

SCALING UP RE-GREENING SOLUTIONS IN AFRICA TO BOOST SMALLHOLDER YIELDS

WEBINAR TRANSCRIPT

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PRESENTATION

Julie MacCartee:

The session today is being recorded, so if you would like to share it with your colleagues after the fact, or review any piece you will be able to do so. In addition, if you are a Twitter aficionado and you would like to follow along on Twitter please use the hash tag "ag events" and also please feel free to share your Twitter handle in the chat box.

Lastly we will be using the chat box as a way to take in questions. We encourage you to type in your questions throughout the seminar today. Let us know what you're thinking, if you have any resources you'd like to share and we'll be pulling questions up between each speaker, especially clarifying questions and then holding a few also until the end if they're questions that are relevant to all three of our speakers.

All right, just to let you know about a couple of upcoming events we have. On January 28th we will be hosting an Ask Ag Twitter chat focusing on volunteerism for agricultural development and so also our next ag __ sector council seminar for February. We'll focus on drought tolerant rice. And that will be on February 26th next month.

I'd also like to quickly call your attention a special even that is happening next week focusing on nature, wealth and power, with new tools, ideas and approach for changing global environments. This is an event that we encourage you to take a look at. It will be Monday, January 27th at 9:00 am. in the Ronald Reagan Building. And if you click on the slide that's on your screen right there on the registration links you can sign up for this in-person or online. And we've got four great speakers for this event and hope you will join.

All right, now to get things started off I would like to introduce Moffat Ngugi with the USAID Bureau for Food Security. He is our climate change advisor and he will be giving a brief introduction to our topic today and letting you know what we will be focusing on. So I'll pass it on over to Moffat.

Moffat Ngugi:

Oh thank you, Julie. As you heard, I sit on the Bureau for Food Securities, _____ implementation office, and I'm usually working on integration of climate change and natural resource management issues within our Feed the Future program.

As you all know we have the program that was launched in 2010 and one of the key cross-cutting themes is climate change and natural resource management. Today we have an opportunity to hear about some concrete examples of work that's going on all over Africa as well as applicable to the rest of the world that focuses on greening. So we look forward to the activities and please engage us all on the chat box and so on. Thank you very much.

Julie MacCartee

Thank you Moffat. All right, now I would just like to give a quick introduction to our three speakers who will be presenting today. First up will be Craig Hanson with the World Resources Institute. And he is the director of WRI's People and Ecosystems program. He has co-developed a number of the program's project work, including the Global Forest Watch 2.0 and a few others, and he's also managed their Green Power Market Development Group which is a coalition of a dozen Fortune 500 companies that helps pioneer corporate energy markets in the U.S. So he will be up first.

And then we will switch over to Jerry Glover with the USAID Bureau for Food Security who is a National Geographic Society explorer and senior sustainable agricultural systems advisor for USAID.

And then lastly we will be passing it on to Bob Winterbottom, also of World Resource Institute who is the director of WRI's Ecosystem Services Initiative and deputy director of the People and Ecosystems program.

All right, we will go ahead and jump right in, since we got started just a bit late today. And so I will pass the microphone over to Mike.

Craig Hanson:

Thank you, Julie. Good morning and good afternoon to everyone. This is Craig Hanson here. We have a very exciting session today on solutions for scaling up re-greening. What I'd -- the agenda for today's webinar is to briefly talk first about the global food challenge and the menu of solutions for actually addressing that challenge and then dive deep into improved land and water management

impacts, and then really tackle the question of how do you actually scale up the successes that we've been seeing in places in sub-Saharan Africa, and then conclude by having a bit of discussion.

I'm going to kick off at the global level for a moment before we dive more deeply into sub-Saharan Africa and greening to lay out what we are talking here at WRI and some of our partners talking about the menu of solutions to creating a sustainable food future.

Every three years the World Resources Institute publishes' research called the World Resources Report where we pick a topic or theme at the nexus of environment and development that is a pertinent issue of the day. And for the current World Resources Report we've chosen the theme of creating a sustainable food future. We don't do this research alone; our partners in this endeavor include the World Bank, the United Nations Environment Program and the United Nations Development Program and for this World Resources Report. We're also working with two French agriculture research institutions, Shihad and Inra.

We recently published our interim findings, the cover page of which you see here on the screen and which can be accessed through the website on the upper left hand corner of your screen. If you want hard copies you can feel free to contact us and we can send them to you.

