



# **Preventing Postharvest Losses from Field to Market: A Food Security Imperative**

## **Presentation Transcript**

**March 27, 2013**

### **Presenters**

**John Bowman  
USAID, BFS**

**Steve Sonka  
University of Illinois**

**Philippe Villers  
GainPro**

### **Sponsor**

**United States Agency for International Development**

*Zachary Baquet:*

I'd like to welcome you to the March Ag-Sector Council. I'm glad you could join us today. I just have a few brief announcements before we get started. Just to say that we have about 50 people or so online and we have a sort of guest facilitator online – Bob Rabatsky is joining us from FinTrac to sort of facilitate conversation online as well, so please take advantage of that resource for those of you online. We have about 65 people online, so thank you for joining us from all around the globe. We have probably about 30 people here in person joining us today for today's talk on preventing postharvest losses from field-to-market, a food security imperative.

With that, I'm going to kind of say please silence or put on vibrate cell phones so we don't disturb the speakers. Also, please keep Q&A questions until the very end. This allows us to make sure that people online have the opportunity to hear what questions you're asking. Also, when asking a question, please state your name and organization before asking the question. With that, just would like to say to keep your eyes out for the next Ag-Sector Council, which is going to be April 24<sup>th</sup>. IFDC – Ahmet Roy is going to come and speak about some of the latest things around urea placement, some of the research they've been doing, and some of the ongoing work they've been doing and spreading it to India and Africa as well.

With that, I'd like to give a little bit of acknowledgement shout-out to PPL's USAID Learning Lab. This is a site dedicated to capturing the lessons learned around learning, and how do we do better knowledge sharing within the context of development, so please check that out. That's USAIDLearningLab.org – some great \_\_\_ there. They also do a series talking about thought leaders in learning as well. With that, I'm glad to have Rob Bertram, the director of the Office of Agriculture Research and Policy within the Bureau for Food Security, who's going to give our introductions for today. Rob?

*Robert Bertram:*

Thank you, Zachary, and good morning everybody, and I guess whatever time of day it is for those joining us remotely, appropriate greetings to you. When we did a couple years ago at the outset of Feed the Future, developed along with USDA and \_\_ partners, a research strategy, \_\_ R&D \_\_ three areas emerged – amassing the productivity frontier, \_\_ \_\_ breeding and genetics and vaccines and so forth that we often think about in terms of agricultural research. Second area was transforming systems, which is in a sense a key means for achieving what we call sustainable, intense vacation. And the third area was enhancing nutrition and food safety.

And it was that third area that, in a sense, is somewhat crosscutting but it was also probably the area that was most weakly represented in the work

that we had ongoing at the time. We had just started the Nutrition Crisp, which has led to two Crisps led out of Tufts University now we are calling them innovation labs. And but on postharvest, we didn't have a lot of targeted efforts in that area. AID once did, years ago, about things like \_\_ \_\_ pests, and postharvest institute for perishables, lot of activities that had gone away with the decline of agriculture in the mission's portfolios.

So now we wanted to look afresh, because if you think about either the food safety and nutrition goal on the one hand, or the productivity goal, it's pretty clear that postharvest losses and postharvest handling in general have roles to play in achieving either of those objectives. So one of the first things we did after developing that strategy was recruit our first speaker today, which is John Bowman. John, Dr. Bowman, came to us after – actually came back to us, because John and I worked together at AID back starting in the early 90s, when he was with in the Office of Nutrition, and John is providing I think terrific leadership for us going forward in these areas, working with partners like the World Vegetable Center, developing the new RFA that has closed now but has a postharvest, a Title 12 RFA for US universities with opportunities in postharvest loss prevention.

So we have – And he has a terrific background for doing this. He's worked with the private sector extensively in Asia. He's worked with international centers and he has provided a lot of leadership over the decades to AID's external efforts in areas like SPS – Sanitary and Phyto-Sanitary. So it's a wonderful background that he brings to this, and we're really delighted, and I think John is going to talk this morning about some of the ways that we are approaching this. I think you could probably say a lot of the investments we make are more at the front-loaded end of productivity but I think John's been looking hard at seeing how we are looking down the value chain and thinking about postharvest losses in doing so.

And our second speaker this morning is Steve Sonka. Steve is going to be joining us from the University of Illinois, where he heads the Archer Daniels Midlands Institute for Prevention of Postharvest Losses. So Steve is an economist, and which is a very important I think perspective I think to bring to postharvest work. A lot of – Economics is important across the board, but I think we need very clear discernment in thinking through what are the public goods, investments that AID and its partners ought to be making, versus those that the private sector is going to make on its own, and seeing how we can get the most – the optimal connection between those two ends, and I think Steve has been a leader in this for decades now with the whole area of approaching strategic decision-making in food and agriculture, using computers in agricultural production.

