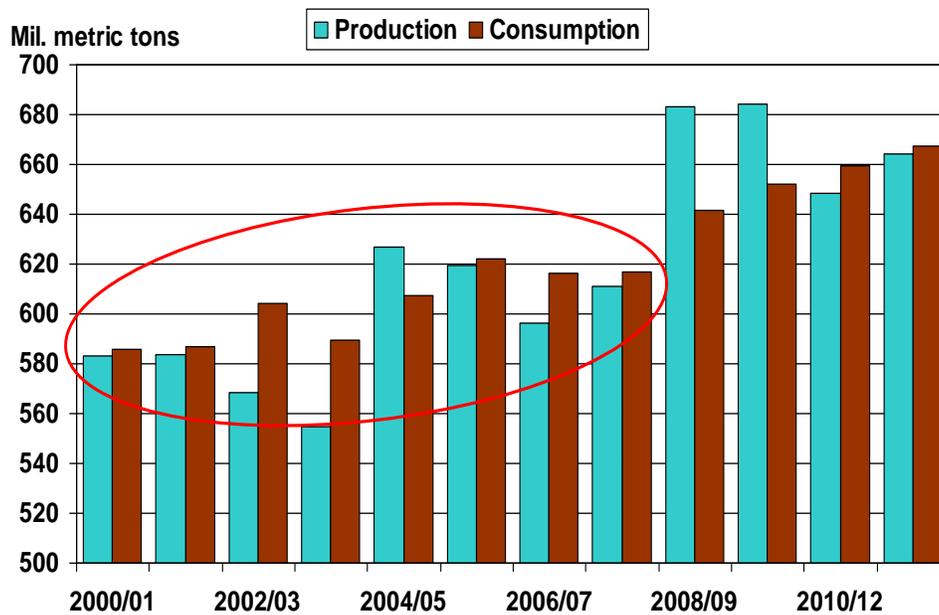
**Chart 7: Trade-weighted Value of the U.S. Dollar**



Briefly, let's go through some commodities. On the wheat front, going into the 2007-08 period, we had a lot of years where production fell short of consumption [Chart 8]. We saw stock levels go down to about 125 million tons on a global basis. That fall

we had very high prices. That was followed by two outstanding years – global records for 2008-09 and 2009-10 – where the world really responded to high prices, came back in hard, and rebuilt stock levels. Then in 2010, there were problems with the Black Sea crop in general and also a lot of quality problems – rains in Australia – quality problems coming out of Canada, and some drawdown in stocks. If you think back a year ago, events in the Black Sea area was one of the things that first started to boost prices generally for grains and oilseeds.

**Chart 8: World Wheat Production and Consumption**



Source: USDA-WAOB, *World Agricultural Supply and Demand Estimates*, April 2011..

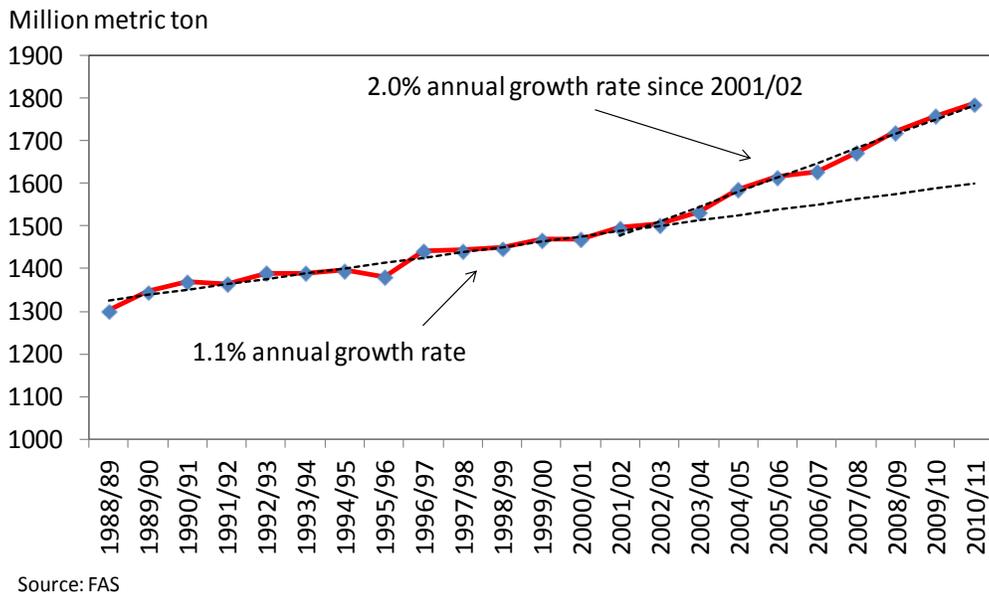
This year, we are looking at some rebound, but obviously we have a lot of problems in the southern Plains in the U.S. There was a problem with planting due to a wet spring, which has affected the Canadian crop. The European crop, too, has come back a bit but also had problems with drought this spring.

That said, USDA still projects a rebound in production from last year. Again, note the strength on the consumption side. That means taking down world stock levels just a bit more. Production is not nearly as tight as what we saw in 2007-08, but still tight.

