THE *SHIFTING* NEXUS OF GLOBAL AGRICULTURE

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Session 1:

Investing in Global Farm Productivity

Investing in Global Farm Productivity (Paper)

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All opinions expresses are those of the authors and do not necessarily reflect the views of FAPRI or the University of Missouri.

Introduction

Feeding a growing world is an important challenge, and investments in global farm productivity will be a necessary part of any strategy to ensure global food security. The paper will try to frame the challenge by discussing some of the factors that will determine future demand for agricultural products before looking more closely at investments that have been made and that will be necessary.

The basic thesis of the paper is that the future profitability of U.S. agriculture will depend on the balance of local and global productivity gains relative to the expansion of global demand for food, feed, fuel and fiber. As simple economics suggests, it is the balance of all the factors driving global supply and demand that will determine future prices and profits. Productivity investments will be critical, but so are a host of other factors.

Food demand

Investments in global farm productivity only make sense if there is a need to increase or maintain agricultural production. As has been noted frequently, the world's population is expected to exceed 9 billion by 2050, meaning a need to feed an additional 2 billion people in the next 37 years (Figure 1). As daunting as the challenge will be, it is important to note that the annual rate of increase in the world's population is slowing (Figure 2). The world's population grew by 2 percent per year in the 1960s, but that has declined to a little over 1 percent per year today and is expected to decline to just 0.5 percent per year in the 2040s.

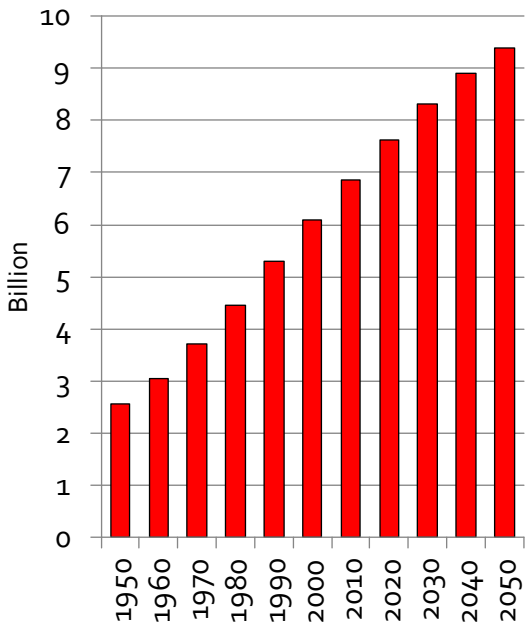


Figure 1. World population, based on estimates by the U.S. Census Bureau

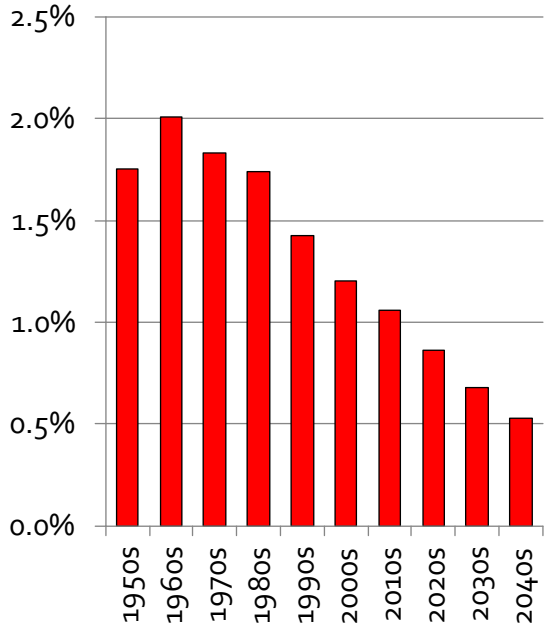


Figure 2.Annual rate of increase in the world population, by decade, based on estimates by the U.S. Census Bureau

Another way to think about the changes in the world population is to focus on the net number of people being added to the world's population each year. In the 1980s, the world's population grew by an average of 84 million people each year, based on U.S. Census Bureau estimates. That's down to 77 million people per year this decade, and it's expected to decline to less than 50 million people per year in the 2040s.

In other words, the world's population continues to grow, but there will be fewer *new* mouths to feed each year in the future, if current demographic trends continue. If the only goal were to maintain current levels of per-capita food consumption, that suggests growth in demand for agricultural products should slow in the years ahead.

Of course, there is no reason to assume that future food consumption per person will remain constant. Rising incomes, especially in low- and middle-income countries, are likely to result in significant dietary changes, and the use of agricultural products for biofuels and other non-food purposes may also change.

To illustrate the point, consider four essential crops: Wheat, rice, corn and soybeans. Wheat and rice are staple foods for much of the world's population, while corn and soybeans have a variety of food uses and provide much of the feed consumed by the world's livestock and poultry. For wheat and rice, per-capita consumption has been fairly steady since 1990, but the use of corn and

soybeans has increased far more rapidly than the world's population (Figure 3). Per-capita corn use has increased by more than 1 percent per year, while per-person soybean use has grown by more than 2 percent per year (Table 1).

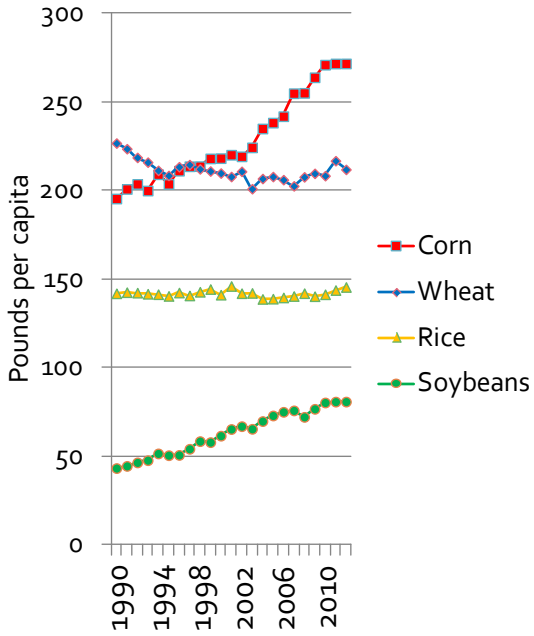


Figure 3. World per-capita use of four major crops. Source: Author calculations based on data from USDA's PSD Online database.

	2010-12 average	Annual growth rate	Percent growth rate
Corn	271	3.6	1.3%
Wheat	212	-0.5	-0.2%
Milled rice	143	0.0	0.0%
Soybeans	81	1.8	2.3%

Table 1. World per-capita use of four major crops, in pounds. Annual estimated growth rates were calculated by the authors by fitting a simple linear trend over 1990-2012 data, with the percentage growth rate evaluated relative to the 2010-2012 average.

Approximately 39 percent of the increase in world corn use per-capita since 1990 can be attributed to increases in the amount of corn fed to livestock. The rest is explained by increased production of ethanol and other non-feed uses of corn. Much of the growth has occurred in China, which has increased its use of corn as a livestock feed and to make corn starch for industrial purposes. The growth in soybean use has been even more dramatic. China again has played a dominant role, as the country has dramatically increased the amount of soybean meal included in feed rations and has also sharply increased its consumption of soybean oil.

Just how much demand for these and other agricultural products will increase in the future, of course, remains uncertain. If incomes continue to rise at a rapid pace in middle-income countries like China, it is likely that consumption of meat, dairy products, and other high-value foods will also continue to increase. That could well mean that demand for corn and soybeans will continue to grow more rapidly than the world's population, even if per-capita consumption of wheat and rice is less likely to increase.

As population growth slows, therefore, it seems likely that income growth will gain in relative importance as a driver of future food consumption growth. That will not be true for all farm commodities, but it is likely be true for the commodities that account for the bulk of farm receipts in the U.S. Midwest: corn, soybeans and livestock products.

Food supply

Global agricultural production has increased sharply in recent decades, both because of increased use of land and other resources and also because of important increases in productivity. Crop yields (Figure 4) may increase because of increased use of fertilizer and other inputs, but new seeds and other technological innovations also account for much of the observed growth.

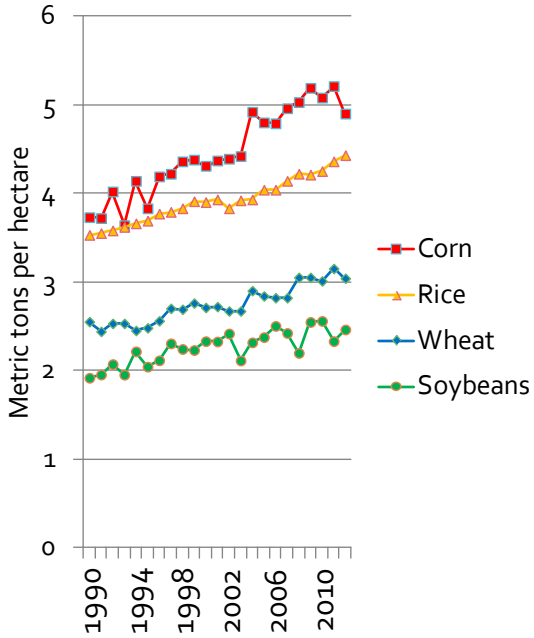


Figure 4. World crop yields. Source: USDA's PSD Online data base.

	2010-12 average	Annual growth rate	Percent growth rate
Corn	81 bu/a	1.1 bu/a	1.4%
Rough rice	3,878 lb/a	33 lb/a	0.9%
Wheat	46 bu/a	0.4 bu/a	0.9%
Soybeans	36 bu/a	0.3 bu/a	0.9%

Table 2. World crop yields for four major crops. Annual estimated growth rates were calculated by the authors by fitting a simple linear trend over 1990-2012 data, with the percentage growth rate evaluated relative to the 2010-2012 average.

For all four major crops, the annual trend rate of increase in world average crop yields is currently about 1 percent per year, with corn yields growing faster than yields for soybeans, wheat and rice. Note that the world's population is also growing by about 1 percent per year. That means that it would be possible to maintain per-capita consumption of these four major crops without increasing the amount of land used to produce them, if current rates of yield growth continue.

Indeed, with the projected reduction in global population growth rates, it would be possible to maintain per-capita use and actually reduce the amount of land used for crop production.

In reality, increases in per-capita consumption, especially of corn and soybeans, have meant that the increase in global food consumption has not been met by yield growth alone. Area harvested for these four major crops has increased sharply over the last decade. Based on USDA data, corn, soybean, rice and wheat area harvested increased by 78 million hectares (193 million acres) between 2002 and 2012 (Figures 5 and 6).