So he brings to us a terrific background, and he's been a prolific author – hundreds of papers, books – and so we're delighted that he's going to be joining us. And I should mention also that the research that he leads at that center, the Archer Daniel Midlands Center at the University of Illinois is a really nice example of that public-private connection. It's funded by ADM, and yet it's in the context of a university, so it's a huge boon, making that bridge. I think as we cross that bridge we come to our third speaker – Philippe Villars.

Philippe heads the Grain Pro Company. Philippe and his company are actually out there with a proven technology, working to advance this effort by reducing postharvest losses, and very importantly reducing aflatoxin contamination, for example, and that scenarios where we then go right from postharvest handling to nutrition and food safety and the objectives that we have there, and Philippe, again, brings another key set of experiences and perspectives as a mechanical engineer from MIT, and then also comes out of Harvard. He's founded several companies – I won't go through them, but he's worked and succeeded I think in a series of companies.

I was also interested, Philippe, a little bit of extracurricular comment here – He's also been really active in things like promoting access to healthcare and human rights around the world and such, so he's one of these people that somehow managed to do a lot more than most of us and but we're delighted to have him here, and he's really – he and his company are out there at the coal-face so to speak, working in developing countries to try to advance the objectives that we all share. So we have his engineering background, Steve as an economist, and John as a plant pathologist. We have a terrific set of speakers that I think are going to really bridge this spectrum from research through application all the way to delivery of technology.

So I'm delighted to have you all here this morning and now we'll turn it over to our first speaker, John Bowman.

*John Bowman:*

Yes, I certainly am mic'd. I can hear myself pretty well. Well, good morning everybody. I'm tasked with kind of giving you the quick and dirty overview of the postharvest loss situation, and my colleagues from academia and private sector will hopefully dig down much deeper into the weeds and give you some more of the interesting details, but I've got a lot to burn through in terms of slides, so I'm going to have to start the speed rather quickly. I'm going to just talk about a few of the current issues swirling around postharvest loss and its relationship to Feed the Future. I'll give an overview, a quick overview, of some of the many research and implementation activities that are going on, and if I have time, if Zachary

allows me, I'm going to talk about a particular case study at the end which is a nice integrated example of many projects working on a postharvest activity jointly.

Issues – Does Feed the Future have enough coverage in postharvest losses? When I came here about two, three years ago and was asked to kind of shepherd this area and start to look into what is Feed the Future doing about postharvest loss? I started to scratch my head. Doesn't seem like we were doing too much, back then, but I guess the good news is between then and now I can report we are doing a bunch of – several interesting interventions. Is it enough? I'm not quite sure. That, we can address in the Q&A section. There's always been this traditional focus on productivity and the front end of the value chains as opposed to the post – – why exactly is that?

We need to talk about that more, and I wasn't around during the genesis of Feed the Future, but maybe some in the room have some answers to that question. What we do currently have is a balance of standalone postharvest loss mitigation projects, and postharvest projects that are kind of part or play a component role in some of the larger value chain projects or resource programs. So we have some standalone and some small component projects. Is the balance that we currently have appropriate? We need to look at that question.

And then more analysis probably needed on the basic barriers to why postharvest losses – slow to – impact and success, low-levels of funding – why? Why has progress been so slow when some of, most of the interventions, and most of the solutions, are relatively simple ones? You probably have all seen this slide before, I'm not going to belabor the price hikes of 2009 and the L'Aquila Conference and all that and the FEL projections, but what I want to focus on here is definitely Feed the Future is kind of a renaissance of the Green Revolution, if I can say that, and how many pictures of Norman Borlaug do you see in grain storages? Or in food technology laboratories? You don't. You see – You see him working hard in the field.

And that may have something to do with, in some sort of strange way, why under Feed the Future there's much more work on the front end of the value chains than on the rear end with postharvest. We've kind of maybe failed to break away from the wonder of the Green Revolution and all those wonderful front end productivity gains – increased yields, lodging resistance, disease resistance, fertilizer management. And then we have this new effort in Feed the Future on sustainable intensification, which is kind of getting back to the Green Revolution again, although there's much more focus on soil and water conservation and preservation of the

ecosystems, these four major agro ecosystems that we're working with under Feed the Future.

I think that's part of the problem. Where we do – What are the linkage of postharvest losses to Feed the Future? Well, under Feed the Future, we're mostly concerned about postharvest losses in relationship to the small holder farmer. We have linkages to agricultural productivity, obvious linkages. We work on postharvest losses under Feed the Future to get better expansions of markets and trade. That's not only regional and international markets, but also local markets within some of our target countries. And, lastly, we do focus on postharvest losses in the sense of economic resilience for vulnerable communities, work on postharvest losses in storage and food preservation. Nutrient preservation essentially helps our vulnerable target population to have better resilience to climatic shocks.