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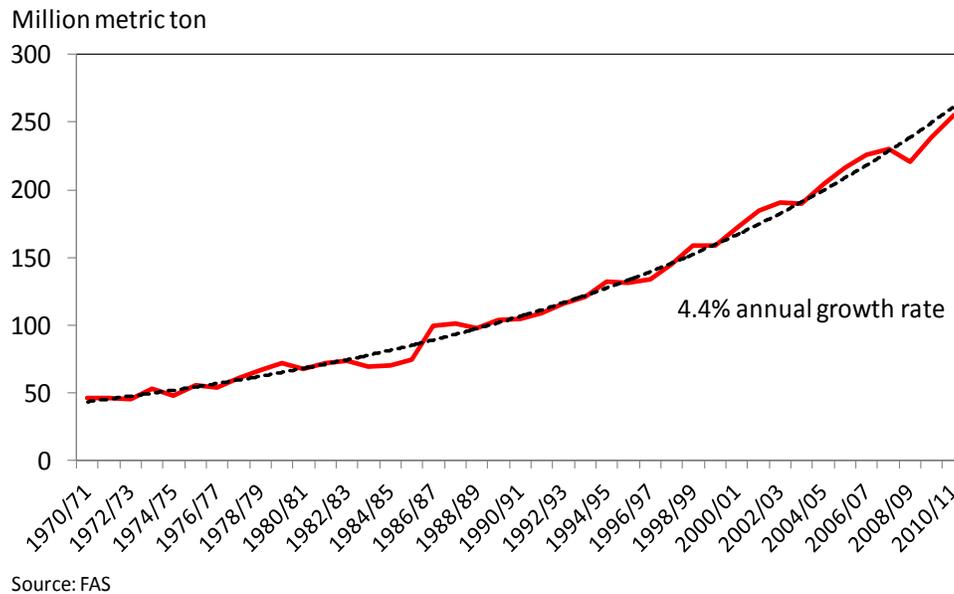
Looking at world wheat and coarse grain demand, there you really have seen the change from a very low growth rate – remember that chart I showed you on world exports where wheat was one of those lines on the lower part of the graph with very little growth – so small growth [Chart 9]. That has changed a lot, because this is built in with coarse grain demand, you have a lot of that being driven by U.S. bio-fuel production. The increase there we have seen on the demand for corn at least. Also we have seen increases – as evidenced by the previous chart – in terms of wheat consumption. You can see those brown lines trending upward.

**Chart 9: World Wheat and Coarse Grain Demand**



If you move over to soybean supply, there too, USDA projects a drawdown going into 2008-09. Remember the droughts, particularly in the southern hemisphere, where we had very poor crops out of Argentina and Brazil that brought world stock levels down. We've had very good crops generally since then. South American crops look good again this year. With a strong *real*, the increase in soybean prices has not been translated quite as fully to Brazil because of the currency appreciation over that time. Nonetheless, we have seen some strong production come out of that region. Certainly, the U.S. is still in a pretty tight situation for soybeans.

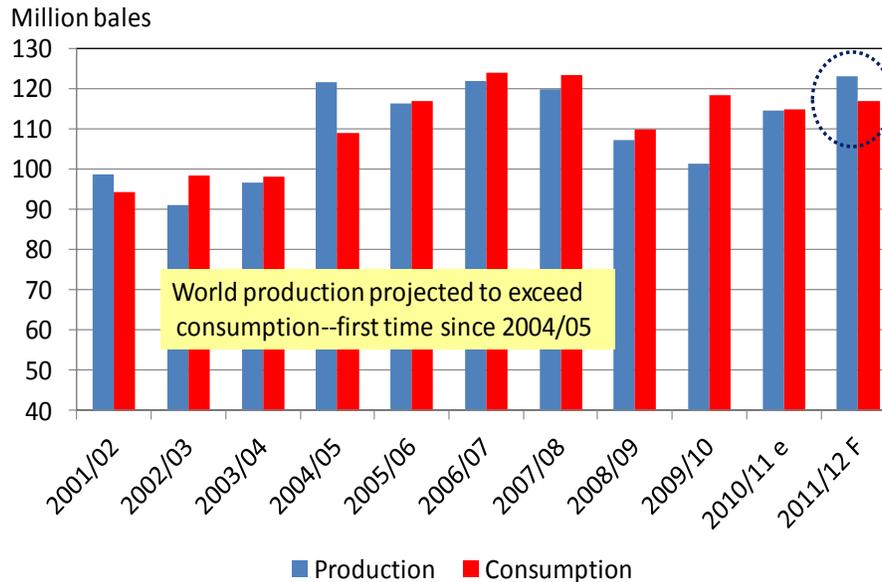
Chart 10: World Soybean Demand



Soybean demand has been remarkable, though [Chart 10]. This is a trend that goes all the way back to 1970. Soybean demand has been growing at an incredible rate of about 4.4 percent per year since 1970. It doesn't really show many signs of letting up.

Cotton, of course, had record prices over the last year or so and prices are still very strong, despite the recent collapse. We're trading more down in the dollar range for cotton, far below the peaks we saw in the spring but high relative to historical levels. There has been a big world production response to the high prices which has contributed to the more recent fall in prices. The only worldwide problem with cotton is what is happening in Texas, due to the unprecedented drought decimating the crop there. It also looks like we are going to see record abandonment of area in the cotton regions of west Texas and other parts in Texas. So that has taken a little bit off world production potential. All the same, we should see a good response globally.

Chart 11: Global Cotton Production



With the remaining time I have, I want to point out some issues facing U.S. agricultural trade. We are focusing a lot on income. I have talked a lot about currencies, which are important. Certainly, as we've seen the growth of producers like Brazil and others that are competing with the U.S. over a variety of commodities for these lucrative markets, what does come up a lot are barriers to trade.