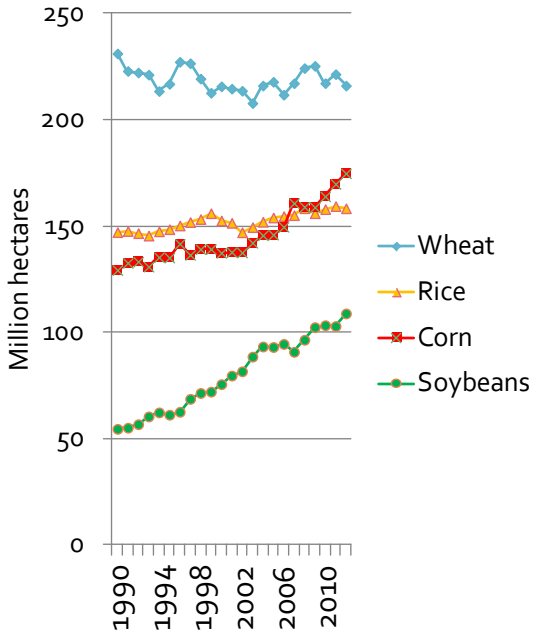


Figure 5: Global crop area harvested. Source: USDA PSD Online.

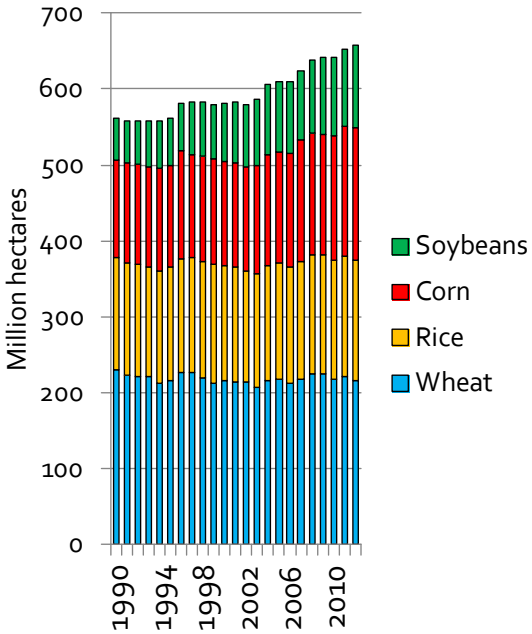


Figure 6. Global crop area harvested, four-crop total. Source: USDA PSD Online.

Some of that increase can be explained by expansions of the land used for crop production in places like Brazil, some of it is explained by reductions in land idling and production of other crops in countries like the United States, and some of it is explained by increased double cropping in countries like China and India (each physical acre can count as two or more harvested acres if multiple crops are harvested off the same plot in a particular year). India, Brazil, China and the United States (in that order) account for 59% of the increase in global area harvested for these four major crops since 2002.

The world's agriculture is a lot more than just corn, soybeans, wheat and rice. Other grains and oilseeds each have their own dynamic, with some rising in relative importance and others

declining. Fruit and vegetable production does not occupy large amounts of land in most countries, but it does account for considerable use of labor and generally requires far greater investments per acre than field crops. Sugar, coffee, palm oil and other tropical crops are very important in some countries and also tend to be costly to produce on a per-acre basis. Productivity gains have been greater for some of these products than others.

It is common to focus on crop production in discussing productivity gains, but some of the largest increases have occurred in livestock, poultry and dairy production. Increases in meat and milk production per breeding animal can be attributed both to more intensive use of inputs and to productivity gains caused by new genetics and practices. In the United States, the increase in pork production per sow (Figure 7) and milk production per cow (Figure 8) has been phenomenal.

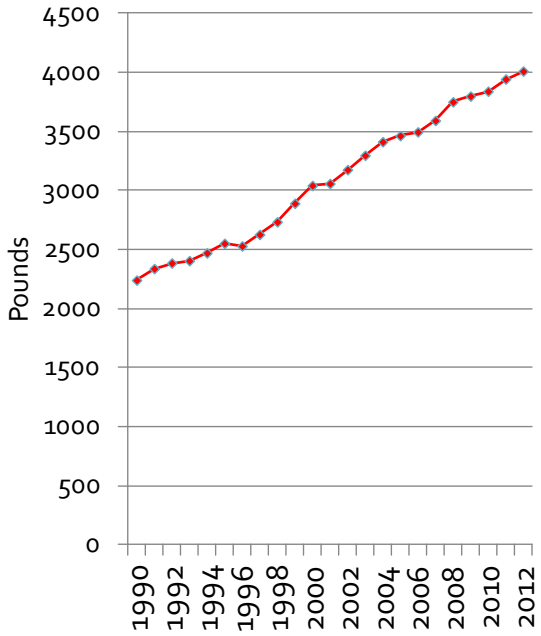


Figure 7. U.S. pork production per sow. Source: Author calculations based on USDA data, as maintained in MU-AMAP database.

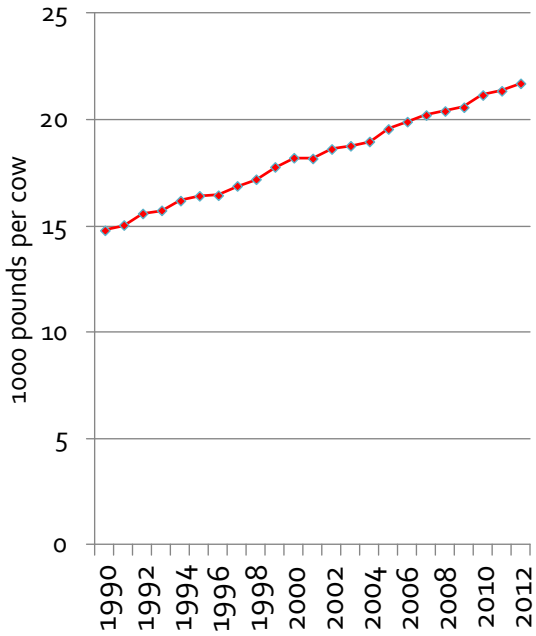


Figure 8: U.S. milk production per cow. Source: Author calculations based on USDA data, as maintained in MU-AMAP database.

Two ways to increase future yields per acre or per animal are to develop new technologies and to more broadly utilize existing technologies. To illustrate the point, consider average yields per hectare for corn and soybeans across several major producing countries (Figures 9 and 10). In the case of corn, U.S. yields are generally far above those in the rest of the world. Broader adoption of current U.S. practices could reduce some of the existing yield gaps. In Brazil, for example, average corn yields remain well below U.S. levels, but are increasing far more rapidly.

In contrast, soybean yields in the United States, Argentina and Brazil are very similar. Yields in China trail, and show little evidence of "catching up" with yields in the exporting countries. It is important to be careful not to draw overly broad conclusions from these types of comparisons, of course, as differences in yields may reflect differences in soils, climate and other factors unrelated to technology adoption. For example, U.S. wheat yields are far below those in Europe, but the difference probably has more to do with differences in the quality of land used to grow wheat and the amount of rainfall received in wheat-growing regions than to any inherent superiority of European wheat production technologies.

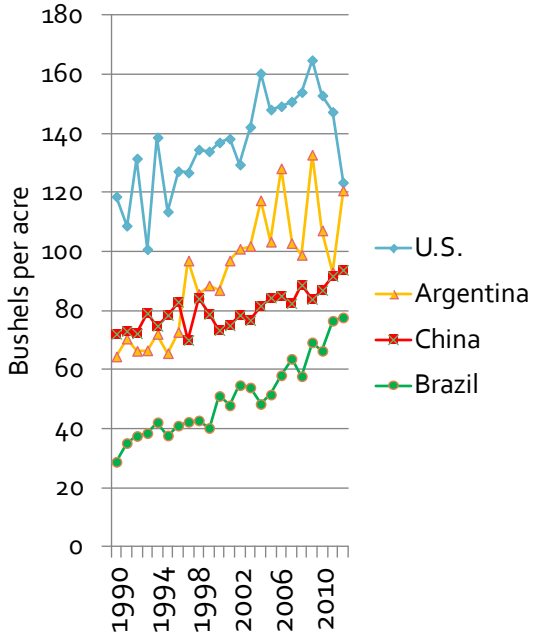


Figure 9. Corn yields. Source: Author calculations based on PSD Online data

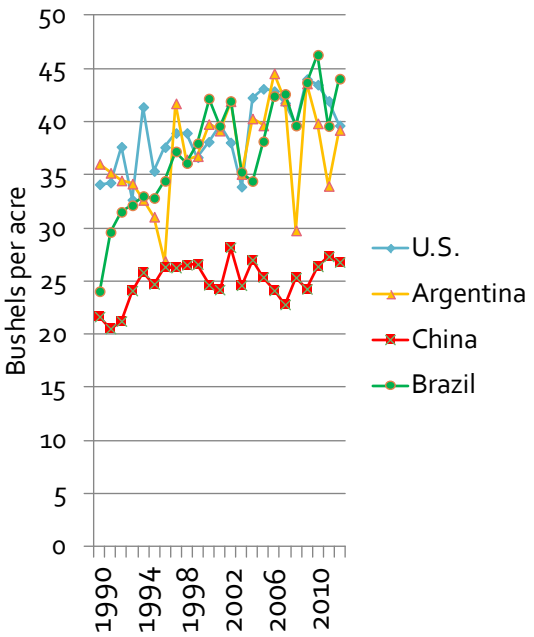


Figure 10. Soybean yields. Source: Author calculations based on PSD Online data

Investments in farm productivity

Global agricultural production has been increasing in large part because of increases in productivity that allow farmers to obtain more outputs per inputs used. Whether these increases in productivity will continue at the current pace, speed up or slow down is critical to global food markets. The rate of future productivity gains is likely to be closely related to the amount and quality of investments in farm productivity.

According to Pardey, et al., U.S. real (inflation-corrected) spending on agricultural research and development (R&D) increased by 3.77 percent per year between 1950 and 1970. The rate of increase declined to 2.66 percent per year between 1970 and 1990, and to just 1.20 percent per year

from 1990-2009. Continued increases in R&D spending should be a positive factor encouraging increased productivity, but the slowing rate of expansion in R&D spending might be expected to slow the rate of advancement.

Data on multi-factor productivity gains in U.S. agriculture confirm this conjecture. Multi-factor productivity measures the increase in outputs for any given amount of inputs. If crop yields increase proportionally to an increase in fertilizer and other inputs, that would not represent an increase in multi-factor productivity. However, if yields increase for any given rate of application of fertilizer and other inputs because of improved seeds, that would represent an increase in multi-factor productivity.

Pardey et al report that multi-factor productivity in the agricultural sector increased by an average of 2.02 percent per year between 1949 and 1990. That rate slowed to just 1.18 percent per year between 1990 and 2007. These estimates should be treated with caution, given all the difficulty involved in measuring both R&D spending and multi-factor productivity, but it is not surprising that a slowdown in the growth of R&D spending is correlated with a slowdown in the growth of multi-factor productivity. All else equal, this might make one less confident in projections that agricultural production will be able to grow at the same pace as it has in the past, unless the pace of R&D investments picks up.

In 2009, Pardey, et al. report that most U.S. agricultural R&D spending in 2009 was done by the private sector (Figure 11). State Agricultural Experiment Stations (SAES) and other university research accounted for just under a third of the total, and direct federal research accounted for about 11 percent.

