

GLOBAL FOOD SECURITY AND NATIONAL SECURITY

Speakers: *Gregory F. Treverton and Rod Schoonover*

October 12, 2016 - 2:15 p.m.

Introduction

Ambassador Kenneth M. Quinn

President - World Food Prize Foundation

So now we're going to move to part two of the afternoon on global food security and national security, and we have to follow the experiences of the three ambassadors and their personal stories and anecdotes and sense of the trendlines. I've reached out to the Director of U.S. National Security, because in my 32 years in the State Department, I learned that the best analyses that are done are those turned out by the American intelligence community. So they're not here to present classified briefings — there won't be that. But they do incredible analytical work, and the Director of National Intelligence in the United States, General James Clapper, has sent the head of the National Intelligence Council, Dr. Greg Treverton. He has a very distinguished academic background and many years of service with RAND Corporation, and he's brought with him Dr. Rod Schoonover. And they are going to lay out for you the view of these issues of global food security and food production and trendlines and their assessment of it. So, Dr. Treverton.

Gregory F. Treverton

Chairman, National Intelligence Council

As usual, Ken has been so generous, I feel like I've peaked and should probably just sit down. It's a great pleasure and a great honor to be here, to be able to laud the laureates this year. It's also a pleasure because of Norman Borlaug. One of my first jobs was in Latin America with the Ford Foundation; and I didn't have the opportunity to work with him, but he was very much a presence in everything we did. We were building, for instance, agricultural economic programs in various Latin American universities, and he was really an inspiration for us.

I say it's a little daunting to speak to this group. I feel like I'm talking about ark building to a room full of Noahs, but let me give you our perspective from the National Intelligence Council. We do take a very broad view of security, as I think one has to these days. In that sense, my origins, thinking about economic development, I feel, serve me well in trying to take a broader view of security. We obviously do lots of work on traditional security issues — missiles, weapons of mass destruction, terrorism and the like — but we also do a lot of work, much of it unclassified, on health, on water, on food and on energy.

We just recently published a commercial message, an unclassified piece on the national security implications of climate change; and last year we did a major work on global water security. So it's very much on our minds. Also, a second short commercial — We do every four years a look

forward 5 to 20 years. I'm mindful of Ryan's comments about the Middle East, that long-term thinking is next Tuesday, but we try and jump to a longer-term perspective and look out 5 years and then 20 years that's called "global trends." It will be out in December – notice, safely after November – trying to look out 5 years and 20 years. And so I draw on both works, specific work on food security and our longer work on global trends.

In thinking about food security and national security, two points strike me as really important. We do worry, first, about the longer term, the adequacy of food in the world by 2050; but, as several of the other people on the previous panel have said, we've done actually quite well in terms of food production. The main challenges for the moment have to do with distribution and with price.

The second big point, and I think one that runs through all of our conversations and I suspect yours as well, is that we can't isolate food. It's hard to talk about food without also talking about the connection to water, and that also then takes to you to a connection to energy. And as particularly Ryan emphasized on the previous panel, we also need to think about infrastructure, particularly roads. So it's really that combination of factors that bears on the security implications of food. We know, for instance, that 70% of the world's water goes to produce food. I come from California, and I'm keenly aware of that fact where I live.

The 2015 work that we did suggests, as you can imagine, food insecurity can be either a cause or an effect, but we talk about it in that work as a likely cause of political instability and social disorder. We see that as an increasing risk around the world and identify a number of particular places where it's especially likely.

But the other big point that study makes is that all of this is made much worse by bad government, by bad policies and bad choices. I suppose if we had to pick, sadly, a poster child for that point, these days it would be Venezuela, a relatively rich country with huge food shortages and dislocations about food, almost entirely the result of bad policies.

Food becomes an explicit national security and security and concern in two ways, I think. The first, Wendy was very eloquent about, talking about food used directly as a weapon – the Syria cases, sadly, a very glaring example of that use of food explicitly and with malice of forethought being used as a weapon.