The easy ones are tariffs. Yet, for agricultural products, with the exception of some key markets, tariffs have come down a lot. Certainly, they are low in the U.S. Even in a lot of developing countries where the bound rates are high, the applied rates have been lowered, because the markets are so tight that countries see benefits of bringing in products. So their applied rates – at least what they are charging on the books – are quite low.

Out there are still critical markets that have been very difficult to get into. Most challenging has been the non-tariff barrier side, particularly the sanitary and phyto-sanitary issues, as well as other barriers. Where we've seen barriers has been on GMO [Genetically Modified Organism] products. Less so recently, but always potential problems, are subsidies, both production subsidies that distort market signals for producers but also export subsidies and more explicit forms of subsidies that affect trade.

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Trade agreements can boost trade by lowering these barriers. We currently have a pending free-trade agreement with Korea that based on estimates done by USDA's Economic Research Service would bring benefits on the order of \$1.9 billion a year in increased trade. Likewise free-trade agreements with Colombia and Panama, while having smaller impacts on trade than Korea, would still have a significant impact on products such as livestock and dairy products.

The broader round of negotiations in Doha, which include all 155 or so WTO [World Trade Organization] members, is a far more encompassing agreement in that it would affect not only tariffs but domestic support disciplines and also export competition disciplines. Most of the deadlock on Doha right now is surprisingly enough not due to the agricultural negotiations but the nonagricultural issues.

Trade disputes can have very large ramifications. The U.S. has had a long-standing dispute on cotton with Brazil. We are currently embroiled in country-of-origin labeling dispute with Canada and Mexico. Actions other countries have taken against us include China, who has imposed restrictions on poultry imports from the U.S. and issues with Mexico over trucking, which hopefully now is settled.

These bilateral and multilateral issues are not easy things to solve. Just take Doha, for example, where we're some 10-odd years in there and still a long way from completing it, but it can have very large impacts on trade.

I would conclude by stressing how the engine for world growth in consumption and trade continues to be in the developing world. That's where we see the large income gains. That's where we are seeing shifts in household food consumption. I think the recovering U.S. economy will likely mean foreign currencies will continue to be strong relative to the dollar. That should help and enhance U.S. competitiveness. That said, the U.S. can expect to face continued competition from exporting developing countries. Countries like Brazil, Argentina, and even India are big players in markets for things like cotton and wheat and have been strong competitors. Eastern Europe and the Black Sea region are areas that 10 years ago weren't very big factors on world markets but now are. For the U.S., it is not surprising that we may see declining world shares. However, with growing world markets, we will still see growth in those markets for the U.S. and trade

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will remain a very, very important part of each individual balance sheet as we move forward.

If you look at these overall trade agreements, it is important for the U.S. to be an active player. Other countries certainly are pursuing that path. You can't afford to stand still or you risk being isolated, as other countries pursue more trade liberalization agendas.

With that, I conclude.

## **Industry Panelist**

## **Transcript**

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*Mike Baroni*

*Archer Daniels Midland Company (ADM)*

Thank you, Dr. Glauber, for your very informative overview. It's really a pleasure to be here this afternoon. We're here talking about some of the most important issues facing U.S. and global agriculture.

While most of you here in the room are somewhat familiar with ADM, I should tell you that our perspective on all of the various topics we will talk about today is really shaped by what our position is on this global agricultural value chain.

We don't grow crops at ADM, with some very rare exceptions – maybe a little sugar in Brazil and we've experimented with some Stevia in Paraguay. But, for the most part, we don't grow crops. What we primarily do is source crops. We source corn, oilseeds, wheat, and cocoa from all over the world. Then we either sell or trade those crops where and as needed. Or we will transport them to our processing plants, using a huge network of trucks, railcars, barges, and ships. In those processing plants then, we will transform them into a very broad range of different products from food ingredients to various animal feeds, fuels, biofuels, and other industrial products, which we then distribute to large commercial companies around the world.

Our corporate overall growth strategy and all our investment decisions today are driven largely by these same fundamental forces that are shaping the future of our planet, and its people that Dr. Glauber talked about – namely, population growth, income growth around the world, urbanization (a key trend), and the resulting need from all of that for a lot more food and a lot more energy.

While we tend to think these forces are inexorable and inevitable, we also know, of course, and we recognize there are any number of conditions or developments that could impact these projections one way or the other. Things like major economic shocks, some type of global health crisis, maybe the population trends not quite going the way we thought, or unforeseen changes in diets very specifically related to meat consumption,

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could very easily affect these trends in a big way. If the unusual weather events, economic gyrations, and political upheavals of the last few years are any indication, it has taught us that none of us can really anticipate every possible turn of events that will occur.

So, from our perspective, what's ultimately the most important isn't really so much whether or not these demand estimates vary from what we're projecting, but how the global food industry and the entities that govern it respond to these changes in both supply and demand one way or another.

Many of the companies in our sector are accustomed to managing through volatility. In fact, we consider risk management and market forecasting two of ADM's core competencies. We view our vast network of origination, storage, trading, transportation, and processing as a global shock absorber. A supply and demand shock absorber that is helping to smooth out these supply and demand bumps by moving raw materials and finished products from surplus regions to deficit regions, as needed.

Many food companies, including us, are investing billions of dollars to expand their base of assets to develop new products, access new markets, create new markets and operating efficiencies, and otherwise ensure that we're prepared to serve a vast and growing number of new consumers and to deal with these market imbalances as they occur. Now that's our role. We can do these things. And we can do them extremely well, particularly when we work in partnership with growers, governments, NGOs [non-government organizations], and other key stakeholders such as yourselves throughout the whole agricultural chain.