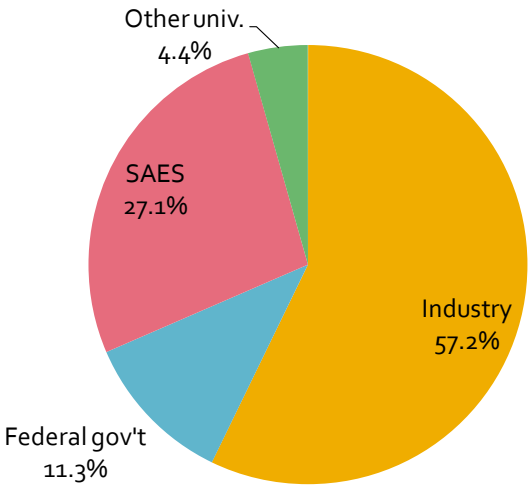


Figure 11. U.S. spending on agricultural research and development, 2009. Total spending was $11.1 billion. Source: Pardey, et al, Figure 3.

Seed and biotech spending accounts for the largest share of the increase in private sector R&D spending in recent years (Figure 12). Private R&D spending on farm machinery and animal health have also increased, but R&D spending on crop production was no more in 2010 than it was in the late 1990s. These patterns suggest where private firms thought investments would have the greatest private returns, but this might not always reflect societal priorities if certain investments have different effects on private and social returns. For example, a private farmer might not be willing to pay for a new technology that would reduce negative consequences for neighboring farmers and consumers if the expected return to the farmer is even a few pennies less than the cost to the farmer.

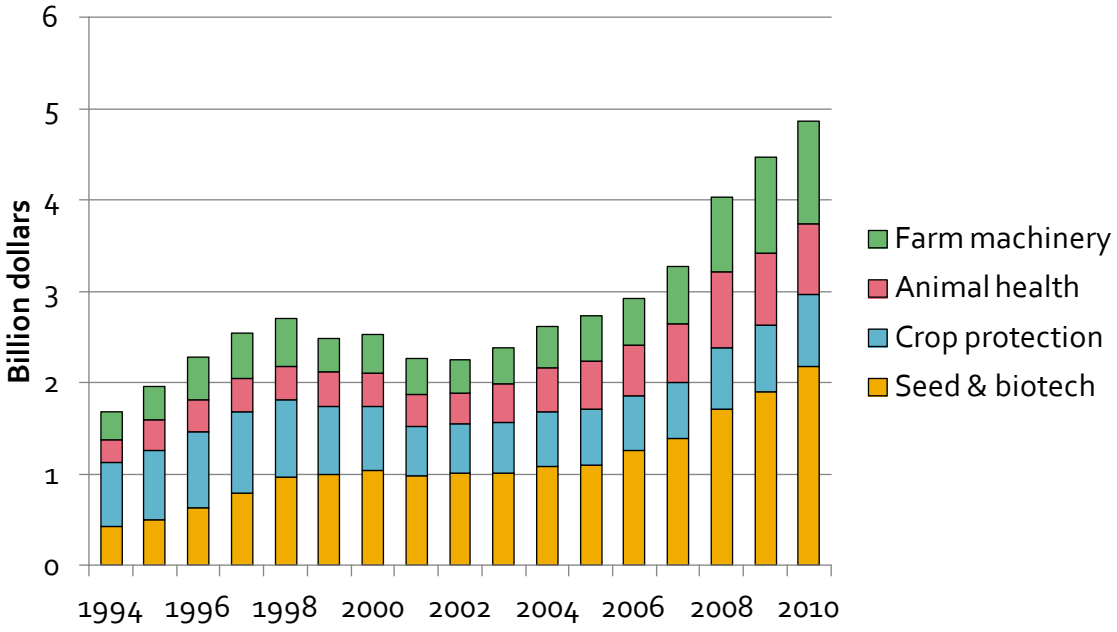


Figure 12. Private U.S. agricultural research and development spending. Source: Fuglie et al, Table 5.

The mix of public and private spending on agricultural research and development is very different in high-income countries like the United States relative to the rest of the world (Figures 13 and 14). While the years, data and regional definitions may not be identical in the two cited sources, the basic message is that North America and Europe account for most private agricultural R&D

spending, while public sector research is spread around more widely, including countries like China with large agricultural sectors but low levels of GDP per capita.

Public and private sector R&D efforts are likely to have different objectives. Public sector research may be focused on societal concerns where there is less likely to be an incentive for private sector research. In many cases, public and private R&D efforts may be very complementary. For example, the public sector may focus on basic research while the private sector uses that basic research in more applied research and product development efforts. Of course, there are also many examples where public and private R&D efforts do not achieve desired synergies because one or both fail to fulfill their appropriate roles.

It is striking to note that several private firms spend more on agricultural research and development than some important public sector institutions. For example, Bayer, Syngenta and Monsanto all spent more on agricultural R&D in 2007 than the crop and animal science programs funded by USDA's Agricultural Research Service (Fuglie, et al., Table 11).

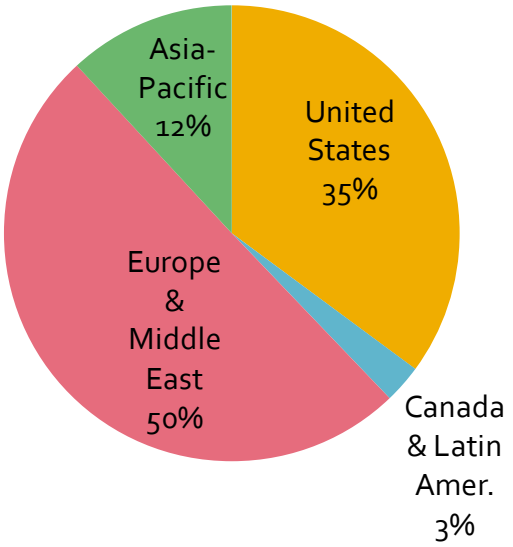


Figure 13. Private sector R&D spending, 2006. Total amount: $8 billion. Source: Fuglie, et al., Table 4.

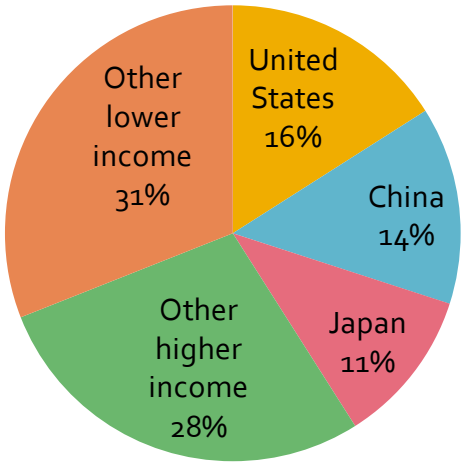


Figure 14. Public sector R&D spending, 2005. Total amount: $27 billion. Source: Pardey et al., Figure 5.

As discussed by other speakers at the symposium, R&D spending is just one portion of the investments being made in global agricultural productivity. Investments in port facilities, railroads and river transportation can reduce the cost of moving agricultural inputs and food products around the world, to the benefit of both farmers and consumers. Private farmers invest in machinery and new technologies in the hopes of increasing production and reducing per-unit costs. Firms develop new food and nonfood products, providing new market opportunities to agricultural producers around the world.

The market context and consequences of farm productivity investments

Each year, the Food and Agricultural Policy Research Institute at the University of Missouri (FAPRI-MU) and collaborating institutes make projections of U.S. and international agricultural markets. These projections rely on a long set of assumptions, such as a continuation of current government policies and a continuation of current trends in productivity changes. The resulting baseline projections can then be used as a point of comparison to investigate the impacts of alternative scenarios, such as changes in policy or rates of technological change.

It seems reasonable to assume that farmers and other players in the agricultural sector will be much more interested in making investments in agricultural productivity when output prices are high than when they are low. Recent high prices for grains, oilseeds and other farm products have almost certainly resulted in greater investments in productivity both in the United States and around the world than would have occurred without the commodity boom.

Under average weather conditions, the FAPRI-MU baseline projects that yields for corn and other crops will rebound from the effects of the 2012 drought. Of course, weather in any given year probably will not be average, and other factors can also contribute to yields that differ greatly from those projected under average conditions.

For this and other reasons, FAPRI-MU uses stochastic analysis to investigate the consequences of 500 different sets of assumptions about crop growing conditions, petroleum prices, and a host of other factors that affect the supply and demand for agricultural products. The resulting set of 500 market outcomes can be summarized by indicating both average results and ranges around those averages. For example, U.S. corn yields in 2014 might be expected to be about 164 bushels per acre under normal conditions,

but there is about a one in ten chance of them exceeding 178 bushels per acre, and about a one in ten chance of them falling short of 148 bushels per acre, given all the assumptions of the FAPRI-MU analysis (Figure 15).

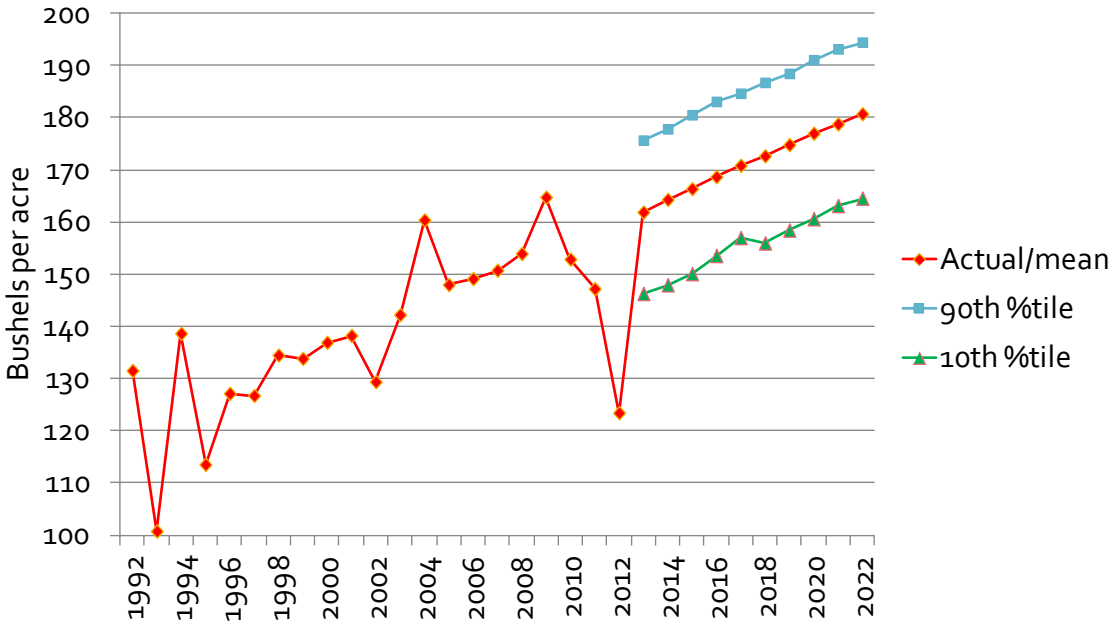


Figure 15. U.S. corn yields in the FAPRI-MU 2013 stochastic baseline. Source: FAPRI-MU.