The question we are tackling in this World Resources Report is the following: how can the world feed more than 9 billion people in the year 2050 in a manner that advances economic development as well as reduces pressure on the environment. In our view we think this is one of the grand challenges of the next 40 years. So answer that question we believe it requires a great balancing act of three needs: first, the world needs to close a food gap. The world actually needs about 69 percent more calories in the year 2050 than was available in the year 2006 to adequately feed the entire population of 9.6 billion by the year 2050. That's a massive increase in food availability that has not been seen on an absolute basis in the history of humankind.

The second need we have is that the world needs agriculture to continue to support economic and social development. More than a quarter of the world's

population is directly or indirectly employed by agriculture. Agriculture is a foundation for many national economies; it's a means of livelihood for people in rural communities and a means of lifting people out of poverty if done right.

The third need is the need to reduce agriculture's environmental impact. It's interesting to note the share of impact agriculture has across a variety of environmental parameters. Take greenhouse gas emissions, for instance. About a quarter of all the planet's greenhouse gas emissions per year are generated by agriculture directly or by land use change, the majority of which is triggered by agriculture. Or look at land use: 37 percent of the Earth's land mass is used to grow food, outside of Antarctica. Or take water: 70 percent of the world's water withdrawals are used for bio-agriculture, and even more, more than 80 percent of the water that's consumed is consumed by agriculture. So agriculture has a big impact on the environment as well.

What we are doing with the World Bank, UNEP and UNDP and the World Resource Report is coming up with a menu of solutions to create and achieve a stable food future, a menu of solutions that helps close the food gap between now and the year 2050 as well as meets a number of development and environmental criteria, namely helping to alleviate poverty, helping to advance gender equity and the livelihoods of women, reducing the conversion and impact on ecosystems, reducing agriculture's contribution to greenhouse gas emissions as well as reducing agriculture's consumption and pressure on freshwater resources. That's a big ask.

But to create a stable food future, in our view, requires a suite or menu of strategies that meets all of these criteria. Just briefly, and we lay these out in our interim of findings, I wanted to share with you a few of the menu items. On the consumption side we aren't just looking at production; we're also looking at consumption side, you see the four menu items there that we dive more deeply into as being part, in our view, of a stable food future.

One of them is to reduce food loss in waste. About eight months or so ago we leased one of the installments of the World Resources Report where we dove more deeply into this question of the problem of food loss and waste. As you know about a quarter of all the calories generated are lost between farm and fork. That's a massive amount of inefficiencies.

Where food loss and waste occurs in the value chain varies by region. Here on the slide before you see that the vast majority of food loss and waste occurs close to the farm, in production and in handling and storage, say in sub-Saharan Africa. Whereas if you go to other parts of the planet like North America and Europe more than half of the food loss and waste occurs near the fork, near the point of consumption. In fact in North America 61 percent of the food calories lost and wasted occurs at the home or in restaurants. So the nature of the problem differs by where you are on the planet.

This data here comes from the FAO, but it's at a regional level. One thing in our research we've found is countries and companies are starting to ask more and more for information about how much and where food is being lost and waste within their own country boundaries and within their own corporate food supply chains.

And that data doesn't exist. In fact no methodology exists for actually measuring them.

And so in the spirit of what gets measured, gets managed, what we've done is we have kicked off a process in October of 2013 to develop what's called a global food loss and waste protocol. This will be a standardized approach for measuring and monitoring food loss and waste within national borders and within corporate supply chains. We're doing it with a number of partners -- there you see on the screen the FAO, UNEP, we have several organizations involved with the private sector such as the World Business Council for Standard Development. There'll be a global protocol applicable to any country on the planet as well as any company and any corporate supply chain. Just an example of the types of solutions that were starting to develop through this World Resource Report.

On the production side we're looking at both -- on our menu is activities to actually sustainably increase crop yields as well as activities to sustainably increase the productivity of livestock, the amount of meat per hectare that can be produced on the planet, looking at both land-based livestock as well as fish.

In terms of sustainably increasing crop yields, as many of you on this webinar are aware, it's an acute problem especially in sub-Saharan Africa. And as you see on this slide here you're seeing the growth in terms of metric tons per hectare of cereal yields over the past 50 years and the degree to which sub-Saharan Africa still has relatively low yields. This is a pertinent issue we're going to dive into

more deeper today with a set of strategies that could help boost those yields for sub-Saharan Africa.

In the WRR we are looking at a variety of means of boosting crop yields. One is to improve yields to -- leveraging advances in genomics, which is DNA analysis to help advance and accelerate the increases in productivity through conventional plant breeding, and through looking at options such as orphan crops, those crops that are a source of food and nutrition for many people but haven't yet to receive a lot of the analysis and research support that some of the staple crops like wheat and corn have received over the years.

Likewise another strategy on our menu is to improve land and water management practices, enriching soil organic matter, retaining soil moisture through a variety of practices such as agroforestry and water harvesting and the like to actually help boost yields and currently lower productivity in regions of the planet. And we're going to dive into this menu item in a few moments.