Together, we are confident and know we can create an environment conducive to agriculture's ongoing growth and developments by focusing on three areas in particular. First, we believe it is critically important to have clear pricing signals to guide investment, to guide growth, and to help market participants manage risk. To help ensure such signals are clearly transmitted, governments and regulators can be thoughtful in their responses to recent price volatility and mindful that any abrupt actions can sometimes exacerbate already challenging market conditions. It is important to remember that the utility of markets in translating pricing information and managing risk should always be the priority.

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In recent months, there has been a lot of talk about the possibility of developing an international database, what they are calling the Agricultural Market Information System, or AMIS, at the FAO [Food and Agriculture Organization]. This system will help gather and disseminate national-level information on supply stocks and usage data. We think this idea has merit. It is the kind of practical technology that may well facilitate better decision-making from governments all the way down to growers.

Next, we at ADM believe it is important that public policy serve to facilitate the flow of food from where it is grown to where it is needed. We have seen in the past several months that export bans, import tariffs, and other types of trade restrictions can and have sharply limited the availability of grain and oilseed supplies to those who need them the most. And we think they have contributed sharply to recent price volatility as well. That is why we are actively working with fellow industry participants in the World Economic Forum's G-20 Working Group on Food Security to help talk to governments and try to convince them these types of barriers to international commerce should be discouraged or even prohibited.

Finally, we need better infrastructure in developed and developing markets to help link growers to world markets. We need more roads, better roads, railroads, waterways, bridges, ports, and on and on. And we need to prevent the waste of millions of tons of grains and oilseeds that are lost every year to after harvest. We need to build storage capacity to absorb overages and handle shortages.

Clearly, it is important that agricultural infrastructure investments promote an enhanced productivity. But, at the same time, we have to work to make more of the crops that we already grow. That's why we at ADM, in addition to the billions of dollars in investments we are making as a company to expand our global network of storage, transportation, and processing assets, recently founded the ADM Institute for the Prevention of Post-Harvest Loss at the University of Illinois. This research center is focused on finding ways to help farmers in the developing world protect the crops they already grow today with a view to maximizing the value of the total world harvest. It's probably a bigger problem than many people realize.

In 2007, the last year data were available, it was estimated that as much as 30 million tons of corn, 20 million tons of wheat, and 3 million tons of soybeans were lost

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after harvest to things like bad storage, weather contamination, but also to lack of access to markets for farmers to sell their surplus.

In conclusion, based on both the enormous increases in agricultural productivity the world has already experienced in recent decades and on the innovations, investments, and partnerships already forming throughout the agricultural value chain, we at ADM believe the world has the ingenuity and the determination to meet this growing demand. We look forward to continuing to collaborate with many of you in this room, including innovative companies such as that represented by David, our next speaker, to achieve these common goals.

So thank you and I look forward to the discussion in a few minutes.

## **Industry Panelist**

## **Transcript**

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*David Fischhoff*

*Monsanto*

Thank you very much. It's a great pleasure to be here today to speak to this group. I'd like to build on some of themes we've heard already in the first two talks, starting out with our view at Monsanto. I'm sure, and as you've heard already, we're not unique in this view on the demand side. It's abundantly clear from what we've heard already and what we all know that demand for grains, in particular for food and feed as well as fuel, are going to increase dramatically in the coming years.

From our analysis, this is especially the case for corn and soybeans. The trends there, especially in terms of the shift in diet toward increasing amounts of animal protein in developing countries, really highlight this increased demand for corn and soy, which isn't to say there won't be increasing demand for other crops such as wheat and rice. But we would expect that demand to grow more slowly – albeit needing some of the same types of innovation and technological improvements that I'll talk about in a few minutes, specifically with reference to corn and soy.

At the same time as we see populations increase and diets shift leading to this increased demand, agriculture – whether it is in the United States or in many other parts of the world – is under increasing pressures in terms of production to meet that demand. The amount of arable land that could be put into production is quite small. We can even expect decreases in arable land in many parts of the world, as we see increased urbanization and other trends.

At the same time, there are increased pressures on water. Agriculture accounts for about 70 percent of the fresh water withdrawals already. Again, with increasing population and increasing urbanization, water use is going to become even more critical as we go forward.

Then there are additional pressures on agriculture – for example, from global climate change, although there may be some near-term benefits from global warming in

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some regions of the world – for example, in the northern part of the Northern Hemisphere as well as perhaps the southern part of Latin America. At the same time, long term, the trends as illustrated in the various IPCC [Intergovernmental Panel on Climate Change] studies would indicate that instead we will see more extreme weather patterns, more extreme droughts, for example, in parts of the world that are already quite dry, including the southwestern part of the U.S.. Although we can't make precise predictions on local weather patterns with any great degree of confidence today, overall the trends are pretty clear, and they are not especially promising.

The question for all of us – not just us at Monsanto working on the technology side of agriculture, but all of us involved in food production and the agricultural food chain – is, “What can we do in the face of this increased demand for increased production?”

The good news from our perspective, and I hope for all of you, is that we see great promise in technologies as applied to agriculture to help meet this demand. I'll illustrate this specifically with reference to corn and soybeans, especially in the U.S., but I want to touch also on other crops in other parts of the world and some of the conditions that will be necessary for all of this to come to pass.