Going to quickly mention that the Office of Agricultural Research and Policy, which I work for, we underwent a recent reorganization. We now have a – We are now working as a Food Security and Innovation Center and we've essentially divided all of our programs – We've got seven new programmatic areas. And where we've put the postharvest loss work is in this area of safe and nutritious foods, because in many ways postharvest loss interventions are the ones that can most affect safety and nutrition of foods. Safety in the sense of keeping often contamination with the pesticides, with the aflatoxin, with enteric pathogens, occurs during the postharvest process, and in terms of nutritional quality, often high percentages of nutritional quality are lost if postharvest work is not properly done.

And so our portfolio in this area of safe and nutritious foods includes work with the CGIAR CRPs, such as the meat, milk, fish, and nutrition CRPs, the innovation labs formerly known as the CRSPs, horticulture, livestock, aquaculture and nutrition, and then we have new standalone investments to the World Vegetable Center for postharvest research, and we have a, as Rob mentioned, a procurement on the street that will be for postharvest research in a non-horticultural area. And we also have direct investments to USAID in aflatoxin research.

In terms of some of the actual standalone postharvest projects that we have under Feed the Future, I think the most impressive one is with the Rwanda mission. They have a project – it's recently ended – called the Postharvest Handling and Storage Program. It was very robust and comprehensive program on postharvest loss management. The Tanzania Mission has the Tuberoshi Food Fortification Project. That's a project that's exclusively working at the postharvest end, working with grain millers and helping grain millers in Tanzania fortify their foods with micronutrients. We have

the Ghana mission, which has a grain warehouse management project in association with AGRO – The Alliance for Green Revolution and Agriculture. We have standalone aflatoxin programs that are funded by the missions in Nigeria, Zambia, Mozambique, and Mali.

In our office, we had this new AVRDC, Postharvest Vegetable Research Program and the new postharvest research grant in the non-vegetable area that's on the street, and we have the investment of the USDA ARS and our sister office NPI has a standalone postharvest project. It's a private public sector partnership with Gates and Meridian that's comparing household grain storage structures in Kenya, doing a comparative analysis between plastic bins, cement bins, clay structures – those are the kind of standalone projects.

Then we have – I wanted to spend a little more time explaining the Rwanda project, because that's the most robust standalone comprehensive project we have on postharvest loss in Feed the Future. They had these training modules that reached over 30,000 farmers. They were able to work with the national government to actually approve a national postharvest strategy. They cost-shared the construction and rehabilitation of over 11 \_\_ storage facilities, and they brokered memorandums of understanding with the World Food Program and the Ministry of Agriculture to buy the grain from the small farmers that they have graded through their modules and training.

They also pilot a \_\_ SMS system linking grain buyers and grain sellers. As to why we don't have five, six, seven of those kind of projects under Feed the Future really beats the hell out of me, as to why tiny Rwanda went for it and the other big countries didn't also kind of baffled me, but that's what happened when I came on board. Then, in terms of mission projects under Feed the Future that kind of big value chain efforts but and postharvest losses kind of a partial component of those projects, we have the East Africa Regional Mission, with the Compete and MLR projects that was using warehouse with Seats models linking farmers to the World Food Program's Purchase for Progress programs, the Tanzanian Mission, all the work in the Sagcot Corridor, there's a strong emphasis on investments in cold storage and grain storage.

The Ghana Mission had a project that's focused on the advanced project on postharvest losses and through the establishment of investment fund. The Bangladesh Mission, for example, has a horticultural initiative which has a fairly significant potato storage component to it. So we are doing some things. Most every value chain project in the Feed the Future addresses postharvest loss to some extent, but they tend – the action on the postharvest side tends to get overwhelmed and buried by all the action on

the front end. Then, in the resource portfolios, we work, we have many of our research investments partially work on postharvest issues.

For example, the horticultural Crisp or innovation lab as we now call it, they're working on cool storage technologies known as the cool bot. They're working on special drying bead technologies to dry and preserve seeds for long periods of time under hermetic conditions, advanced work on solar driers. A little too – I can't go through all these examples. Simit, for example, is working as a project on promoting the use of galvanized steel storage structures in Africa, and Latin America. Eerie has a very robust postharvest unit working on – They have an engineering unit that's taking care of all the postharvest problems and they produce prototype equipment at Eerie in the Philippines, and then essentially take the prototypes to some of the target countries, work with local manufacturers, cooperatives, and they build a business model with the private sector to essentially tweak those prototypes and get them appropriately adapted for use in those countries.