But we can also think of more subtle ways in which food could become a weapon. We're worried, as you can imagine, at the National Intelligence Council, about bioterrorism; but that also makes us conscious of the link between food safety and possible terrorist or other malevolent uses of food. Those would be hard to identify, hard to attribute, but then they also could be relatively targeted, since food distribution has different channels. They might not kill many people, but you can certainly imagine the kind of panic that would ensue, particularly in the developed world, but all over the world, if people weren't confident that the food they were buying was safe and indeed might be extremely unsafe.

This is a somber subject, but maybe I can leaven it a bit with an anecdote. I have been the object of food as a weapon only once in my career, and happily it was a diplomatic weapon and not an actual weapon. As a young National Security Council staffer many long years ago, I was working on Greece and Turkey. Like every administration, we thought we could fix the troubles between those two – take a few months, be easy. Not likely. But in one of our trips we were spending time with Archbishop Makarios who was then the president of Cyprus,

primarily then Greek Cyprus. And so he had us to a very nice lunch. The lunch was at his archbishop's palace, which was nicer than the presidential palace. So we had drinks before lunch, hot Cyprus day. Then we went inside and had this lovely meal, the entrée of which was called "buf shahale." Well, we all got – having been a little tired, maybe having a couple glasses of wine and a drink – we got this football-size filet dumped on our plate and so looked there agog at this plate. Meanwhile, Archbishop Makarios announced that he'd given up meat for Lent. And a waiter came out of another door with a plate of vegetables for Archbishop Makarios, and I thought – what a son of a gun, seizing the moral upper hand. He already had an advantage, because you had to address him as, "Your Beatitude." Nobody at NIC calls me "Beatitude," to be sure.

The other main way food becomes a security issue is when populations get displaced, when they move into areas seeking food, forage, water, when they move into areas either where they're not wanted or where there is not capacity to deal with them. And obviously that will be an increasing problem as climate change means people have to move more often, look for food and water more often in other places from where they are.

That will be compounded by shocks to the system. Now, we primarily think of those shocks as emanating, I think, from climate change where we have bigger and more frequent climate events. But it's also worth noting, as recent studies have, that more mundane, maybe not so mundane, but less dramatic events will also be shocks to the system. You can imagine the effect of the El Niño that didn't quite happen or a pest that emerged in a particular place. What we know is that the system, the entire food system is pretty complex. And while it may be quite resilient to an interruption at one particular node, if there are shocks that affect several parts of the system, like a combination of pests and el Niño, that could cause a real problem.

As we look out, we also worry about the backlash of globalization. Is that going to affect trade, including in food? Might it induce some countries, a country perhaps like China, very concerned about commodities, to stockpile food to the extent it can or maybe continue the process of trying to buy arable land in lots of places to ensure its own psychological future?

We also worry that, as humanitarian crises multiply out there, that may stretch resources and capacity in the richer countries and mean that there is less ability and maybe less will to engage in the longer-term capacity building that is really so important as we think about food security.

I'd like to say a word about fish in the context of food, since they're an important part of food security as well. Four billion people on the planet depend to some extent on fish. A billion depend absolutely on fish. We all know the numbers – 85% of fisheries around the world have either been overfished or fished out, and that means that aquaculture as well as agriculture is a big piece of the food future.

In a very real sense, even something like the dispute over the South China Sea has a lot to do with fish. Indeed, we had a funny, in retrospect, episode recently. We noticed from the imagery and other sources that the Chinese Coast Guard was moving lots of vessels into an area near one of the disputed rocks. We worried about it – what does this mean? Is this ratcheting up the tension? Well, again, it probably was the case that it was fish at fault. A big school of fish, apparently, was running. The fishing boats multiplied, seeking the fish, and the coast guard went in to make sure they restored order. It reminded me a little bit of the very old episode during the Cold War when we worried about Soviet submarines incurring in the waters of Sweden and other countries. And there were such incursions, we're quite confident, but it also

turned out in that episode that some of the things that were thought to be submarines actually probably were fish. So fish may be an under-appreciated category of national security threat.