It is very important to recognize that the high corn prices of the 2012/13 marketing year were largely a function of the exceptionally poor yields caused by the 2012 drought. Even a moderate rebound in crop yields in 2013 and later years is likely to result in lower prices than occurred in 2012/13, in spite of rising world demand for agricultural products. FAPRI-MU projections prepared in January 2013 suggest that $5 per bushel corn prices are likely to be the norm in the future, but that prices could easily exceed $6 per bushel or fall below $4 per bushel in any given year, depending on the weather and other short-term factors that drive commodity supply and demand (Figure 16). Even this may understate the true range of uncertainty in agricultural markets, as all 500 stochastic outcomes assume the same government policies and the same underlying rate of technological change.

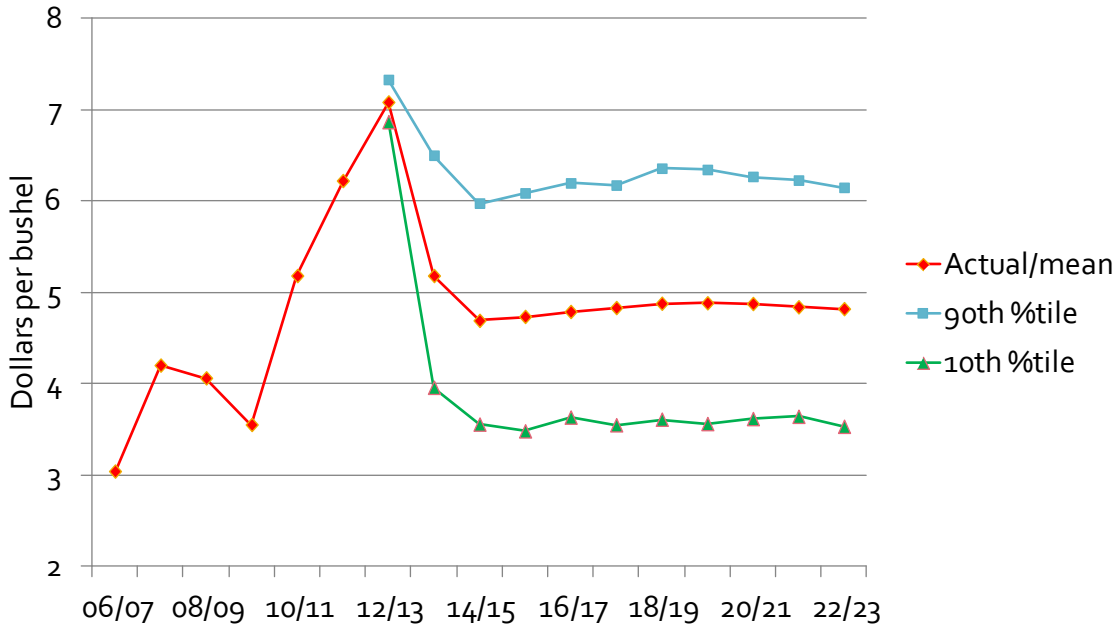


Figure 16. U.S. corn prices in the FAPRI-MU 2013 stochastic baseline. Source: FAPRI-MU.

If prices for corn and other commodities retreat from recent peak levels, it could reduce incentives to invest in agricultural productivity. However, projected prices remain well above the levels that prevailed before 2007, so it seems reasonable to expect continued strong rates of investment.

Lower agricultural commodity prices could also have other consequences. For example, recent increases in agricultural real estate values can be attributed in part to high commodity prices and low interest rates. If commodity prices decline and interest rates rise, it could remove two fundamental sources of support for agricultural land prices.

Summary comments

Agricultural productivity has increased in the United States and around the world as a result of public and private sector investments. Future rates of growth in global agricultural production, farm profits, and the prices consumers pay for food will all continue to be tied to investments in global farm productivity.

Agricultural market outcomes will always depend on a balance of supply and demand factors. Slowing rates of population growth and the tempering of the biofuel boom could slow future agricultural product demand, but rising incomes in low- and middle-income countries could have the opposite effect. To oversimplify a bit, if productivity increases

more rapidly and demand grows more slowly, farm product prices are likely to fall; if demand growth accelerates and productivity stagnates, prices will probably rise. While this is a very simple description of a very complex set of issues, it sometimes is valuable to remember the importance of the basic principles of supply and demand.

References

Food and Agricultural Policy Research Institute at the University of Missouri. "U.S. Baseline Briefing Book." FAPRI-MU Report #01-13 and associated data bases. Food and Agricultural Policy Research Institute, University of Missouri, Columbia, Missouri, March 2013. Available at www.fapri.missouri.edu.

Fuglie, Keith O., Paul W. Heisey, John L. King, Kelly Day-Rubenstein, David Schimmelpfennig, and Sun Ling Wang, "Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide." USDA Economic Research Service Economic Information Bulletin Number 90, December 2011. Available at http://www.ers.usda.gov/publications/err-economic-research-report/err130.aspx.

Pardey, Philip G., Julian M. Alston and Connie Chan-Kang. "Public Food and Agricultural Research in the United States: The Rise and Decline of Public Investments, and Policies for Renewal." AGree report, April 2013. Available at www.foodandagpolicy.com. .

U.S. Census Bureau international database. Available at http://www.census.gov/population/international/data/idb/informationGateway.php.

U.S. Department of Agriculture. Foreign Agricultural Service, *PSD Online* database. Available at http://www.fas.usda.gov/psdonline/.

General Discussion (Transcript)

Moderator: Nathan Kauffman
Economist
Federal Reserve Bank of Kansas City, Omaha Branch

Nathan Kauffman: We have time for some questions now. Before we transition to the panel, if you have a question, I would just ask again that you make your way to the microphone and state your name and affiliation before asking your question.

Richard Henderson, AXA Equitable AgriFinance, LLC: We saw the charts about growth in Argentina and Brazil. I've heard rumors, but I don't know, is there a significant enough disruption in infrastructure in exporting that product to cause temporary disruptions and fluctuations in the U.S. market?

Patrick Westhoff: The question was about infrastructure investments that occurred in Brazil and elsewhere in South America and if there are enough uncertainties in their problems that could cause disruptions in the global markets. The answer is yes. We have seen cases where, especially in Argentina, changes both in policy and changes that have occurred for other reasons ended up turning on and off the spigot for trade in soybeans in particular. For the most part, this resulted in delays. It doesn't really change the long-term picture very much, I don't think. I would welcome other comments about that.

As soon as we talk about people living in the interior of Brazil, we are talking about a firm in Mato Grosso. It matters tremendously how much it is going to cost to get those soybeans and corn products flown all over the country to local markets. It is going to affect transportation costs, how well the infrastructure works, how smooth the policies are have a lot to do with how they choose to invest their money and how they are going to play in the future.

One question that came up at lunch today was, Why aren't we seeing more investment in production agriculture, extreme activities in Brazil and Argentina? Why are they only selling crops when they go to the market? Why aren't they selling more meat and more dairy products? The answer is yes, they are doing some of that already, but the potential would be a whole lot more, if the infrastructure would make it happen.

Kirk Weih, Hertz Farm Management, Inc.: You had some assumptions with your corn price of sub-$5 for the next 10 years. Within those assumptions, can you share your assumptions for harvested acres and yield?

Patrick Westhoff: Sure, there again, for the projections I was showing you from my baseline back in January, FAPRI baseline assumptions at that time, we had built an average yield of 162 bushels per acre. You probably saw the USDA's report that came out here last week with an average yield in the 150s. So it is a very plausible outcome, but lots of uncertainty about this crop because it was planted late. So I am not going to try to prejudge how large this year's crop is going to be. I just want to make the major point that, as we go forward, prices around $5 will be more the norm than an exception. We are not going to have $7 corn forever, unless the world changes in very fundamental ways.

_____: You showed the chart, showing the differences in yields for corn, for the United States, China, Brazil, and Argentina and the fact that the yields in the United States are so much higher. Could you speak specifically to the potential that these other countries have for getting their yields up, at least approaching those that are found in the United States?

Patrick Westhoff: I do want to make the point that I wouldn't want to assume that the appropriate yield for some other country is the U.S. yield. Obviously, where you grow the crop, along with agronomic potential, matters tremendously. Having said that, we are growing a lot of corn in Brazil and we are growing a lot of corn in Argentina using very productive soils and probably can do a lot of business today if we just apply technologies that are indeed available or could become available.

An example where this does get more complicated, is needing to be careful in doing the comparisons. If you look at wheat yields, U.S. wheat yields are far lower than those in Europe. It doesn't mean we are inefficient in growing wheat; it means we are growing wheat in places that are far less productive. Whereas in Europe some of their prime farmland is being used for wheat production, here we tend to have land with less productive capability being used for wheat. So you have to be careful in making those simple comparisons of yield levels. But I do think it is safe to say, especially in South America, in Ukraine, and a variety of other places around the world, there is great potential to see increased yields, if the investments are right and if the incentives are right.

Timothy Gallagher, Bunge North America: I am curious. Your rate of yield increase in beans was identical to the rate of yield increase in wheat, despite the fact that the seed technology companies have spent a tremendous amount on corn and beans. What is your perspective on that?

Patrick Westhoff: Right. And again, this is where we have to be a little bit careful, because we are doing global averages here. When acreages shift around, it is going to affect what the average rate of reported yield growth is. So, for example, suppose that in South America we are expanding soybeans on land that is less productive than land that is being used today. That will tend to drag down the average at least a little bit. Whereas we were using virtually the same land to grow wheat every year, that is a truer measure of what the underlying growth rate is for wheat yields around the world.

But I do think it is important to point out, then, a lot of people have the perception that we have all the investment going on in corn and soybeans, yields are growing tremendously, while wheat and rice are dragging. Well, that does not tell the entire story, at least not for wheat versus rice versus soybeans.

Walt Gardiner, Farm Credit Administration: Pat, you alluded to the fact, and I guess others talked about, the possibility of corn dropping down into the $4 range and you even toyed with $3 corn and we have to go back to 2006 before we see that. And I know you all have the FAPRI model there and I'm sure you have done some sensitivity analysis. But what are the prospects of it even getting close to that before countries like China, India, and others would respond to that by developing more in their livestock sector? What is the excess capacity, say, in the biofuels sector to absorb some of that? And certainly what would happen in the southern hemisphere, which again we have two crops a year? How would the Argentinians and Brazil respond to the decline in those prices at that level? I am just wondering if we could see things drop to that level?

Patrick Westhoff: That is asking about the possibility of how other countries are going to respond if we were to see prices drop as much or more when we are projecting our baseline. Certainly, that is one of the big questions. Would we see more investments in agricultural research and development of new lands around the world? Yes, we probably would. Would that tend to slow overall production? Yes, it probably would. Might it encourage more use of biofuels around the world? Yes, it probably would. This is how large these effects might be. I would point out something I am particularly concerned about right

now is we are projecting a fairly noticeable decline in U.S. corn acreage next year, in response to overall prices. Well, we'll see whether it will happen or not. Around the world we've seen new lands coming into production. It would make them go back out again. It may not be the same thing going down, as it was going up.