The final element of our portfolio is a series of menu items that are about improving the environmental performance of agriculture but through measures that don't necessarily increase the amount of calories produced but do reduce the environmental pressure. We call these, the production items, menu items, including improving livestock feeding efficiency, increasing the efficiency of fertilizer use, and managing rice paddies to reduce emissions especially of greenhouse gases.

If you wonder why we've chosen those this next slide here gives you an indication of that. If you look at the greenhouse gas emissions from just agricultural production directly agriculture contributes about 13 percent of global greenhouse gas emissions currently. If you look at that ruminants, your cattle, your sheep, your goats comprise almost 50 percent of those emissions. The yellow and orange bars on the right hand side. Issues dealing with soil fertilization, fertilizer application are 20 percent of those emissions, and rice paddies along emit 10 percent of greenhouse gas emissions that come from agriculture. Combined, those three areas, ruminants, fertilization and rice are about 75 of the greenhouse gas emissions from agriculture production and hence finding strategies to help reduce those emissions, while still helping to feed the planet are of critical importance.

That's the menu. To learn more about it I encourage you to read our interim findings. The final World Resource Report will be coming out later on this year.

Now we're going to dive deep into one of those menu items, namely the improvements of land and water management. To that I will turn to Jerry Glover.

Jerry Glover:

Good day all and thank you, Mike, for a great introduction to the topic. And I certainly want to thank all my colleagues over a WRI for getting this report organized and on the agenda. It's important to the mission of USAID and many other organizations looking at how we can meet those challenges that Mike laid out over the next 50 years.

For farmers in sub-Saharan Africa, when we say that they, for regional food security needs they need to increase food production that's a big challenge because many farmers in many regions of sub-Saharan Africa face some serious biophysical limitations associated with soil, water and intercepting sunlight, of course important for plant productivity. So we're essentially asking farmers to, in many cases, double their production at the same time that they are rehabilitating heavily degraded lands or lands that are inherently poor to begin with and address the issues of climate change adaptation. And increasingly farmers are being looked to to decrease their climate change, their greenhouse gas emissions.

So as Mike pointed out this is a big ask and farmers are facing what I think are some unique and big challenges that as a global community we need to come together and help offer some solutions.

So my intention today is not to thoroughly cover the possible approaches that the working paper "Improving Land and Water Management" that WRI has produced but just to give a brief overview, identify some of the key challenges in land and water management, and some of the basic ecological principles of why the strategies that we've identified, the four strategies that we've identified, why they actually work in boosting productivity and addressing some of those other challenges.

But first, just to go through some of the key challenges many sub-Saharan African farmers face in terms of soil many of Africa's lands are very ancient.

They're very weathered, some of the key nutrients have been leached out of the system just through natural weathering processes. And then farmers over the centuries, or thousands of years of farming, have withdrawn more nutrients than has been replaced. This type of nutrient mining is quite severe and extensive in sub-Saharan Africa.

The lower productivity that's in part due to those poor soil conditions means that the soil isn't protected as well by plants. So that often increases the erosion. Not only are we mining the soils, we're also creating higher rates of erosion many times. Of course both nutrient mining and erosion is related to the management of water.

When we get low productivity systems we typically get high rates of runoff. So when the rain falls often 70 percent can be lost through surface runoff. Some more than can be lost through deep soil percolation and the soils, if they don't have large amounts of soil, organic matter or clay they can have low potential to store that water.

This all means that too little of the water falling on the landscape is cycled through plants and transpired out. That's where we want a lot of that water to be directed, through the plants. That sponsors plant productivity, capturing sunlight, transpiring water, those are all indications of good plant productivity. Of course the result is if you have small, failing plants on an eroded landscape you're intercepting too little of the sunlight available during the growing season.

Of course farmers ultimately rely on the sunlight and the plants to convert that sunlight into energy for both below ground processes but of course for our above ground harvest. Those are some of the challenges that they face in sub-Saharan Africa.

I'm just going to run through what that looks like, the processes and characteristics. If we start out with a natural ecosystem and some of the characteristics of it we see -- [*off mic conversation*] -- you'll see the five suns I have on this slide. That depicts the sunlight that can be intercepted throughout the whole growing season. For good plant productivity of course you want your plants intercepting as much of that as possible.

Of course the rain falling on the land, we want a lot of that soaking into the soil, being stored in the soil for uptake by the plants and very little runoff, little evaporation from the soil surface. Then native plant communities, typically dominated by perennial plants with deep roots, often three meters deep or more, we have a good environment for capturing that water, storing it in the soil and then having it be released to the plants for high productivity. In fact natural plant communities typically have produced more net primary productivity than our farming systems.