It's said of intelligence analysts that they're inherently pessimistic, that when we see flowers, we think of coffins – and that may be true, and part of our business is looking at things that can go wrong, not things that can go right. But let me conclude with a couple of the hopeful things that I think we're working on as we look to food and national security.

One is it turns out to be interesting that desalinization is getting much cheaper. In terms of energy, that's always been the main constraint. So that at least offers some water-poor but relatively rich countries greater opportunities to deal with their water situations. Probably much more important and much more in the spirit of Norman Borlaug, the technology we have before us when we look at CRISPR-Cas9, the genetic editing that's going to be possible. We in intelligence worry about the downsides and the negatives, but that's also going to be an enormous boon to agriculture, as it will be to lots of other human pursuits. And that does, I think, play very much as the previous panel stressed, to one of the great advantages the United States has, not only technological leadership and a lot of leadership in these walks of life, and the ability to reach out to others and help them do better for themselves.

Let me stop there and turn to my colleague, Dr. Rod Schoonover, and he will correct all the things I've gotten wrong and add some more. Thank you.

Rod Schoonover

Director of Environment and Natural Resources, National Intelligence Council

Thanks to Ambassador Quinn and the World Food Prize staff for the invitation to come talk to you guys. It's good to be back in the Midwest. My father was born about 80 miles south from here in a little town, Centerville, Iowa, 5,000 people. I grew up in Kansas City. It's much calmer here than it is in D.C.

So my talk will hopefully provide a loose framework about thinking about how food security becomes a national security issue. I've been looking at Environment and Natural Resources for about seven years now. Before that, I was a college professor. I'm a scientist by training. I hope that this presentation does not feel like a lecture. There are no quizzes afterwards.

So I'm going to weave through a number of..., actually four recent National Intelligence Council products. These are all unclassified derivatives of classified reports. They only differ by a little. Anyone can find them on our website there down at the bottom. The top two are about 30 pages each. The bottom two are about 80 to a hundred pages. Interestingly, the second one, the Global Implications of Illegal Unreported and Unregulated Fishing, was requested by Secretary of State Kerry. It was published just a couple weeks ago. The first one there on climate change I'm going to actually talk about first, because it identifies food security as a national security component. And the bottom two were actually requested by Secretary of State Clinton and USAID Administrator Rajiv Shah back in 2012.

So just a couple weeks ago, we put on our website the implications for U.S. national security of anticipated climate change. I wanted to start with this, even though another document is more explicitly food based, so that you can kind of see how we might tether apart some of the different factors that go into why something may become a national security issue. And so of all of these that we were looking for in the climate change realm... And again we weren't looking at direct impacts on the U.S. homeland – that's a whole 'nother set of issues – but adverse effects on food prices and availability, which I'm going to talk about for a couple slides.

And also the very last sentence or the last bit there – Potential climate discontinuities and secondary surprises, depending on how little sleep you want to get, if you really think about how little we know about climate disruptions, potential tipping points, and how they may propagate through oceans, biodiversity, food and human systems. So I'm going to touch on that just very briefly.

So one of the first parts of our designation of food prices and availability having adverse effects. And again this is over a 20-year period. We were asked to look at 5 and 20 years. This probably is 5 and increasingly to 20 years. But the first thing you think of are the more extreme weather events would significantly threaten ag production. And I'm showing two of those types – one, the floods, and these were particularly treacherous in Pakistan in 2014; I don't think they've recovered yet, in fact. And then the South African drought. And these are just two examples.

And so one of the things I should point out is that this talk is just illustrative of ways that food security may become national security issues. I could spend... We could all spend an entire week or two just honing down every little element.

So we identified, moving away from extreme weather events, that some long-term climate trends would be detrimental as well, such as hot days or very hot days, especially if you have a long string of hot days, changing precipitation patterns, a poleward shift of tropical clouds that's often under-appreciated in the global climate system and its impacts on food prices, and I should say food availability as well.