So, while I think there are a lot of good reasons to be relatively optimistic about the global agricultural picture, I think it is a mistake to understate how severe the downside risk might actually be right now. There certainly is a potential for a pretty significant drop in price that could stand there a couple of years if you were to have an unusually large crop or a negative demand shift.

Terry Detrick, American Farmers & Ranchers: We look at the yields of U.S. crops being more than some of the foreign competitors. We know about technology – for example, GMOs. What is your projection globally?

Patrick Westhoff: Future biotechnology, of course, is one of the big unknowns as we go forward. If you are asking me what I personally think, I think it is unlikely we are going to see much GMO adoption in Europe anytime soon, for example. If the question is going to be on some of the other parts of the world where it is accepted right now, we have a project in South Africa and I will be going there in a couple weeks' time to talk to our colleagues there. As many of you know, South Africa does allow GMO production and has indeed become a major source of new technology development in that part of the world. Other countries in Africa likewise are trying to make choices about that, as we speak, and are facing some severe question marks. Not so much about internal risks, but whether or not there would be a need for global markets if they were to adopt GMOs.

It is true, though, as we've pointed out what seems to be the case, there hasn't been GMO investment, so there is no relation to yields in any meaningful way. Yet, we've seen yield growth for those crops that isn't terribly different than soybeans and is only a little bit below that of corn.

I am not saying GMOs are not important. Of course, they are and they have very major impacts, not necessarily just on yields but also on costs of production. One of the reasons we've seen increased production of corn and soybeans, is that we've seen reduced costs of producing those crops. Corn still has to be shipped to areas not producing those crops, even if yields per se aren't increasing that much more rapidly than they were before.

Nathan Kauffman: Dr. Westhoff, when we think about the competitiveness of U.S. agriculture, a lot of people are focused on the Black Sea region and South America (you mentioned India). What other regions do you see as being potential wildcards that could influence the competitiveness of agriculture maybe that haven't been mentioned?

Patrick Westhoff: Yes, South America and the Black Sea region are two often-mentioned candidates and they certainly are important and will be very important. There are probably some countries in southern Africa that have more potential, agronomically at least, than they've been able to realize so far. They have to get their political houses in order. They are going to have to demand better reforms before they are going to be able to take advantage of that. But there is certainly the capability in that part of the world to see big increases.

Central and Eastern Europe as a whole, and not just Ukraine and Russia, but many other countries in that part of the world have considerable agronomic potential but also have had bad incentive structures in the past that have inhibited investments and heavy productivity gains.

Nathan Kauffman: Thank you for your insights, Dr. Westhoff. I would ask that you don't go too far. We'll have some time at the end of the panel for some additional questions. So audience members, if you have questions, just write them down at this time and we'll have some time after the panel.

To provide another perspective on global agricultural investments, I am pleased to welcome Joseph Bond. [applause]

In his role as managing director of NCH Capital, Joseph Bond is responsible for the firm's international sales and marketing activities, focusing on the corporate and public pension fund market segments. He has more than 30 years of investment management and corporate banking experience. Welcome, Mr. Bond.

Industry Panel (Remarks)

Joseph Bond
Managing Director
NCH Capital

Good afternoon, everyone. I've been asked to give a brief introduction and overview of what NCH has accomplished in Eastern Europe. So I'll be doing that very briefly. I want to first of all thank President George and Nathan for the invitation to participate in this symposium. I hope this will be informative to you.

NCH is a New York-based organization. We currently manage approximately $3.7 billion. Of that amount, $1.4 billion is focused on agriculture. We currently have over 850,000 hectares of farmland, either under ownership or under long-term lease. That also includes 1.4 million metric tons of grain-storage capacity.

We started our activities in 1991. George Rohr and Moris Tabacinic are the two general partners. They invested their own personal capital in Eastern Europe in 1991 and then we raised our first fund in 1993.

Fast forward, we have two decades of experience exclusively managing money for institutional investors throughout Eastern Europe. In 2005, we raised an opportunistic real estate fund. It was approximately $550 million and $200 million of that went into agriculture in Ukraine. The market and our activities were such that in 2007 we raised $1.2 billion, our first fully designated agricultural fund that focused not only in Ukraine but also Russia – which today are our two major markets – as well as a number of other countries, specifically Kazakhstan, Romania, Bulgaria, and Moldova.

That means that today we have approximately seven years of experience. We've accumulated a management team that is a combination of western education, but also these are gentlemen who were born, and are living, locally throughout Eastern Europe.

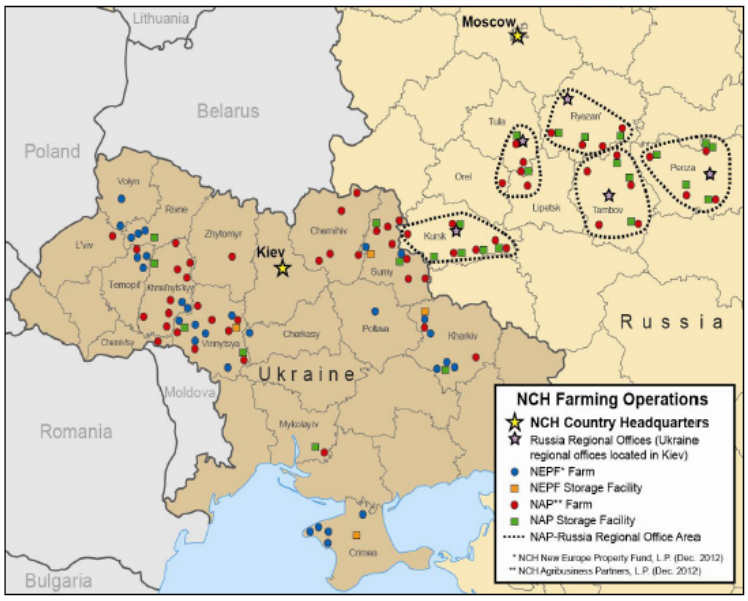
As an example, the fellow who runs our Kiev office is formerly East German. He went to school in Odessa for nuclear engineering and worked for ABB, has a Harvard MBA, and then came to work for us. Conversely, the fellow who runs our Russian operation, is Moldovan, has multiple degrees from both Harvard and Princeton, worked for Bunge, and

then joined us. That gives you an indication of the type of management we have in our focus.

We generally don't have joint venture partners. We decided to develop our business organically. And, in that regard, we think it has proven to be our successful strategy. We currently manage money for both U.S. corporate pension plans, as well as international public pension plans, universities, foundations, and endowments.

If you look at the map here, the dots represent our farms (Map 1). That represents 12 holding companies. The average farm size is approximately 8,000 hectares. We employ today over 7,000 people on the farm level. If you look at that dot right next to Poland all the way over on the far left to the farms in central Russia there on the far right, that represents approximately 2,000 kilometers. If you added all of our farms together, it would represent approximately half the size of Rhode Island. Last year, we produced over 2.2 million metric tons of grains and seeds that were sold either internationally or consumed internally throughout the Eastern European region.

Map 1:
NCH Ukraine/Russia: Current Farming Operations



Very simply, I'd like to give you a quick overview of how our investment strategy works. It is sort of a phased-in approach. What we will do – I'll show this in a slide momentarily – we acquire or lease large tracts of land at a very steep discount to other global markets. We ultimately then will start farming that will increase crop yields. And that is

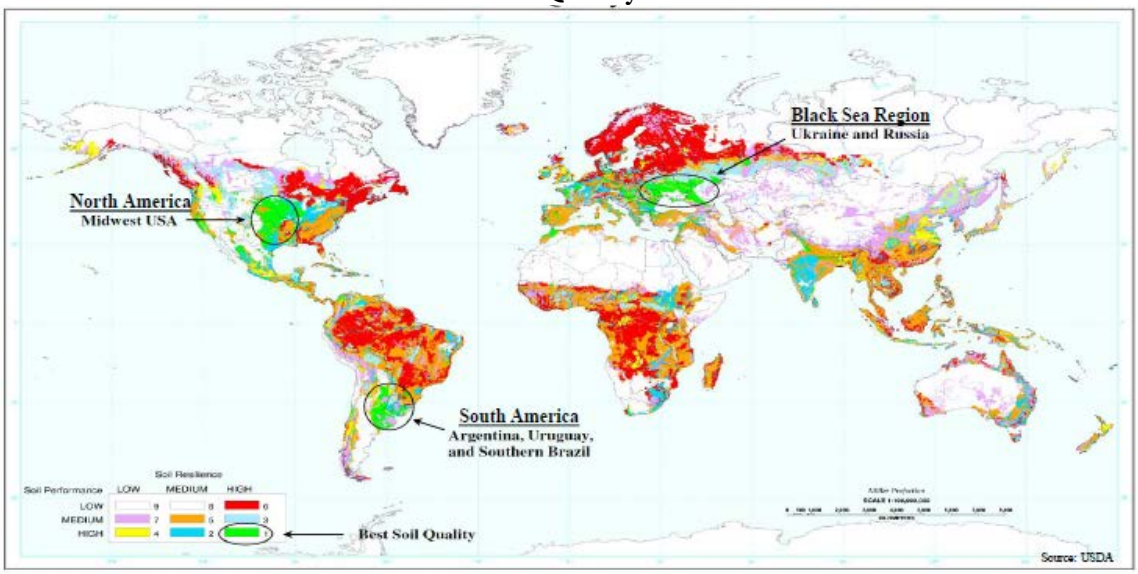
basically a result of the introduction of modern farming techniques and also the use of the most modern equipment and so forth.

An integral part of our strategy, though, is also grain storage. We currently have 1.4 million metric tons. In that regard, the purpose is to maintain grain quality for sales, because as you all know, when grain comes off the land it has to be dried and so forth and that maintains our quality and it also helps us in negotiations with organizations. If we don't particularly like the price, we'll just throw it in the grain silo until prices improve.

Moving into Eastern Europe, there is a perception of a barrier to entry. We have two decades of experience of successfully operating in the region. We have eight offices in seven countries and over 200 full-time staff members. That is on top of the 7,000+ we employ on the farm level.

Map 2 shows the three major grain-exporting regions of the world today. Obviously you know North America and we had some discussions regarding South America – Argentina, Uruguay, southern Brazil — and where we operate in the Black Sea area. One of the reasons we are there is the Black Sea area has black earth. It has a very high nutrient level. It has superior moisture retention. Consequently this area has really been, if you look back to the Middle Ages, the former breadbasket of Europe, and that continues today to potentially be one of the leading producers of grains and seeds for the world going forward.

Map 2
Inherent Land Quality Assessment



The question I get a lot is, Why Eastern Europe? And you are going to see in the next slide in a moment, but basically the point is that we can pick up land or purchase land at a fraction of competitive rates to other global markets. There is a low cost of operations. There is a favorable climate. We average anywhere from 18 to 26 inches of rain annually.