At Monsanto, as we have looked at this quandary over the past several years, we've concluded that a realistic goal, not necessarily a slam-dunk by any means, but a realistic goal, is to aim to double production in terms of total yield or average yield per acre in the major row crops – such as corn and soybeans – by the year 2030 compared with the year 2000, which we picked simply because we had good data available going back to 2000 for many crops in many parts of the world. We're already about 10 years or so into that 30-year horizon that we identified.

If you think about it, what that would mean for U.S. corn, as an example, is going from somewhere on the order of 150 bushels an acre up to close to 300 bushels an acre, as average U.S. corn yields over that 30-year timeframe. To put that into perspective, if you turn the clock back to 1970 or 1975, U.S. corn productivity on a bushel-per-acre basis actually doubled in that timeframe from 75 to about 150 bushels an acre. Although it is a dramatic change to increase by another 150 or so bushels an acre, on average, by the time we get to 2030 it is certainly within the historical norms we've seen in the past.

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In many other parts of the world, as we heard in the first talk, there is really significantly more headroom than in the U.S., because corn yields, for example, in many sophisticated agricultural systems like in Brazil don't yet approach the U.S. averages currently. With changes in practices there, we can see those increases occur even more rapidly.

So then the question is, "How might we achieve this kind of increased productivity on a per-acre basis?" The way we've looked at the problem, we see the solution being built on what we would think of as three pillars. One is increases due to plant breeding. The second is changes and enhancements based on agronomic practices of a whole host of types. And the third is new biotechnology traits.

Let me spend a couple of minutes describing how we see this playing out, again thinking about U.S. corn and soybeans as the primary example. First, we'll start with plant breeding. Plant breeding, although it has been around for a long time – since the dawn of agriculture – has undergone a very significant technological revolution in the last decade or two, something akin to what we've seen in biotechnology but perhaps not nearly as well-publicized. The main driver for this is a combination of technologies, the primary one being the use of DNA markers to really understand the genetics of crops – DNA markers of the same type you see on television shows like CSI or used in paternity tests and things like that. The way they are used in breeding for agriculture is we can much more precisely now understand the genetic makeup of the germ plasma that our breeders are using and do much more in the nature of predictive crosses of plants, identifying which parents really will lead to better performing progeny.

In our hands already at Monsanto, we have seen about a doubling of the rate of yield gains. You think of plant breeders historically as having increased average yields year after year after year, simply by tapping into genetic diversity and identifying better combinations. With the use of DNA markers, we can actually double that rate of gain. We're well on our way toward achieving these sorts of goals in plant breeding. That is accompanied by a whole variety of technologies, such as increased automation to allow the breeding operation to be much more efficient.

With the use of multiseason nurseries, for example, at Monsanto, our corn plants are grown three generations a year – sometimes even four – by taking advantage of the

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Southern Hemisphere and especially utilization of land in Hawaii, where we can plant corn year round. We can make much more rapid gains on a yearly basis than simply a single cycle, as breeding was historically carried out on an annual basis. So, plant breeding is a key piece of this.

Going along with that are improved agronomic practices. These go hand in hand. One of the key changes in agronomic practices we've seen historically over the last 10 years or so, which has crept up on us, is increasing plant density, at least for corn. Plant densities are much higher than they have been historically and that has led to an increased yield per acre. You can't simply jam more plants into a given acre, unless the plants are adapted for that. And that is why breeding plus agronomic practices go hand in hand.

In addition to this, though, there is a whole variety of technologies, including more adoption of aspects of precision agriculture that we see moving ahead and allowing increased rates of gain through agronomic practices, as well.

Finally, there is biotechnology. Monsanto is maybe best known for biotechnology, but it is really only one piece of this pie. Each of these aspects I've talked about – breeding, agronomic practices, and biotechnology – are approximately equal contributors in our models for how we might double grain yields by 2030.

In terms of biotechnology, although it has been extremely well-adopted in some crops in some parts of the world – for example, U.S. corn and soybeans – it is important to reflect on the fact that it has only been around in a commercial sense for about 15 years or so. Really, when you look at it, we have only yet through biotechnology delivered two types of traits – primarily herbicide tolerance, largely glyphosate tolerance, and insect resistance to yet just a handful of insects and in just a couple of crops, mainly corn and cotton.

As we look forward with biotechnology, we are beginning now – and this is just the beginning of this era – to see the possibility both for enhancing the types of traits we've already worked on, such as insect resistance, herbicide tolerance, some aspects of plant disease resistance, but also moving into new types of traits – the kinds of things we refer to as yield and stress traits. Examples of those would be single genes that can directly boost the yield potential of a crop. We have examples of this in our pipeline at Monsanto and many other companies do, as well, in both corn and soybeans where single

genes can give about a 5 percent increase in yield directly. Stress tolerance traits of the type that have traditionally been dealt with by plant breeding we now see at least the beginnings of those through biotechnology for traits such as drought tolerance.

If you add all of these together the way we have looked at it, we believe it is a realistic view to aim for doubling crop yields in places, in crops, and parts of the world where we can adopt all of these technologies. This won't come about just by Monsanto doing research in our own labs; it will take efforts across the whole agriculture value chain. For example, changes in agronomic practices go hand in hand with changes in equipment, as we go to increased plant densities – narrow rows for example or more precise application of fertilizers – all of which depends on other participants not just the breeding and biotech companies like Monsanto.