And so one of the judgments – and again it was in the prior panel and in Dr. Treverton's remarks – we make it clear that, just like food in itself is not a primary driver of insecurity, it's the mess of things that come together, so in this case, weak political institutions, social disruption, etc.

So these are all examples of food riots in the past, I think, five years. And so just to mention Venezuela. There's Mozambique, India, South Africa. And I think food riots are an interesting thing to highlight. They are not necessarily security issues. Sometimes demonstrations and protests are perhaps a reasonable outlet for unhappiness. But one of the things that seems to be true is, once people overcome the activation energy of getting into the streets, and then, depending on what the response is by governmental institutions, perhaps there's an overreach. You can actually lead to a complicated situation very quickly.

So other than food riots and using food as a weapon of war, I want to underscore another linkage that isn't often thought about, and that's, when you have food shortages or food insecurity, you can perhaps open a vacuum for other actors to come in. And so these are two examples where Al-Shabaab exploited (and "exploited" is probably even a weak use of that term) the famine in Somalia to coerce and tax international aid agencies. And in Mali, locals

were enlisted and coerced to participate in jihad so that they could be fed. So just another way that security and security outcomes can come from food shortages.

So hitting on the secondary surprises: So unexpected climate linkages is another way that I would phrase that. And again I'm still talking about this climate change memo that came out a couple weeks ago. So in 2015, Yemen, which was already under a lot of stress from conflict, severe water shortage was experienced. Two separate tropical cyclones within ten days – that's just one picture that I pulled off the Internet – first hurricane-strength storms to hit the country. So the picture on the right represents the aftermath of ten years of rain falling in ten days. So...now, Yemen is perhaps the most water-stressed country in the Middle East. If they knew that was coming, they may be able to build some kind of water storage to capture it, but most of it was washed away. But that's not the unexpected link. That's just part of the predicted, unusual behavior of extreme weather events. Climate scientists say they're coming more with some more intensity, perhaps more frequency, and maybe in places that we don't expect. So that part is somewhat unexpected.

But the “knock-on effect” was perhaps unpredictable to agriculture professionals. The idea of locusts – I mean, this goes back to biblical times. The large amounts of water in the region fueled an unprecedented outbreak of desert locusts. One of the reasons... So that's not something you would necessarily predict. Oh, when the rain comes, these locusts are going to populate. Once you see it, you can. Interestingly, the difficulties of dealing with the locust outbreak, when insects hit crops, the reasonable thing to do is to use insecticide. The problem with that is Yemen (and that's the picture on the right) is heavily dependent on apiculture – is that how you pronounce it? – bees, honey. So they were less able to use insecticide, because that threatened the honey industry.

So I'm going to turn now. I'm putting the climate change document away, because this isn't really a discussion about climate change. It's an important part of it, but it's not really the key piece of this. And we printed or we published this 80-page document on global food security, and it's an intelligence community assessment. I assume if I pass this around, not everyone would be able to get to it, so I'm going to go through the first two key judgments and then expand into a few other topics.

And so basically there are four key judgments to this document. The first one is that food insecurity is increasing, and the scope, the timeframe that we looked was under ten years; and it's a pretty banal statement, truthfully, but we judged that the overall risk of food security in countries of strategic importance to the United States will increase during the next ten years because of... And again the 1 and 2 identified the ways that food insecurity could arise, and one is from food availability, economics, purchasing power, and sometimes or maybe often counterproductive government policies. So, demographic shifts and constraints on key inputs, such as land and water, will compound the risk. I think that that bottom sentence is really important, and I'm not giving it as much importance that I should.

If you look at the global water picture... And so this is taken from our prior assessment on global water security, so this is the projected change in water stress to 2025. So this isn't what it will be in 2025; this is the change from current situations. So if it's already bad now and it has a dark red next to it, it's going to get worse for those parts that we can predict. So there is also other parts, especially human policies and choices that we can't predict. But if you look at just climate and projected water withdrawals from agriculture and other sources, then this is the picture. If you overlay this with a state fragility map, there is a lot of overlaps.