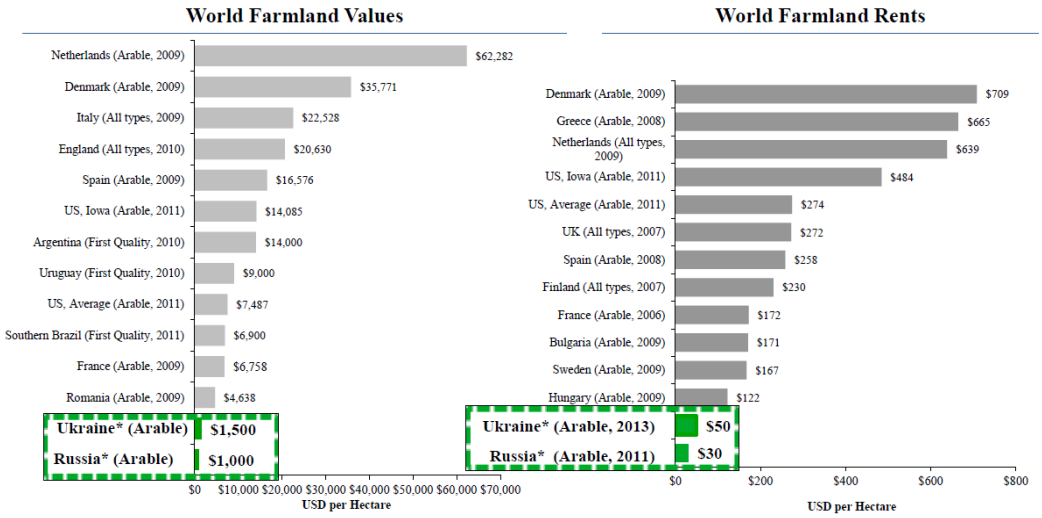
For logistics, during Soviet times – using Ukraine as an example – the Russians did a very good job of building a rail system throughout Ukraine. So, with round figures, it costs us about $35 to $40 to ship grains to the Black Sea port. It is very effective and very efficient. Most of what we produce ultimately gets exported into the Middle East from a geographic perspective. You are starting to see China moving into the region with some activity, but basically that is where most of our grains go.

We export most of our produce in Ukraine. At this point, a lot of what we are producing in Russia is internally consumed.

The point just made by the professor is there is some real potential for improvement in growth and yields here. The big constraint really is a shortage of capital. I am going to go into that momentarily. Basically, there are few places in the world today where you can assemble large tracts of land. Over seven years from start to where we are today, and we have over 850,000 hectares of farmland, there are very few places in the world where we can get very high-quality farmland. That is, I think, part of the rationale for us when we implement our economies of scale to drive down our costs to be globally cost-efficient and competitive in a global market, which agriculture is today.

Using Russia as an example, we are able to purchase a hectare of prime farmland for approximately $1,000, which today is a fraction of the cost of comparable farmland in the United States and certainly other geographic parts of the world (Chart 1).

Chart 1



When it comes to leasing, we still have the same situation. In Ukraine, we lease most of our land. It is again a fraction of the cost of comparable leases throughout Western Europe and the United States.

It's basically a situation where you have a shortage of capital which has artificially kept the true value of this land depressed, quite frankly. While we've been there, we initially bought land in Russia for as low as $400 and the average price now is up to over $1,000 for some of it. You are seeing an improvement during that period of time. But, if you contrast that with how the prices of U.S. farmland have increased over the last seven years, it is still a very, very nominal amount.

A little history lesson I thought would be useful here. During Soviet times in the 1980s, the Soviet bloc ran a relatively efficient farming operation, for better or for worse. Then, with the collapse of the Soviet Union, the large collective farms were broken up. So, if we all worked on a collective farm, we would be allocated somewhere between 2 and 3 hectares and that would be payment-in-kind.

That ultimately ended up causing massive fragmentation and inefficiency, because to small farming units, capital was not available. The strategy there was based upon what the Soviets did in the real estate sector. In Moscow, as an example, if you lived in government housing, you were given your unit for a very small price. That basically turned into the down payment for a future investment. It worked very well.

They used the same model for farming and it didn't work out quite frankly, because 2 or 3 hectares are not a manageable size. It becomes subsistence farming very simply.

Another structural difficulty was that the laws both in Ukraine and Russia did not permit farmers to pledge their land to the banks for working capital. So there has been a chronic shortage of working capital, which has ultimately driven down the yields, historically speaking.

We are all talking about potential for different regions, focusing on the Black Sea region. If you look at the map here from the USDA, it certainly indicates, looking at the last 20 years, the Black Sea region, which would include Ukraine, Russia, and Kazakhstan, has increased almost threefold in terms of its world share of exports of grains and seeds (Map 2).

Looking at Ukraine, the agency forecasts by 2025 grain production could increase to 96 million tons. They were at approximately 46 million tons last year. They are forecasting to go to 50-54 million tons this year. So it is almost twice as large.

There are approximately 35,000 hectares of farmland in Ukraine. But, of that amount, approximately 20,000 hectares are farmed on a subsistence level.

So that is where your increased yield is going to come from. You are going to take these inefficient small plots and consolidate them into more of an operating unit.

We did some simple math. If those 20,000 hectares were as profitable as NCH's today, we still have some ways to go, that would grow the production by 30 million tons, from 50 million tons last year up to 80 million tons. That would also increase their exports from 20 to 50. And correspondingly, and most importantly, their export revenues would rise from $4 billion to $10 billion.

The issue then is, Why hasn't that occurred? The reason for that is basically there is a chronic shortage of capital. For that to occur, we estimate it would take anywhere from $40-$60 billion of investment that would need to be made into the farming sector. Using Ukraine as an example, they just don't have the money. They are running trade deficits. They owe a lot to the Russians. Ultimately, the answer will be organizations like ourselves, not necessarily the United States, but certainly from Western Europe that would make foreign direct investment into the agricultural sector.

Russia is an interesting situation. Their harvest this year is estimated to come in at about 90-95 million tons. Last year, it was about 71 million tons. Under the Russian government's long-term forecast going out to 2030, which was recently mentioned by Premier Medvedev, they are forecasting their grain production could go up to 127 million to

140 million tons. They are talking about increased plantings of acreage and also an increased yield.

Again, this is possible and it is clearly something they are working on, but it will require substantial investment of capital. Not only will it cost for equipment, but you are talking about infrastructure as well, in terms of rail cars, elevators, and so forth.

The Black Sea region certainly does have the capacity and the potential to increase its yields over the next 20 or 30 years. It has been, as I mentioned earlier, the former breadbasket of Europe, so there is a track record in that regard. But it will require an increase in capital investments.

In conclusion, NCH is in the process where we are raising our third fund. We are going to be raising another $1 billion to make further investments into the Eastern European region. What we do is multi-crop rotations. So we run four to five crops: winter wheat, winter rapeseed, corn, soya, and sunflower. In Russia, we're also doing barley and sugar beets.

We're doing much more of a sustainable best practices process. We're a member of the SAI Platform, which was started by Unilever, Kraft, and so forth. For the new fund, we'll be doing the United Nations' Principles for Responsible Investment. We get that a lot from our European investors, which is very important. We haven't seen as much activity in that regard over here.

We don't use GMO. It is not permitted by the governments in both Ukraine and Russia at this point. If it does become permitted, then there will be a further increase in yields potentially. I don't know if that is practical. Certainly we sell into the European market and as long as we do that and as long as the European market has that barrier, I am not quite sure that would be practical.

That concludes my comments. Thank you.

Industry Panel (Remarks)

William Mott
President and Founder
Agland Investment Service, Inc.

Special thanks to the Federal Reserve for the invitation and also special thanks to Nathan for organizing this section. As you can see, we've been working quite a bit in the area of international agriculture for over 40 years. This session is certainly focused on the international markets. I have a few more comments to add to it and hopefully maybe we can have some discussion with our group afterward.

One of the early projects that I focused on was in Bogotá, Colombia. There with a small amount of money, we started a cut-flower farm, feeling they had the right environment, the right cost of goods, and some transportation to key markets in Europe and the United States. It started with about a $300,000 investment and then it caught fire and became one of the largest cut-flower farms in the world. Then, the Colombians started building their own farms and now Colombia exports $600 million of cut flowers, which is bigger than their banana business.

You might say we're somewhat of a niche player in agriculture. California is our base. What we produce are often called specialty crops, but some of these specialty crops are getting quite large.

We're also involved in the wine industry. We helped start several wineries. Clos du Val Winery in Napa Valley has become one of the largest cabernet wineries in the valley.

More recently, we've been involved in a U.S. government project of helping agriculture in Iraq. Under difficult conditions, we did introduce California-type strawberry growing to the Iraqis and they took to it very quickly. It was very profitable and has continued to expand, using California strawberry varieties that the University of California develops and gets a very big chunk of money every year from the varieties they grow.

We've also been involved in Ethiopia in a grain-farming operation. I'll talk a little bit about that later.

Today, I'd like to mainly talk about the current situation in the global market -- the market and production, the opportunity, why invest in agriculture overseas, and the future and structure of agricultural land investments.

The global food market is interesting, if we look at food production in its entirety. The food market has minimal barriers; it is highly efficient; it utilizes the latest information technology; it utilizes very modern ports in many countries that help with the logistics of moving food around the world; and we have commodity exchanges that set prices on a daily or hourly basis.

But, then, if we look at production agriculture around the world, there are numerous failures to entry. As we heard, in Ukraine, it's hard to loan on land. In Brazil, it is hard for foreigners to own land. Production is very fragmented in comparison to many small businesses. To top it off, it's very capital-intensive.

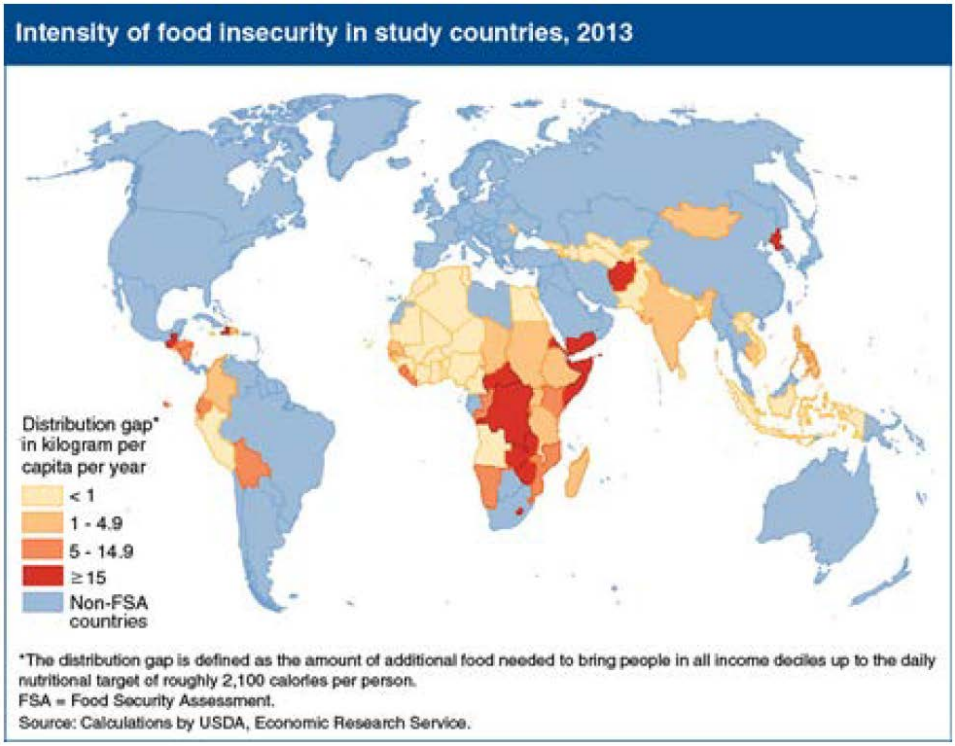
We think of the oil industry or the steel industry as being capital-intensive. There the ratio of sales to investment is about 1 to 1. In commercial mechanized agriculture it is more like 7 or 8 to 1, if you count the value of land for one to produce a $1 of product. So it is very capital-intensive and this is a theme that will go through our presentation that agriculture is starved for capital overseas.