Most of that work is going on in places like Bangladesh, India, Pakistan, Nepal. AVRDC has a very robust program – the research we're doing with them in terms of breeding for postharvest quality in vegetables for and doing nutrient analysis on vegetables under postharvest stress, and a lot of work in the area of food technology – preservation, preservation techniques and recipe formulations for some of the many of the both exotic and indigenous vegetables that they work with.

Just some quick pictures from the field. Some of these activities. This is the VinTrack-led TAPP project, in Tanzania, working on charcoal coolers. In Zanzibar, removing field heat with primitive efficient systems, the TAP project also works just basically to help onion and vanilla growers to do the proper types of curing. If you don't do this properly, you lose a lot of loss, and you lose a lot of quality in the final product. AVRDC tomato breeding emphasis on postharvest quality, tougher skins, higher nutrients, disease resistance to postharvest pests, this kind of thing. And working closely on breeding tomatoes with the private sector for bricks levels, for lycopene content, for the ability to produce sauces and pastes from these kind of tomatoes.

Horticultural Crisp working on cool bot cool storage technologies taking simple insulated structures, adding a home type air conditioner, and getting levels, whether through electrical or solar power, down to anywhere from 3 to 10 degrees centigrade in very remote locations. Horticultural Crisp also working on \_ \_ \_ their solar driers, advanced solar driers, \_ \_ \_ bubble driers that Eerie is producing, which simply use hoops and plastic linings and strong mechanical air, air blowers. Yes.

And another Eerie postharvest focus on these simple flatbed rice driers, which so many of the countries – the drying process for rice is critical, and when you get it wrong, you get moisture, and when you have moisture, you can also have the aflatoxin problems and other molds in rice and big loss of quality, so they developed prototypes of these flatbed driers in the Philippines and \_\_ them in other countries, as they do with small simple combine harvesters, laser leveling. You lose if you don't have the patties properly leveled you can have a lot of postharvest loss in the rice, and they also have a close relationship with Grain Pro in hermetic storage systems throughout South Asia.

Now this final project I wanted to talk about where we – this is kind of a story of many projects coming together to work on a postharvest vegetable success story. These are the African indigenous leafy vegetables of East Africa. AVRDC the World Vegetable Center has always had a focus on these, but under Feed the Future, this particular vegetable crop is getting more focus. So what's going on here is we have an integrated project. What's really nice about this – We have AVRDC working together with several of the mission-led value chain projects in Tanzania and Kenya. The one in Kenya is called KHCP, also led by FinTrac, and then I mentioned before, TAPP.

These indigenous vegetables aren't of the highest priority to these value chain projects, but the value chain implementers know that now the target beneficiaries they're working with, these AIVs always come up, where can I get more seed, I want to work with these vegetables with you, not tomatoes and beans for export. There's a high level of interest, but of course these country programs had to focus. So these vegetables get a lower level of interest, but in combination with the research projects, we can get more emphasis on these African indigenous vegetables without losing too much of the focus of the value chain projects on the other crops they want to work with. So there's collaboration with AVRDC in the area of new improved varieties. There's AVRDC and the value chain projects are trying to make linkages to seed companies, good high quality seed of these African indigenous vegetables is very lacking right now.

AVRDC has a certain amount of output that they can't scale it out properly. They need the private sector to step in, and the value chain projects help make the connections to the private sector. AVRDC leads demonstration trials on the experiment stations, whereas the actual value chain projects lead demonstration trials with the farmers out in the field. The horticulture Crisp in combination with a private sector company, Mays Foods, is working on postharvest drying techniques, working on those techniques that caused the least loss of nutrients during the postharvest processes. And the horticultural Crisp is also working on nutrition education aspects with the small farmers of these vegetables.

They're highly packed with micronutrients and then the food company and the value chain project in Kenya is actually processing these vegetables for export into Europe with the African diaspora that has had very high demand for these products in Europe.

So you get income boost to the European export, and then you get the local stimulation through the researchers and through the Horti-Crisp essentially going after nutrition education. In addition to all that, in Kenya, we have – there's a linkage to vulnerable groups. They're teaching HIV-affected populations that are essentially through the Am Path project, which is an Indiana project, Indiana University project, that's gone on for about ten years now trying to get the HIV-affected farmers to not only consume the AIV vegetables but not to grow them for project, so that's a quick show some pictures, trying to build linkages to the seed companies.