So just this key judgment actually has several lines in it, so my apologies. So in some countries the food security will decline and almost certainly contribute to social disruptions or large-scale political instability or conflict. So the prior panel gave examples. This is just a statement that not only do we think that food insecurity is on the increase, we also think it's going to be a trigger for social disruption. So we have a lot of sources, academic sources especially, that make those linkages pretty explicit.

So it's been said several times already, but worsening food insecurity highlights the inadequacy of government institutions and developmental assistance to improve the resilience of the agriculture sector. I think we're not trying to beat up on the developmental assistance; I think we're trying to recognize that it's difficult to do this with so many different factors. Complicating these efforts, some actors use food security as a political tool – there were examples in the prior panel – and do not seek necessarily increased food security for all portions of the population.

So what's important here? It's not just about from our perspective. It's not just about food availability, it's about food governance also and control of food. And so sometimes, especially in some of the riots, the pictures of the riots that I showed earlier, those weren't necessarily the most hungry out in the streets. A lot of the times when people take to the streets in protest, it's when their standard of living has changed and they don't have any kind of input into those changes.

So in this document we identified the threats to food availability during the next ten years, population growth, extreme weather, climate change, conflict. So I think it's important to note that we look at food as a factor for conflict, and conflict as a driver for food insecurity. Most of these have two-way streets, so diseases and changing disease factors, so both in animals and in plants, resource constraints such as water or soil, environmental degradation, and supply chain breakdown, which I'm going to talk about in a few minutes.

So in this assessment we highlighted the food price spikes in 2007, 2008 and 2010-11. We may have had some unintended consequences in that perhaps some governments implemented some short-term policies that may affect their long-term sustainability, so trade restrictions and some other self-sufficiency goals.

So on food prices and food riots, this comes from an academic paper put together. I think it's off screen, but it's the New England Complex Systems Institute in Boston. So on the left is the food price index. This is the global food price index, and stated are some food riots that became precedents. And you can note that, I mean, all the author suggests is that there is a correlation between the global food price index and localized food riots. We're going to get more into the connection in a few minutes, but clearly not everyone in the world had food riots during this time, and it's actually quite unpredictable to try to predict. That was a bad sentence. It's perhaps unpredictable to localize where these outbursts and food riots may occur. But it's an interesting idea that these things may be coupled. And it seems obvious when you see the plot, but I think it's an interesting thing to watch out for.

So that was all Key Judgment A, so the next is Key Judgment B, and we were asked to look at regions at risk. And so we thought that countries that already have food insecurity-based factors that could worsen through 2025, and again the intersection of food insecurity with governance gaps may result in social disruption, political turmoil and conflict.

And so just to put the focus a little bit more on these elements, the increase in food insecurity is likely to be most prominent in Africa, the Middle East and South Asia. The prior panel talked about the Middle East. We should also be cognizant that a lot of the same situations occur elsewhere. Risk factors will worsen. Again, I hate to be the negative part of the afternoon. That's kind of what we do in the intelligence community. So the increase in risk factors will worsen already-high levels of food insecurity and threaten to undermine governments that do not have... I think that should say "sustainable food security policies."

So most countries with increasing risk of worsening food insecurity are highly vulnerable to production disruptions, resulting from environmental degradation, conflict and disease. And we saw the regions most at risk for this were Africa and Asia and where subsistence in small-scale farming comprised a majority of those people who were food insecure.

So it's an unusual thing for the intelligence community to be talking about food in general. I mean, it's not that... I mean, in the field of topics that we look at, I think it's fairly recent that we have come to food, we've come to water, we've come to climate change, we've come to fishing. And I think we're also getting... Probably everyone else in this room could talk more about soil quality more than the U.S. intelligence community, but I think we do recognize this as a growing factor, soil quality and trends in the loss of arable soil worldwide.

So countries with rising exposure to food insecurity due to purchasing power and local economics and counterproductive governments we identified in Africa, Asia and Latin America. And we saw government leases maybe stoking conflict in areas without well-defined land ownership and regulations.