The lesson that we've learned is that with institutional money into land overseas, it is best to start small, lean, and build a management team that is very capable of handling the lands. Too often we've seen people jump into buying land, but not having the mechanism to manage the land.

Of course, the other way you deal with the variability of agriculture is to be integrated into production processing and marketing. But, because of the capital needs of an integrated operation, again that is generally restricted to some pretty large firms.

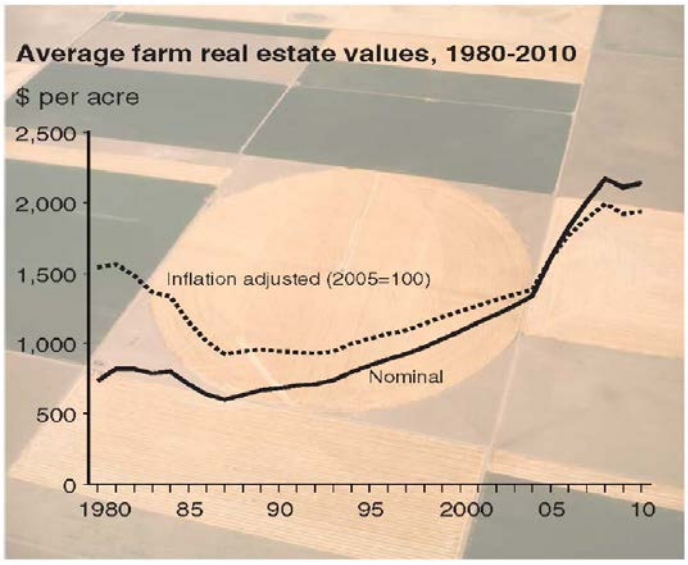
Because of this starvation of capital in international crop production, it is no wonder we see some global shortages of food from time to time. This is a USDA map of areas where the per-capita consumption of food is way below the minimum needed (Map 1). You can see Africa is front and center on that. We believe that there are going to be food shortages over the next 20 or 30 years. It will be up and down, but there are definitely going to be some. In particular, a few natural disasters with the low stock of food can create quite a bit of havoc in the market.

Map 1



The run-up in the farm real estate market in the United States certainly has not gone unnoticed (Chart 1). I am sure you are all familiar with it. This, of course, is what has led to interest in investing in overseas markets in land in Ukraine, Brazil, or Australia. The idea is that, if I can get land at very low cost and I can get labor at low cost, there must be a profit to be made between low-cost production and an international market for that commodity.

Chart 1



This is certainly true in Brazil. That's the reason we've seen such a large increase in soybean, corn, and sugarcane farming there. And Brazil can produce soybeans at a lower cost than we can in the United States. But there is this one problem of logistics in that they don't have the Mississippi River to ship the corn or the soybeans to the market and get it to the market efficiently. So their cost of logistics is high. As we just heard, one of the reasons to look at Ukraine is the cost of logistics. They are much better developed than they are in Brazil.

Increasingly, as we look at international farming operations, we are not so concerned about the cost of production, but we are more concerned about the infrastructure and the cost of logistics and the cost of having storage facilities for that crop. We see that as being a bigger issue than the actual cost of production.

Where are the most attractive locations for global investing in farmland? The United States, Canada, Australia have certainly not gone unnoticed. A big reason for the run-up in land prices here is that we have, here in the United States, a system setup that people can feel confident in over the long run.

Each of these countries has over 30 million hectares of land for crop production. That is 75 million acres each. Brazil, Argentina, and Australia also have over 5 million hectares of additional suitable land that could be brought into production. Also in Ukraine and Russia there are lands that are not currently being used for crops that were used under the Soviet system. So there is land out there.

I didn't put Africa on this list. Africa has huge amounts of land that could be farmed. But politically speaking it has been very hard to attract the capital needed to develop those lands.

Secondly, if you are even given the land, there is tremendous cost to provide the infrastructure -- from housing to grain storage to roads to farm equipment. We did have a project where we were asked to rescue a farm in Ethiopia that had two years of crop failures. Someone said, "This looks like a farm maybe in Iowa with the rainstorms you've had here."

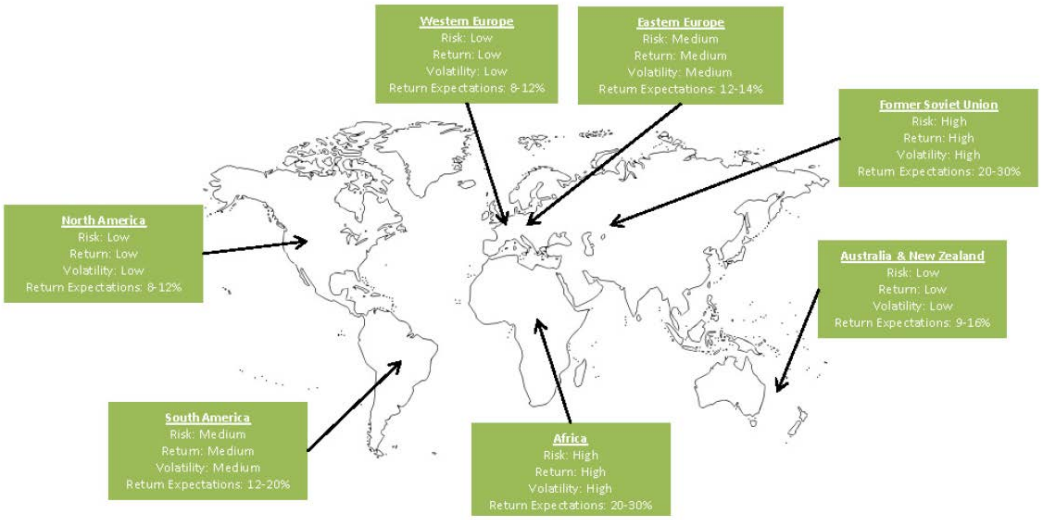
This was a case where they had a very limited farm management team. They had a lot of equipment, but didn't know how to use it. They asked us to come in and see if we couldn't produce a crop of corn. We came in rather quickly, using a team of Minnesota farmers and South African farm managers and did produce and harvest a 1,000 hectares of

corn that year. But, here again, they can't expand the farm, because they don't have the money to put in the infrastructure that's needed.

In Africa, unfortunately, there have been quite a few failures of production. People have rushed in getting land for pennies, but that is only the start of an agricultural operation, particularly if it is raw land.

Chart 2 is a financial profile for expectations of land in different parts of the world As you can see, in North America the risk is considered low, the return is considered low, the volatility is considered low, and the expectation of profit is about 8 to 12 percent a year. This is how global investors look at land in different parts of the world.

Chart 2
Global Land Financial Profile and Expectations



Again, in South America we've jumped more from a risk of low to medium, a medium return, and an expectation of profit of 12 to 20 percent. In Australia, we go back more to a U.S.-type profile of low risk, low return, low volatility, but a little higher profit expectation of 9 to 16 percent.

Eastern Europe shows a more medium-type risk profile, medium-type return, and profit expectation of 12 to 14 percent per year. Russia and Africa are rated high risk, high return, high volatility, and a profit expectation of 20 to 30 percent per year. This is somewhat of the profile we are now facing.

What is the future outlook we see? Yesterday, we had government-driven agriculture with no institutional interest in land. I remember in the 1990s we were working to put

together a portfolio of agricultural land investments. We went to various parties and they said, "Why should we invest in agricultural land? We don't know anything about it (again this is the 1990s). We like shopping centers, we like commercial buildings, and so forth."

There was very little interest. Of course, now things have changed. The profitability of agricultural land has changed the dynamics. Also what has changed the dynamics was a recession and poor stock market performance, poor real estate performance – at least for commercial real estate, and suddenly the spotlight has shown on agricultural land.

Today we are in a market-driven agriculture. There is scarcity around the world of food crops. There are low inventories of food. I was just reading that Egypt has only two months' worth of wheat. The largest importer of wheat in the world is Egypt. They only have two months left and, if they don't get some credits from Russia or the United States, that could be a major political problem on top of an already existing problem. The new realities are we're getting institutional money into agriculture, as we've just discussed, but it is still a droplet in the pond.

We're seeing now the interdependence of agriculture and the energy industry. The statistics I've seen show that 22 percent of sugar production goes to producing energy, 15 percent of vegetable oil production is converted to energy, and 12 percent of coarse grains around the world. We're very dependent on these two going together and there isn't too much of an indication that energy prices are going to go down -- only up, which will also have a pull on agricultural prices moving up.

Technology that we use overseas is fairly limited. As you heard, GMOs are not able to be used in many countries. Where we have used them, we have found them very effective. GPS is also quite useful overseas. A number of times we've gone to a landowner who says, "Well, I have 10,000 hectares here."

Using GPS, we quickly measure it and we find it is only 7,000 hectares or so. In little things like that, we find technology is useful. Of course, we are talking about drones now and that is still to come.

The main message here is that we're in a situation overseas where we're starved for long-term capital for land development. I like to think of agriculture as being broken into some parts. There is the land development side of agriculture, which can be a very profitable business, if done right. We've been involved in taking $200 acre pastureland in

Washington State, putting irrigation on it, and planting a vineyard. Suddenly it is worth $12,000 or $15,000 an acre. So there is a profit to be made in that area.

Historically, we've found that about 75 percent of the return on agricultural investments comes from land appreciation and maybe 25 percent from income. Maybe that has changed a bit in the last few years, but I think you'll find a very large part of total agricultural return is coming from land appreciation. In Ukraine and in Romania where we've worked, we've already seen some significant land appreciation occur.

These are the main points I wanted to make. Maybe we can get into a discussion with our panel here to further refine some of these concepts.

General Discussion (Transcript)

Moderator: Nathan Kauffman
Economist
Federal Reserve Bank of Kansas City – Omaha Branch

Antony Bahr, CoBank: I was wondering if you each could comment about your investment time horizons. I imagine they are pretty long in nature, compared to other asset classes. And how do you look at quality water availability and climate change conditions, if your time horizons are long enough to take those things into account in your evaluation models?

Joseph Bond: The structure of our funds is basically 12-year funds, with two to three potential annual extensions. It is much more of a private equity model, so for return expectations we're looking at 25 percent and from an operating basis – once we get our farms stabilized and producing – we're looking at a stabilized number internally at about a 15 percent cash-on-cash return. From that point, there would be a reduction of working capital and fees. An LP should reasonably expect to receive something in the area of 10 to 12 percent return. Then the difference would be on the exit at the very end of the fund.