These linkages are not tight enough yet. There's not enough good quality seed of these vegetables. I haven't mentioned these vegetables yet. These are amaranths, spider plant, and nightshades, primarily, and also African indigenous eggplant. This is some typical farm – small farmer's field. Some of the rustic primitive ways that these vegetables are grown and then here you see on the AVRDC station in Arusa, Tangenia, with proper seed, proper agronomics, then get a much higher yield for the small farmer if you can transfer the technology effectively. This is in Kenya. This is with the Am Path project that I talked about before that works with the HIV-affected farmers and getting them to use drip irrigation and other agronomic techniques so they can get higher yields, make more money.

At least one Dutch company has taken AVRDC germplasm and is now going to try to release a commercial variety of the African Eggplant. We have AVRDC and the horticulture Crisp also working on recipe formulation of for the various African indigenous vegetables so that using the best teaching, teaching mothers the best possible recipe formulations that will not lose nutrients, as they use the vegetables, and here's some of these vegetables being dried for export to Europe. And then the packaging process. This is essentially the turf area of the company and the value chain project which is more focused on the export linkages.

That's a quick overview. I've probably gone over my time limit a little bit of kind of the panorama of things we're doing through research and through the value chain implementation projects. I think the best – the best story yet is when the research projects and the value chain projects come together and do some sort of an integrated project like that, so thank you very much.

*[Applause]*

*Zachary Baquet:* Steve? Are you online?

*Steven Sonka:* Hi. Is this Zach?

*Zachary Baquet:* Yes it is, how are you Steve?

*Steven Sonka:* So my Power Point should be coming. There we go. All right, great, thank you. Well, thanks to USAID for inviting me. Hello from snowy Central Illinois. Even though it's the last week in March we got about a foot of snow Sunday, so I'm enjoying the view of snow across campus. I do apologize for not being present in DC for this, but I have a board meeting of our board here in about an hour, so it wouldn't have been possible to participate without doing it this way. And I have to admit, I'm new to being the presenter on a webinar, so hopefully I can handle all the various things going on.

I just have a few slides. I'd like to accomplish about three things as we move through these. I want to talk about complexity for a minute, and how that relates to postharvest loss, and I think how that may relate to some of John's comments and Rob's comments about perceived lack of progress even though we are making progress that the kind of wide frustration – why aren't we making it faster? I then want to give a little bit of background at the ADM Institute, which is part of the University of Illinois, and we'll explain that a little more in a couple minutes. And then I want to think about an evidence portal initiative, ask for help in this, but I'll explain what an evidence portal is and what we hope to accomplish and provide.

So as we move to the next slide, here are some standard things we've seen before that the beliefs that about a third of ag production is wasted, doesn't reach the food consumer, that the investment required to reduce PHL would be modest, technology advances can make reduction more feasible less expensive, and that this is a sustainability issue – land, water, energy, and limited supply. I think we've heard these and I'm guessing that everyone on the webinar would say yes. But from a decision-making perspective, and Rob mentioned I do bear the cross of being an economist, these are really hypotheses.

And I don't mean that in kind of the scientific let's-find-a-five-percent-confidence-in-our-interval, I'm talking about from a decision maker perspective I may believe these things, but when you say to me, if I'm a small farmer, I need to take some portion of my very small disposable income or even more importantly my time, these are hypotheses. These are not – And we tend to lack evidence. We tend to lack specific data, and it doesn't matter if we're a small farmer, a regional manager, or someone

in a funding agency. We're dealing kind of in the world of belief, and lots of individual anecdotes but that don't necessarily add up to a strong consensus based on evidence and measurement.

And I think that's really important, that we appreciate that and understand that. Just and these we're dealing really here with really complex systems, and that's made the problem more different, more difficult. What I have here in front of us is some work we did in India with a product called Black Gram which is a lentil – it's an important product in India. We're working in a number of small villages with a partner organization in India called MART, trying to understand what was the source of postharvest loss from sort of the village to the eventual user?

One of the things that struck me, the reason I have these up there, some of this work was done in villages in Maharashtra, some were done in Pradesh, maybe 200 miles, 250 miles apart, same crop, same production systems, at least from an Illinois or an Iowa farm boy perspective, very similar types of terrain, type of crops – quite different beliefs, quite different estimates were drawn from the people about not the total loss but where the loss was occurring, and if we ever – and the thing that strikes me as I look at this is these are very similar locations. If you were to put a blindfold over my eyes and drove me there and then took the blindfold off, I wouldn't have known which of the locations I was in, yet the people on the ground saw the world very differently in terms of where the sources, where the major sources of loss were, even though these are very similar kinds of circumstances.

And that's part of our problem, part of what we need to address. This is – and John mentioned Eerie. We work with Eerie as well. This is a slide that I appropriate from Al Shmidley at Eerie and the reason I like this slide is yes, it gives us good data, and data from I think a lot of experience, but it really emphasizes quality, and quality declines for many of our commodities for many of our crops, whether they're staple crops, fruits and vegetables, maybe as important as physical losses, yet we tend to have data which is much more on the physical loss side than on the quality loss. How do we deal with quality losses when the product is still being used?