In order to make this possible, let me touch on a few final comments. What's really required – and this isn't just for Monsanto but for the whole agriculture value chain – in order to make this yield doubling a reality, we need more technology applied to agriculture and that depends not only on private-sector investment, but also really robust public-sector investment. Certainly, in the current atmosphere for public-sector funding of science and technology, especially agricultural sciences, the promise there is not as great as it might once have been. We can only hope for a return to increased funding for agricultural research on the public side.

The second thing we need, especially for the types of innovations I've touched on, is strong intellectual property positions, not just in the U.S. where we have good intellectual property laws, but to allow the dissemination of these technologies around the world really depends on intellectual property protection worldwide.

The third component, which relates especially to biotechnology, is a strong, robust, and science-based regulatory system. In the U.S., we have been lucky to have strong science-based regulations. In other parts of the world, we see regulatory bodies being more able to evaluate and then approve new biotechnology traits. We've seen a real sea change on that front in Brazil in recent years, which has one of the best track records now for evaluating, assessing, and finally approving biotech traits. Yet that is a challenge in many parts of the world.

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Finally, what we need is a strong effort worldwide, not just by private-sector scientists, but by public-sector scientists to collaborate across the public-private divide. This is going to be especially true in crops that go beyond the main commodity crops here in the U.S. For the same types of efforts to be applied to – for example, rice in Asia – will depend strongly on public-private partnerships.

With that I'll end and look forward to the discussion. Thank you.

## **General Discussion**

## **Transcript**

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*Moderator: Jason Henderson*

*Vice President and Omaha Branch Executive*

*Federal Reserve Bank of Kansas City*

**Mr. Jason Henderson:** My rule of thumb is that farmers always produce themselves out of prosperity. While we are in the middle of a commodity price boom, how long is this going to last and who is going to be producing themselves out of prosperity? Is it going to be U.S. producers? Or is it going to be a global supply response?

**Mr. Joseph Glauber:** I would say a global supply response. If you look at the big boost over the last five years, there is no question things like biofuel production had a very big impact on markets, just in the sense of the big boost in prices. In the U.S., under the Renewable Fuel Standard, corn-based ethanol is limited. It is limited both by the mandates themselves, but also limited currently by the blend wall. I'm not saying if that were solved in some way, given energy prices, you'd see a lot more corn going into ethanol. Given it is currently a constraint, you look and see productivity growth – that even with conservative assumptions on the 1 percent for corn, two bushels a year or whatever – over time you build stocks.

One of the problems over the last couple years is that not only have the markets been tight, but when you have a supply shortfall at that point, then you see prices spike. Over time, you will see a rebuilding. There are a lot of other things in play here. Over the long run, we still have a very big issue, if you look over 20, 30, or 40 years, if indeed we have to increase production by 70 percent or doubling production somewhere in that range. That's a challenge. There are certainly areas of the world where there are big gaps between potential and actual yields currently. There we could see some big improvements. The challenge will be to increase production, as Senator Roberts mentioned at the start of the program here. It is a challenge for the U.S. and other producers over the longer run.

**Audience Question:** In the 1970s, we added 60 million acres, or a 20 percent increase in supply, when we had the quantitative easing process that might be similar to today. We don't see those acres coming on. We can't respond in the U.S. like we did in the 1970s. So where are those acres going to come from? What are you seeing as far as the numbers?

Something that comes to my mind is that we see high prices in the U.S. but, for example, the Brazilian *real* or other currencies being strong, they don't see the same high price. Are we seeing the response in acres in those countries like we would expect? Or have we yet to get to a price to really stimulate 20 percent increase in supply?

**Mr. Glauber:** Let me address your last point first. You are right about the currency issue and I mentioned that briefly. If you are looking at the *real* and looking at soybean prices in those terms, the increases haven't been quite as sharp as we've seen in dollar terms. That explains a little bit why we didn't see the area response in Brazil. Now, we are seeing some response and we are seeing some higher production numbers come out of there. Clearly, the big difference between now and the mid-1970s is the fact that we have 32 million acres in the CRP [Conservation Reserve Program]. To bring that out, you'd have to look in the mix. It's a lot of wheat area and a lot of marginal wheat area to boot. You have to look at how much land is there where corn can be grown. The good news is, we are growing corn a lot more places than we weren't growing it in 1970, so it can expand that way.

As policymakers are looking forward and Congress and others are considering this, you are going to have these tradeoffs between environmental benefits and what you want out of the Conservation Reserve Program, for example, tradeoffs with that and meeting food production needs.

**Mr. Kenneth McCauley, Past President, National Corn Growers Association:** Dr. Glauber, I appreciate all of your insight into this. I have to agree with Jason. Looking at this from my point of view as a farmer, farmers tend to produce themselves out. Looking at the carryover, I'm not naïve enough to think we won't eventually build carryovers. But it looks like it is going to take quite awhile to do this, keeping farm profitability pretty high. How do you see the carryover building – over a shorter period or a longer period?

**Mr. Glauber:** Looking at the corn market, I have been saying for some time I thought it would take two or three years to build inventory. It's just hard to build it overnight, particularly given the area we see out there right now. The stock situation frankly has changed that a bit. We have 200 million more bushels than we might have thought before. Again, to think you are going to be back to a 2 billion bushel carryout, or 1.7 or 1.8 billion bushel carryout in corn, which we were carrying just a couple years ago, that takes a lot. It's going to take one or two years more to return to those levels, short of a huge record crop or big changes.

Look at this year, there are all of these high prices. Of course, all commodity prices are high, so you are competing with cotton. Unlike 2007-08 where it was essentially a corn-soybean tradeoff for the most part, here you have high wheat prices and you have high cotton prices, so it's tough.