For water resource availability, we look at the100-year maps. And obviously, if you looked at the map of Ukraine in central Russia, there is a swatch of land and that is the black earth area. We aren't in southern Russia at the moment for a couple of reasons. The prices are much higher and we aren't as comfortable with the weather patterns. We are relying mostly on natural rainfall, as I mentioned somewhere in the area of 18 to 26 inches a year. We are doing about 4,000 hectares of irrigation in the Crimea. Irrigation has a cost factor two times higher than traditional farming.

We abide by all the rules, in terms of clean water and so forth. That is part of why we are in the SAI program and the UN initiative as well.

William Mott: As I mentioned, the infrastructure is often missing overseas. This is the big bugaboo. Fortunately, in a state like California, we have the government build the roads. We have the government build the canals and the dams to irrigate the land. Much of

the infrastructure has really come from the government. Overseas, we don't have that luxury. Suddenly, with irrigated agriculture, we're having to amortize over 15 years and it's very hard to get 15-year debt money for many of these countries. Here again, we go back more to rain-fed agriculture as being the main direction. It is very interesting to note how important the Ukraine [Economic Reform] Fund here is using monies to build grain storage, because that is a very important part that is missing overseas -- the capability to manage your crop once it is harvested.

Joseph Algaier, MRIGlobal: My question is related to the water question. I can't imagine what it's like to manage a farm in other countries, much less the water resources. In your evaluation, with all the different soil types you actually use in the farms, do you see any other elemental analysis that is missing in the soil that can be a limiting factor in, say, the next 10 to 15 years -- for example, potash?

William Mott: Are you talking about soils in Russia or Ukraine?

Joseph Algaier: You're using all sorts of different soil types in these areas where you are. You have volcanic-type soils in Brazil, I assume, versus Ukrainian soils, which I understand are similar to Iowa's soils. There has always been a shortage of potash, but are there any other elements you think in the next 10 or 15 years might be limiting or cost-limiting in farming?

Joseph Bond: It is a relatively simple proposition. They have not used much fertilizer. On average, they're using one-half, if not less. Brazil uses an awful lot. Comparatively speaking, for U.S. crops, we use well less than half of what would be considered in Brazil.

Part of our agronomy bringing into modern farming techniques is the analysis of the soils and bringing them to proper cultivation through the use of inputs. This is some of the richest soil in the world, so we do put potash down in certain areas. Not all of our soil is the same. It is over 2,000 kilometers. That is what the individual farmer and ultimately the holding company director is responsible for. I am not an agronomist, so I apologize but that is about as far as I can go.

The fellow I wish were with me for this particular question is a Penn State agronomist graduate and knows a lot about all of our soils, but unfortunately he's not here at the moment.

Ryan Connors, Janney Montgomery Scott: I had a question on one of the recurring themes of the panel, the lack of capital available internationally in some of the emerging markets. I guess I am surprised to hear that, given the environment we've been in in the last five years with central banks all over the world, including the one we're standing in, flooding the world with liquidity. High commodity prices, in theory, are maybe something that would attract investment in that environment. And, yet, only some adventurous firms like yours, Mr. Bond, are making those kinds of investments.

What do you ascribe that to in terms of what has been a pretty favorable backdrop? The other question is, If not now, when? In other words, if it hasn't happened in the last five years and we do enter an environment of lower commodity prices and higher interest rates, what is the likelihood it is going to happen then? Thank you.

William Mott: One thing I would say is a lot of the money that should go into agriculture, because it is long-term money, is pension funds, they are looking at a 15-year or 20-year horizon. But then they look at the political risk and feel very uncomfortable in investing in many of these countries. Political risk becomes a very big thing in a long-term investor's mind. Certainly, when we talk to some of the people in the Middle East, they are investing quite a bit in Australia, because they feel fairly comfortable with the political risks there. In other areas, they are not so comfortable. Part of the issue is political risk; the other is that a lot of investors don't really understand agricultural land or they feel that agriculture is risky so they are not going there. I think there has been an education going on in the last ten years with many institutional investors, but there is probably a lot more to be done.

Joseph Bond: I'd like to address it country by country, specifically Ukraine as an example. Right now, you are not allowed to own the land, both foreign or organizations. The land is still in the hands of the original workers from the Soviet times on the collective farms. What goes on is that we have long-term leases, anywhere from 8 to 14 years, right of automatic renewal, right of first refusal should the land laws change, and that's part of the issue. In terms of why that is or how it is going to change, we don't know at this point, even though we did expect the land laws were changing.

Basically, if you look at Ukraine, it is running trade deficits. It owes a lot of money to Russia for gas imports. It's blessed with this immense amount of highly fertile land. The best way, as I mentioned earlier, is for them to increase their cultivation activities. But that

will require foreign capital investment. That will probably not occur on a meaningful level until the land laws change.

But we are in a unique position, because we have our 20-year history of operating in Eastern Europe and Ukraine and Russia. So consequently, our investors have the confidence in us to navigate, as Bill mentioned, the political risks. That is part of the reason why prices are as low as they are in terms of the entry level and in terms of either land prices in Russia or the lease prices in Ukraine.

Russia is a little bit different, skipping countries. They are the third-largest foreign currency reserves, they own trade surpluses, President Putin has made it a prime directive to increase the agricultural focus. Russia imports approximately 80 percent of its meat, therefore he has attempted the process of putting programs in place for chicken, pork, and beef. As we all know, farming is a tough business. It is not like running a steel mill. There are a lot of variables and every year it's new. A lot of people would like to own a chemical plant maybe, but at this point there really hasn't been that much of a focus on agriculture. Well there is an increased focus, but a lot of the money went into oil and gas and metals and mining in Russia. It is now being redirected into agriculture and it will come.

Patrick Westhoff: I'd like to quickly add that there are investments happening. If you thought for sure the current environment was going to persist forever, there would probably be a lot more investments happening. As I tried to make clear in my last couple of slides, we have lots of uncertainty in commodity markets right now. Mr. Mott indicated that, while we think energy prices are going up again, maybe. But, at the same time, if you look at oil markets right now, the futures markets suggest the contract delivered in 2021 will be lower than current oil prices. What does the world look like for commodities – agricultural commodities, in particular – if the oil price is $200 a barrel versus if it is $50 a barrel. It would be a very different world and lots of uncertainty out there.

David Miller, Iowa Farm Bureau: I just returned from a trip where we took a group of Iowa farmers over to Ukraine and Romania on an agricultural study tour and looked at a number of operations there. We also had a group of farmers who would have traded the Ukrainian corn crop for what theirs looks like in Iowa right now. We did see a lot of 180-200 bushel corn in central Ukraine. But we also talked with some farmers there that were dealing, on a 15,000 acre farm, with 6,000 landlords on this land structure issue and multiplying every year because they can't sell the land. It can only be inherited. Every time

somebody dies, you get two more landlords for the same piece of land, a huge barrier probably to further consolidation until land laws change.

I saw no improvement of infrastructure in terms of roads, bridges, etc. We traveled 2,000 miles and probably averaged 18 to 20 miles an hour. We never saw a hopper trailer the whole time we were there. I can tell you why, one last week fell apart. Every truck had an 18-inch steel beam frame underneath it to hold it together.

Are you optimistic about the potential for that area to really gain in its grain production or has most of the gain already been done by the agri-holdings that control 60 to 65 percent of the land in that area? Have we made the big gain in the last ten years?

Joseph Bond: I really can't speak for all the competition. I can only really address what NCH is doing and basically we are buying the largest and the newest equipment. We are one of the most productive farming operations in Ukraine. And, in that regard, it is a global market. We have to compete globally, not only within Ukraine but also in international markets.

The organizations that make the capital investment will be the survivors. In terms of the infrastructure, the roads in Ukraine – I will tell you – are bad. There are no two ways about it. But the rail system is very workable.

Consequently, as I mentioned to you, all of our farms and almost all of our grain silos are on rail spurs, so when they come off the field, we dry ship it and it's off to the port. They tried to do a little river work. It hasn't caught yet. In looking at Ukraine as an example, it's a lot of rail. I don't know if you saw rail activity or not, but that's generally the way we operate.

William Mott: I would add that infrastructure in these markets in Brazil, Ukraine, and Russia is lagging behind the possibility of crop production and this is probably going to be the case for a number of years. You just have to deal with it. We have been fortunate in the United States to have much of our infrastructure put in by the national and local governments, and unfortunately we don't have that in many of the other countries.

Nathan Kauffman: In the Midwest, and in our District, we often talk about the Midwest and its capability to be a breadbasket for our country. Joe, you mentioned historically the Black Sea region also being interpreted as a breadbasket for that area. I am curious, when you look at the investment opportunities you've been talking about on a global scale, what do you see as being the challenges in the United States? Or what do some

of the opportunities look like in the United States? Are there challenges or obstacles the United States may need to overcome or what does the prospect look like for the United States as a leading producer?

Patrick Westhoff: Obviously we have seen major productivity gains in this country for years and we will hopefully continue to see them in the future. Some investments have occurred and are occurring. The regulatory environment is one that probably has some people's attention these days and whether that will change the rate of future investment is of course one that we'll be watching with great interest.

I want to circle back to one of my earlier points. You can't talk about supply, without talking about demand. We've all been a little sanguine with what we've seen happen in the last several years. We've become accustomed to this being the new normal. While I think there are good reasons to be relatively optimistic for the future – I just want to keep repeating that – there is indeed a lot of downside risk as well.

If I had one more chart to show you, it is one chart that goes out to 2050. We put together a very simplified version of what the world might look like in 2050. I think oilseeds are one big group. If you can keep up current productivity gains, you have to find some new source of demand for us not to have prices go down. China, yes, has some potential for some future growth, don't get me wrong. But you need somebody else to be that new engine.

The chart I showed you with rising per-capita consumption of corn and soybeans the last several years is very real. But it is basically because of two countries – the United States and China – the United States, because of increased biofuel production, and China, because of increased livestock production there. Eventually, these things play themselves out, so it becomes a new event engine. If you are thinking about major investments that won't pay off for 10 or 20 years in the future, you have to think about what those long-term commodity markets might look like.

William Mott: Speaking more from a California perspective, we do see investment going into specialty crops, such as almonds, where the United States is by far the major producer of almonds for the world. Suddenly money is moving in that direction, buying $10,000-acre land, investing $10,000 into it, and going for the long pull of a 20-year lifespan of an almond tree.

We were recently approached by an Asian investor, who wanted to buy 5,000 acres of alfalfa land in California. We couldn't find it. They wanted to export it to China for the dairy industry along the east coast of China. And they were willing to pay some pretty good prices.

In California, there is not a lot of land for sale and maybe that's the case in the Midwest too when you really look at it, at least at reasonable prices. We see China recently made a deal in Australia to complete an irrigation project in Western Australia and to invest $700 million in doing that and building a sugar mill and then doing some farming. So this is $700 million from China that couldn't find a home in the United States.