The fruits and vegetables that may not end up in a high end grocery store because of cosmetic reasons oftentimes are being used but there's economic loss. That loss is significant, can be significant in particular cases, but if we're just measuring physical loss, that loss doesn't get realized in a weight, in a physical sense. So these are complex systems and we need to address them in a complex way. Just a little bit about the ADM Institute – Archer Daniel Midlands is a major food processor. Its headquarters are in Decatur, Illinois, but it has operations in 65 countries around the world. It is a significant player in the food channel.

In the fall of 2010, we were contacted by ADM and actually the interest in postharvest loss at ADM came from the chief executive officer, Patricia Wertz. ADM had been involved and is involved with a number of food companies and at that particular time, they were responding to the food price hikes that we saw in 2008 and 2009 or thereabouts, and what Patricia observed was that there was all this attention on growing more product and sort of the assumption that whatever more we grew was going to get to the end user. It was her perspective and her experience that isn't the case. And so she actually contacted us. We worked with them to define a domain, an area of work, and moving forward.

The result of those discussions was a \$10 million gift commitment – it's \$2 million for five years. We're just starting our third year. In our initial work, we've been emphasizing India and Brazil, although we're expanding our domain into other areas as time moves forward. We also primarily work in staple crops, and that is just because the private sector knows university folks have a difficult time focusing. And so we do try to focus in the staple crops' developing country domains. And I need – there we go. We see our role as being an information technology hub. We have and I'll show in a minute work relating technologies but we also see the world in a world of systems and as I said our focus is on staple crops and key agricultural domains.

In our first go round in terms of funding, we have allocated about \$2.5 in targeted research and outreach areas that are organized within four themes, and I'll go through these very quickly. I should say that in every one – and there are seven major projects in these four themes – and in every one of these projects, there is U of I faculty in a lead role, but in every case, there are partners around the world who are actively involved in carrying out the research. So this is not – in fact, most of our money, most of our research funding, I think, will eventually be actually allocated to our partners. These partners can be universities, the NGOs, or in some cases the private sector, where we have the best opportunity for partnerships.

So one of our themes, and the theme that has most of our resources is focusing on measurement technology development. We have faculty who have been following combines in Brazil where the soy bean harvest is occurring. Sometimes, people ask, well, why Brazil in particular, or why the Motto-Grasso region of Brazil, which is where the large scale farming is – well, because there's – it's large scale, but it's large numbers, and there are significant losses that we've been able to document in the field, at harvest, and then in what we would call the short haul, from the field to maybe the first organized storage, which might be 50 kilometers in some cases.

The other interesting thing about the Motto-Grasso region of Brazil is its low-latitude agriculture, and we believe that postharvest loss is really different in low-latitude agriculture than in the mid-latitudes, where I'm now looking at snow in late March here in Central Illinois. That's important because a lot of our research, if we go back and look at research that has been done about postharvest loss, it's really been done in post, in the mid-latitudes. And in the mid-latitudes, we do have this wonderful thing called winter, which makes postharvest – I'll say an easier process. So we're finding interesting parallels and challenges in the low-latitude agriculture of Brazil, and the low-latitude agriculture of India where we also have measurement and technology development projects going on.

We are strong believers in systems and informatics and analysis. We have a group that's looking at how do we model systems, how do we model postharvest loss systems? They are doing work both in Brazil and near Mumbai and we will be expanding that.

I'll jump over here to policy analysis, both public and private policies, and in particular across supply chains – how do public and private policies maybe impede or contribute to loss? How can they be improved to reduce loss? So even things like taxes between states can cause very rational behavior that ends up potentially increasing loss, postharvest loss, than what it should be. And the fourth area is in education – the training. We have a particular group called Scientific Animation Without Borders, and their acronym is SAWBO. They're doing very, very creative work with animations, realizing that if we are to move forward postharvest loss production, education and training is needed but it's going to be among populations that are primarily low-literate populations, and using animations is a way that we can cheaply and effectively produce effective content which is available and can be available in multiple languages.

I want to talk a little bit then about innovation and measurement, which I think is a theme. Rob mentioned that I am an economist and I've spent most of my career working on decision-making. The axiom is from the management textbook you can't change what you don't measure. We lack good measurements. We need to think about changing and improving what we measure and how we measure. We need – We have general estimates. I used one earlier in my slides, but we need actual measurements that focus in specific local settings and we need to be able to accumulate those and we also need measurements about the effectiveness of innovations over time.