What I was saying is over time you will see those yields build. As long as demand isn't keeping pace with that, you'll build stocks. It's hard to bet against 60 years of declining prices in real terms, if you are looking five or ten years out.

**Mr. James Andrew, Andrew Farms, Inc.:** I'm an Iowa farmer. Dr. Glauber, I don't think it's probably within your direct purview, but one of the biggest craws in my neck is the inaccuracy of the Crop Reporting Statistical Service. There is more cheap grain purchased and then the USDA or the government corrects that in the dead of winter after everybody without storage has sold their crop at a cheap price. I don't think that is right. In this era of satellite technology, computer technology, and hopefully a little sharper people, I think we could do a better job. Can you give me some idea that is being corrected?

**Mr. Glauber:** You obviously raise a good point. All you would have to do is look at the last two years of running reports. On stock reports with acreage for prospective plantings, we have had limit moves on almost every one of those days.

First of all, I'd also point out that when you are running stock levels as low as we've been running over that period, almost any information hitting the market and anything that surprises market analysts – and there are error rates on these surveys, the last thing I want to do is get into an apologist mode of saying, “Oh well, last year was particularly hard because it was this or that.”

NASS [National Agricultural Statistical Service] has a tough job and all of us would like to go into a lockup and come out with a number that was saying, “That’s exactly what we expected!”

You are absolutely right. What one does need to do, if there are big changes like that, is figure out why there are those changes. Are they legitimate changes or are they errors in measurement? There we spend a lot of time and absolutely that’s an important thing to do. All of this stuff is built on these data. I tell people that I get the NASS numbers just like everyone else does and we incorporate them into the balance sheets, because they are the best numbers one way or the other.

They would be the first ones to tell you too that it is important to look at the methods and constantly review those things. Good point, though.

**Mr. Andrew:** Dr. Fischhoff, I have been privy to your presentations in the past and am always impressed with this doubling of yields. But I don’t know that we’ve done enough as a clarion call to the rest of the country to get ready. I don’t think we have the infrastructure to handle the output, the grain storage capacity to handle it, the trucks on the farm, and the combines to harvest it without dumping every 10 feet. There are a whole bunch of questions that come to my mind. I wish somebody would sponsor either a conference or a study as to all the ramifications of this, because 19 years is coming awfully fast.

**Mr. Fischhoff:** Well thank you. I think that’s an excellent point and it would be great to have such a conference to engage all of the constituents and stakeholders in agriculture. That’s a great idea.

**Mr. Stephen Gabriel, Farm Credit Administration:** I’d like to address this to Dr. Glauber. In your presentation, you pointed out quite clearly the importance of China as a source of demand for farm commodities and, of course, other commodities as well. Yet, we could list a litany of concerns that currently exist with respect to China’s fragile banking system -- the potential for a hard landing as they rein in inflation, lack of transparency in the government, potential for social unrest, and these kinds of things. My question to you is, how much do you worry about China in terms of its future as a source of demand for farm commodities?

**Mr. Glauber:** That is a good question. It is a question that has been asked a lot, particularly as China has grown in prominence. It caught a lot of people off guard last year, as we began to forecast them as our biggest trading partner. As in the chart I showed, you see it has a very different trade profile frankly from other countries. Not surprisingly, they have grown very quickly. It is dominated by soybeans and, to a lesser degree, cotton.

Your question, then, should we be worried about that? I don't think this is the case of what we saw with, say, the former Soviet Union or China in the 1970s, where they were in one year and out the next. This has been a steady growth. So the bigger issue is, what would happen in the event of a collapse of the Chinese economy? Frankly, there the problems are far bigger than soybean exports at that point. Right now, China is a huge engine of growth for the world. If China has problems, there are problems. So, yes, it does, but probably for even broader reasons than agriculture.

There is no question at least right now it is still a very different trade picture. Over time, hopefully, there is a lot of indication that with increasing consumption they may be importing a lot more meat, in which case we may be beneficiaries of that for pork, beef, and poultry. That could start shifting that picture a bit. At this point, it is still developing very rapidly. Your point is well-taken in terms of how dominant that is. I would say it is a fairly diversified picture otherwise. We have a lot of trading partners, but if the Chinese economy were to collapse it would have far bigger implications around the world for trade in general and other things.

**Mr. Henderson:** When I go out in terms of speaking to different groups, one question I always get is, is this the new normal? In other words, for agriculture, is \$6 a bushel corn the new plateau?

**Mr. Glauber:** One part of that the thought has to be that input costs have risen, driven a lot by petroleum costs. If petroleum prices stay at the levels they are, yes, ag commodities will settle at a similar plateau. They have to.

**Mr. Fischhoff:** I would second that. You took the words right out of my mouth. I was going to say, is \$100 a barrel oil the new normal? That is a very important component here. Do we expect, for example, export values to decline? Yes, I would say they will probably decline. These are very, very record-high prices. Sometimes you

break records year after year but, certainly if we are looking at our own outlook, we expect those to fall somewhat, but still remain quite high. That is true with grain prices and oilseed prices. They may correct a bit, but they are still going to be far higher than they were ten years ago.

**Mr. Bill Lapp, Advanced Economics Solutions-Omaha:** Dr. Glauber, I have a question about the risk management agency, prospective plantings, and acreage reports ... but I won't ask it today. [laughter]

Actually I wanted to ask you about 4.4 percent growth. I come up with similar calculations going forward for soybean demand. How are we going to meet that with yields not keeping up, where will the acreage come from, and what is your expectation for meeting that?