And so that's this thing. There's a lot more in it, and I urge you to read through it if you're interested in it. It's basically how the intelligence community sees how food becomes a national security issue writ large. We have two more key judgments that I didn't want to go into. I didn't want to bring the good news today – so improving food access and implications for the United States. And we have a number of appendices. One is food supply and demand outlook. Many of you in the room will be more familiar with that. We're going to touch on the food/water/energy nexus next.

There's a little bit about food safety and fisheries. So Dr. Treverton talked about the fisheries issue, and so I know that this is an agricultural-focused summit, but we should be cognizant of the fact that, if the global fish supply were to be dramatically threatened, those people will turn to agriculture; and so they're connected by populations. And so these two graphs come from the FAO, and I'm not certain how closely everyone follows this, but it's basically the plot on the left is a look at the health of fish stocks globally. And so if you see the top, which is underfished, basically (I'm color blind; I think that's green), that strip at the top is representative of where we can expand further to feed a growing population. So that's underfished. Fully fished and overfished means no more expansion of fish stocks. And so when we look at how far up, despite a lot of fisheries' management efforts, we're getting very close, and that goes to 2013; but we're getting very close to the point where, at least from the oceans, we cannot expand the food supply very easily or certainly not very quickly.

And so the plot on the right is representative of where fish is coming from. And so if you look – capture production, that's from the oceans. That has plateaued probably since about 1990. There are other studies that show that that hasn't plateaued, that that is in fact decreasing. But what this tells us meanwhile – and it's not on this graph – is that the amount of fish that is being

produced for humanity is going up, and it's actually growing faster than the population. And so the globe is becoming more dependent on fish. And so this, the largest part of this need is being filled by aquaculture production. And so perhaps there are limits on aquaculture production as well; that graph has not started to plateau. But one thing that we should recognize is that no reservoir is infinitely expandable. And so whether it's the oceans or aquaculture, there will probably be some kind of limits.

So Dr. Treverton talked about the water/food/energy nexus. Many of you know this concept. It is something that is rather new for the intelligence community to get our hands around. I think we're very good at identifying the problem. I think the solution for addressing this particular problem is going to be difficult, and let me go through this a little bit. I don't know if people in the back can read these at all, but basically the idea is that water, food and energy have connections. For example, food for energy has biofuels. Energy for food has fertilizers, etc. So all three of these are connected at the local level especially, and to a lesser degree, but in an important way, at a national or international level. But as important as that framework is – and I think it's very important to really think of these as a system – is that all three of water, energy and food have been identified at least by us and others as drivers of insecurity and conflict on their own. And so water insecurity can lead to conflict, especially when it's shared water. Food, as we have mentioned, can also. And when the lights go out, people will take to the streets. These are three of the more common ways that make people upset with their governments.

But even on top of that, even as useful as this framework is to explain and to get around... And again addressing one of these three in a non-integrated way has the potential to degrade the other two. Even as useful as a framework that that might be, it's still an oversimplification. I think probably everyone can recognize that there is a health component of human and animal. There's infrastructure, there's roads, commerce, gender, labor, biodiversity. There are knock-on effects for all of these, and it's easy for an intelligence analyst to say that these are all connected. It's another really difficult policy to try to address all of these three, these things together.

So just as an example, in most countries – dare I say, all countries – you have a ministry of water, you have a ministry of agriculture, you have a ministry of health. They're never in the same building. They may not even talk to each other. Usually, energy is higher in priority, not always but usually. So just sort of underscoring the challenges in dealing with this water/food/energy nexus, much less the other factors.

So here is a picture from our assessment that makes this a little bit more concrete and why maybe at the local level you may be able to look at this holistically. My feeling, again with some facts behind it, I suspect that we don't know all of those flows in between; I bet very few communities know all those flows. What's missing here and a critical part of this is a recognition of groundwater, especially groundwater that is not replenished very quickly, and how that can be a drag on the entire system.