The second part is how to measure. And the reason we don't have as much measurement is historically using our historic technology, measurement is costly. It's time and resource-intensive. We have this whole world of ICT and cell phones and sensors. The question, and this is

really a question that I hope we can contribute but just contribute to answering around the world, how can we use these innovations in information and communication technology to address this lack of measurement problem. And I believe if we can address that, we can make much more progress, and we can learn much more rapidly across the domain of the range of postharvest loss projects that are going on.

Last thing I want to mention is an evidence portal. We are embarking at the institute, the ADM Institute, to create an evidence portal even though we – at the one hand, we lack data, we lack measurement. We have lots of projects that have been conducted, that have provided explicit information. The question is, how do we add that up? We are drawing from what's called the evidence-based movement, which has been used most in medicine, but is also being more widely used in the social sciences. Yes, we want to provide access to reports, but we want to provide guidance as to how studies were done. Another word for this, which is fairly similar, is meta-analysis. But giving people who are interested in a particular intervention, a particular problem in a particular region insights not just to a long list of literature, a long list of reports that were done, but a sense of how they were done and what the general findings were that were documentable.

Going over this fairly quickly, I'm sure I'm running out of time. The thing I wanted to mention here, and we are just in the conceptual phase of this for we hope to be rolling out some examples of evidence-based work and evidence portal by this fall. We would certainly welcome people's involvement. And particularly in this conceptual phase, I put up here my email as well as our website that if there are folks participating who would like to engage in this activity or just be aware of what we're doing, please let me know at these websites, and I understand these slides will be available after the set.

So I'm going to conclude. I look forward to questions and answers and hearing what Philippe has to say as well, so with that, I'll conclude my remarks.

*Philippe Villers:*

I have the pleasure of talking to you about key advances in food security through reduction of postharvest losses. We like to think of it as the Green Revolution, Phase Two: The Storage Revolution. It is a fact that in hot, humid climates such as many parts of Africa, postharvest losses can often exceed 25 percent, and yet modern technologies \_ \_ \_ could reduce that to less than 1 percent per year. That would mean that if that were fully implemented, Africa would already be self-sufficient in grains, which it's far from doing at this point. So let's discuss exactly what is it that's being done, why is it being done, how is it being done?

Let's work at the World Bank report of a little over a year ago. It shows that maize losses in the red areas, which is much of East Africa, were on the average 20-25 percent. That's an enormous amount, particularly when we know we could reduce it to less than 1 percent with modern technology. Here are the drivers to these losses. First, insects. Notice that insects have their sweet spot at 86 degrees Fahrenheit, about 27 degrees centigrade, and that \_\_\_\_\_ as an example \_\_\_\_\_ in its 60 day life. That's an enormous amount. And so the question is how do we eliminate that problem? But there's a second problem. Fungi.

Fungi, which like high humidity, and notice what happens when the humidity goes beyond 65 percent. It skyrockets. Much of Africa and parts of Asia and Latin America have that condition. Again, what can be done to eliminate that? Why is the aflatoxin problem so important? Because aflatoxins lower the human immune system, thereby facilitating cancer, HIV, non-thriving in children, etcetera.

In Kenya, in 2010, 10 percent of the maize crop had to be condemned for excessive aflatoxin levels. And in a study by University of Georgia, a field study showed that 40 percent, let me repeat, 40 percent of the products sold on local markets exceeded the permissible international level of 10 to 20 parts per billion of aflatoxins. So it's a major public health problem, and one which can be effectively controlled, as you'll see a little later.

This is data from Uganda. It's recent data – February of this year – done by Millennium Villages. And here's what they found. You can see that even over four months the aflatoxin levels skyrocketed either in ordinary bags or storing directly on the floor. Using hermetic storage, which is what we're talking about, reduces it dramatically to a negligible effect. Although much of the work on aflatoxin control is being done on reducing it in the field, we believe that the neglected low-hanging fruit is the extraordinary rise in aflatoxin levels because of unsafe storage, and this has received inadequate attention and yet answers already are in hand for that using hermetic storage technology. What is hermetic technology?

It's a very simple process. If you have a sufficiently airtight container – sufficiently airtight means that the insect respiration, other microorganisms drive the oxygen level through respiration alone to typically 3 percent or less, which makes it unlivable – they all die, including the eggs – and a high CO2 environment. This also is unfriendly to the growth of aflatoxins because molds need both oxygen and humidity, and if you deny them both, you have insignificant growth of aflatoxin levels. So that's the approach that I wanted to give you some examples of as to how it's already working in over 80 countries. And here are some of the countries. As you see, it's actually 87, which are successfully using

this, but in most instances not yet in a scale which is sufficiently high to make a societal difference.