Then, Dr. Fischhoff, a large share of the growth, according to the data, has it come because we've put more plants into the same area – something like six per square yard now, given our population data? What is your expectation going forward? What share of the growth to get that doubling of yields is going to come from more dense population and what growth is going to come for larger kernels or something else?

Thank you.

**Mr. Fischhoff:** I think we would expect to continue to see increased density in corn, not as dramatic perhaps as what we've seen in the last decade or so. Physiologically, there are some limitations and we will probably be bumping up against some of those. Average densities in the mid-40,000s per acre are probably realistic. We already have seen some data that indicate for many hybrids – both our own and from other companies – densities on average are probably a little lower than they ought to be.

As we get to a better definition of the combination of genetics with soil type, as well as other agronomic practices, it's possible we will also see a shift to a more variable type of agriculture within a given field or certainly across fields where we will have hybrids that are better suited to high densities and some that are better suited to low densities. We will have the equipment available that allow us to do that kind of planting on the fly.

I don't think we've really sorted out the details in terms of these broad buckets between breeding agronomic practices and biotech. Certainly in the latter part of the next

decade when we get out into the mid-2020s and beyond, we expect a greater contribution to that yield doubling to come from new biotechnology traits – things that are either just emerging from our pipelines now or even in some cases yet to be really discovered.

In the near term, the combination of breeding and agronomic practices going hand-in-hand will be the primary contributor through 2020 or so. Separating the two out would show about equal contributions from those two.

**Mr. Glauber:** Let me just say, Bill, I would agree we faced this over the last two or three years, looking at where we can see land come in and how much additional land. Certainly if you compared 1996 plantings with 2007-08 plantings, there was a lot more out there planted. If you go into the details and drill down, all that additional area is really claims. What hits me are more wheat land and probably land that might be now fallow or used less intensively. You don't see a lot of idled acres in the prime Cornbelt. That's for sure.

For soybeans, the real issue there is how much double-cropped area you can get in. We've seen some pretty strong double-cropping over the last few years, but last year also saw one of the lowest levels on record. We've only been carrying double-cropped areas since 1978 or so. Outside of that, there is just not a lot of capacity, with the exception of the CRP. And CRP does contain a lot of wheat land and a lot of land in the Cornbelt as well, with a lot tied up in riparian areas and wetland restoration. Bringing it out again is a careful balance, looking at availability, food needs, and also environmental benefits – making sure what you are running is a pretty lean reserve with high environmental benefits. That makes sense. Land that is productive and has lower environmental benefits should probably be back in production. What we found in running this over time, it is not the easiest thing. It is not something you can turn a switch and say, "Okay, the land is eligible to come back in."

What comes in? You still find a lot of people who want to keep their land in a long-term reserve, because of a long-term return on things. That may have been more true in the 1990s where you were seeing potential prices fall. Again, I am much like everyone else in this audience, you saw land at high prices then followed by low prices. There are uncertainties there. In running a sensible reserve as we expand demand, meeting that is going to have to be done with bringing land out of CRP. Hopefully, what

you do is bring out the land that is more productive and leave the environmentally fragile lands in there and protected.

**Mr. Henderson:** I want to ask one last question before we close the session.

As we think about recognizing risk, a lot of times I ask people, what keeps you up at night? Or, in other words, what are the one or two factors that could really disrupt this outlook we see for agriculture? What do we have to think about going forward that could be the risk that upset the turnip cart?

**Mr. Baroni:** I want to go first. I think the world economy. Clearly, there are a lot of things to worry about: if we were to have another bad recession, or if you were to have, for example, a big increase in interest rates you would certainly have weakness in land markets and other things that could affect the farm economy. I don't see anything on the horizon that would suggest that. These markets have been remarkable in the sense of strong markets across the board for a variety of commodities.

Again, I don't want to take away from Dr. Glauber, who thinks it is going to be great from here on out. Markets do respond and we will have bumper crops and we will see prices fall. There is no question about that.

Generally, if you were to say one thing, it would be the world economy.

**Mr. Fischhoff:** From the technology perspective, there is always risk in technologies. The types of things I talked about are clearly long-term plays. Absent the scientific risk that we won't be able to do what we think we can do – which is always present – the bigger risk I see probably comes from government policies that would slow the adoption of new technologies in various parts of the world. We are lucky in the U.S. to have a good set of policies that foster technology, innovation, intellectual property rights, and a good regulatory framework. We are seeing that develop in many parts of the world, but it is still hit or miss. For various reasons, we run some risk of backsliding in certain parts of the world. An atmosphere where we can actually adopt and employ all of these technologies is the real key to avoiding that kind of risk.

**Mr. Glauber:** Right now it's this weather that is keeping me up at night, especially with the short stocks that we have! [laughter]

We recognize to meet this growing demand we must have increased production and increased productivity from the developing world. As we've talked a number of

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times, there is not a lot of land left in the U.S. Obviously increasing yields here will go a long way. But, to really meet this, we are going to need a lot of productivity in what we call the developing world.

And there are a lot of political and economic issues standing in our way of that happening. We have to connect these small-holder farmers with global markets. You need infrastructure to do that and you need political and economic environments that allow that to occur. There are some parts of the world where we don't yet see a lot of good movement in that direction. But it's going to be essential. It is going to have to happen.

**Mr. Henderson:** Thank you. That concludes our first session.