So these are two... I'm going to pivot a little bit. I'm actually going to augment from the nexus idea and start talking a little bit about the global food system and maybe some emergent vulnerabilities that we may see. And these are two networks that were put together in a NASA study. The one on the left is looking at wheat; the one on the right is looking at rice. It used numbers to get at these nodes and critical nodes. And so my background is in complex systems physics, and when I look at things like this, it makes me think of nerve cells, the way the Internet works, a lot of connections. And both of these, which are very interesting and

complicated and complex – and they're complex in a mathematical way, not just in a descriptive way – are just two representatives of two foodstocks.

So I pulled this – this is a fairly whacky slide – off the Internet. I'm not advocating that this may be accurate. I'm showing it because it's a laudable attempt to describe the global food system in all of the ways. So there is civil security, politics, science security, but most of it is really abstract. And again, as someone who spent a lot of his time in the classroom, took too many biochemistry courses, that looks a lot like a metabolic pathway.

And the reason I'm bringing this up is, again not to get too sciencey on the crowd here, is that complex systems often have new properties that emerge. So an emergent property is a property which the collection has but the individual members do not. So I've given four examples. Water molecule – to talk about it being liquid or gas makes no sense, because it's a single molecule. Another example – a car in itself does not experience traffic; traffic is something that a collection of cars or trucks have. And food networks – if it's really a complex system, and I would argue that it is because of that horrible graph that I just showed you, it's very likely that it has some vulnerabilities that, even if the individual nodes in countries have everything going well for them, it would still have vulnerabilities as a collection.

So, for example, and Dr. Treverton referenced this – A very interesting study from Lloyd's of London, who looked at the insurance impacts of an acute disruption to global food supply. So basically what they were looking at – what would it take to have a real, pretty significant global system shock that people worldwide... So the idea here is – you don't have to be in the country that is feeling food insecure to get the damage to the system or to feel the vulnerability. The increasing globalization, a lot of these connections that are made in the global food system are made as efficiently as possible. Right? You don't want redundancies in your food distribution network – you want them to be efficient. And one of the problems with that is – with efficiency comes brittleness.

And so food shocks have a tendency, or shocks to systems like this, have a tendency to propagate. So what this Lloyd's of London study suggests – you just need a couple simultaneous shocks to the system to produce some rather large perturbations. And this is basically just some kind of modeling exercise, and this won't happen but you can expect that maybe food prices go up for some reason. It may not be clear why they're going up. It may be some link that happened six months prior and no one noticed it, but it just propagated through the system. I don't know if you've ever studied the physics of traffic jams, but oftentimes traffic jams, a shock can go through traffic patterns because someone an hour before hit the brakes real hard when they were looking at the ocean. And that, you know, once everyone sees the red lights, they hit the brakes and it causes a traffic pattern, traffic jam. So something similar to that. That's a really scary idea to us. And so one of the things that I think we want to try to do is try to better understand the global food system.

And so understanding food system vulnerabilities – so just this week, our partners at the National Geospatial Intelligence Agency (they're the ones with the satellites) signed an agreement with the University of Wisconsin at Madison to investigate just this problem – food security, food system data, analytical gaps. We're not going to solve this problem overnight; but once you realize what you don't know, you might be able to fill in some of those vulnerabilities. So this has the ambition to be an unclassified assessment and looking at maybe how the U.S. policy may respond.

Okay, good, I'm done. Thank you.

Ambassador Quinn

So let's have another hand for Dr. Treverton and Dr. Schoonover. So the thing is bringing the structured thinking, and unusual thinking, and way of looking at these issues. And again what we want to bring home to our global food security audience is that, as yields are increasing and the sense of we're doing better at reducing hunger in the world, there are these emerging vulnerabilities. We heard first the political dynamic but now on all the stress in these areas, and all it takes is a couple of them to set things off. And so having the sense of what is possible and what can happen, hopefully, will energize us to be better prepared for it. So you've got an invitation to come back again as you advance this, but we're so very, very grateful for what you've done. I don't know if you have anything to add here. Okay, thank you.