There are exceptions. Currently the Philippines for instance is meeting that because of a decision to make the Philippines self-sufficient in rice, and they are investing heavily in making this technology available to their small farmers. Let's look at examples from around the world. Nepal, this woman in a small cooperative is using what we call super grain bags inside a liner to preserve in this case maize, but it's also used in \_\_ commodities and seeds – seeds can be preserved equally well under cold storage or hermetically, with a big difference in cost and energy consumption. What does a super grain bag look like? It's a liner to an ordinary bag and here's an actual example. Very simple. But not as simple as you might think. Looks like polyethylene. It in fact is three co-extruded layers with the middle layer being proprietary and reduces oxygen permeability – the entrance of oxygen or air by a factor of 500 over ordinary bags, which is why it works.

In larger sizes, this is the material that is used – they're called cocoons. You'll see some examples a little later. Top half, bottom half, zipped together using a zipper developed for use by astronauts, and is very airtight, and is available from one ton to a 1,000 ton capacity. Training is vital because like any technology, hermetic storage can be misused, and therefore we have a major customer support component in our company worldwide to make sure that the units are properly used. I could spend an hour telling you about all the possible forms of misuse. I'll skip it.

South Sudan – you see a medium sized cocoon here. It's a 50-tonner. And they are storing a variety of crops, in this case – excuse me. I think it's maize again, but it could be beans. It could be corn. It could be a variety of commodities. Coffee. Major use. Not so much for quantity losses, although it helps, but quality loss. You can preserve quality for up to a year. One of the very first users in 2001 – since then it has spread worldwide and is becoming in many ways the de facto standard, whether it uses the cocoon or the portable super grain bags, both are widely used, as well as you'll see a way of \_\_ intercontinental transport. This is the ubiquitous – thank you very much –

*John Bowman:*

Coffee, not water.

*Philippe Villers:*

Thank you very much. This is the ubiquitous super grain bag inside a joot bag. We will be announcing in April, as a result of some very hard work and R&D, a novel super grain bag which dispenses with the other bag. It's going to be called the super grain bag forte, because it's very strong, and we see it as a breakthrough in price performance. Afghanistan, you see farmers there, with their super grain bags, courtesy of USAID traders,

on the left, in Ghana, in a public market. Again, the same super grain bag, and it's being sold in Ghana at retail stores.

Large scale use – you see on the left a warehouse in Rwanda storing thousands of tons in the cocoon, the large units, and also use outdoors – you do not need indoors in order to store with hermetic storage, and this is another application, in this case, seeds also in Rwanda. Cocoa, one of the largest users of hermetic storage is the Ghanaian Cocoa Board. Why? They're concerned with growth of free fatty acids. They're concerned with locusts or insects. They're concerned with aflatoxins. And they found cocoons to be a major answer to that.

On the right hand side, you see a cargo application in the Philippines for animal feed. And notice it's an outdoor application. For intercontinental transport, the same material used in super grain bag has been used to provide a hermetic environment during transcontinental shipments and in fact on the right hand side you see a load of coffee being put into a standard 20 foot container with a trans-safe liner. I actually took that picture myself in Guatemala as they were loading the truck.

And back to the Ghanaian Cocoa Board, this shows them in the actual process of loading a cocoon. John showed you an interesting picture of our cooperation with Eerie. We signed an agreement a year and a half ago for worldwide cooperation with Eerie in the introduction of hermetic technology for rice and rice seeds throughout the world as a way of completing their mission and our mission, too. Guatemala – this is through the courtesy of an international agency who have introduced 2,500 of these grain safes – one ton units which allow, unlike other units, bulk storage of grains with continuous in and out. And you see here our continent manager and next to him the farmer that is actually using this. There are 2,500 of them now in Guatemala in use.

Private public partnerships – this is a picture in Mindanao, and this is the artist concept on the right of what we call a grain keep center. An important concept which is now being tested in several parts of the world – the idea is to bring the market to the farmer by creating a regional center which provides both safe storage, warehouse receipts, and an opportunity for the farmer to be paid twice – when they store the product, and then, months later, when the prices rise, they get a share of that. We think that's an extremely important concept in terms of increasing farm income very significantly and has already received support from USAID including in Kenya.

Solar Dryer. This is the collapsible dryer, solar dryer, which represents a significant improvement over conventional drying, such as patios, etcetera. And you saw a sneak preview of the next generation of products,

which we're cooperating with Eerie, it's called our bubble dryer. They're working on testing and improving it. And in summary, then, hermetic storage takes many forms – solar dryer being important to make sure it's properly dried before it goes into the storage, but the story is the same, a natural process, which is what hermetic storage is, being applied to solve one of the world's great problems – post harvest losses. Thank you very much, and I look forward to your questions at the end.

*[Applause]*