So through farming in most regions of the world, decrease net primary productivity. These native plant communities, very good at intercepting sunlight, managing the water, protecting the soil and accessing resources very deep in the soil.

We've changed that quite a bit with agriculture. You'll see I have two of the suns at the top of the slide partially blocked out and that's because with single cropping systems oftentimes we have no crops growing, even though the sunlight's available, water's available and sun and so on. When you have poorly protected soil surface, low plant growth, much of the rainfall runs off the soil surface, as much as 70 percent, as I said before. Of course that creates erosion.

Many of our main primary crops we rely on for our food calories have fairly shallow root systems, so they're actually only accessing a small portion of the soil volume, and that means their access to nutrients and water is limited. So you get this downward cycle of worsening conditions. The soils are eroded, plants aren't able to generate much energy below ground in the form of plant sugars being released through root activity and therefore you're not capturing much of the sunlight. You have all kinds of problems with land degradation, the need to expand agriculture onto new lands and so on. These are the types of activities we want to reverse and achieve some of those characteristics of the native ecosystem.

We can do it through a variety, a range of approaches based on sound land management practices. This is a slide showing some conservation agriculture practices where crop residues are maintained on the soil surface to prevent excessive runoff, to prevent erosion. This can be a fairly simplified system but still just basic soil management practices can achieve a lot of the benefits that we want.

That simple system, though, may not still capture the full amount of sunlight during the growing season that's available; I still have that one sun blocked out slightly. But we can get a bit more sophisticated and farmers actually use fairly complex systems in their everyday systems. For example here we have an agroforestry system combined with conservation ag where the soil's protected. We're still growing a staple food crop intercropped with perennial legume and supported by my poor depiction of a *faidherbia albida* tree. During the maize growing season it's not growing, so it's not competing with the maize for it is providing some inputs into the system in terms of nitrogen and other nutrients generated by its leaves that are dropped when the maize isn't growing. Again, we have quite a range here that offers farmers much more opportunity to capture sunlight, better manage the water and protect the soil surface. One of the key strategies I think we'll be seeing as climate change impacts farmers more is essentially going deeper into the soil for resilience and greater access to water and nutrients.

Just to begin going into the four different strategies we identified based on the evidence available in the literature and on the ground in the regions we were focused on probably one of the most prominent, most widely known is agroforestry. Trees, with their deep roots, their long lifespans can really introduce a lot of resilience to the system.

In dry years, when no crop is going to be harvested, even under the best of circumstances, trees can provide a range of goods and services that farmers can rely on to get them through those hard periods.

In terms of impact on staple food crops we find a lot of evidence that they can have very positive impacts such as from this study in Zambia in which over a number of years these *faidherbia albida* or fertilizer trees had very positive impacts on maize yields. The trees are providing nitrogen through biological nitrogen fixation, they're mining nutrients deep in the soil, bringing them up above the soil in the leaves and then the leaves fall on the soil surface. When they break down they release critical nutrients that can really help boost crop production.

They also help protect the soil surface, allowing more water to infiltrate into the soil, keeping it from running off, so you get some microclimatic effects there, benefits from the trees as well.

A second one that's quite popular in the developed world and is widely adopted in the United States and in some countries in South America is catching on more widely in sub-Saharan Africa. It comes in various forms in sub-Saharan Africa as it's been adapted to specific local conditions. But here you have a field where you can see the crop residue covering the soil surface between the crop rows. I should not right behind the farmer you see some trees growing in the fields. Those look, to me, like *faidherbia* trees and you'll notice that it's the growing season for the main crop there but there are no leaves on those trees. So they're not competing heavily with the crop. As we'll see, conservation agriculture, like any one of these practices, can be combined with other practices for benefit.

Just as an example, in Malawi if we use conservation agriculture practices -- and I should mention that those typically consist of three components. One is you want to minimize soil disturbance so we go with no tillage or reduced tillage options. The farmer must keep the soil protected with crop residues or with living plant cover. And then there's some level of diversity through rotation or intercropping to get the benefit of multiple crops. If we just go with conservation agriculture you get about a ton per hectare yield boost by switching to conservation agriculture alone.

When you combine it with agroforestry you can get a fairly dramatic rise even above conservation agriculture alone. By combining these strategies farmers are getting good yields and good results.

Another category of land and water management practices that have been critical -- and these might be even more critical in some of the dry regions -- is rainwater harvesting, so ensuring that the rainwater that falls on the landscape is preventing from running off, it's kept on the farm field, and in fact in this picture shown here it's been concentrated in smaller areas because the overall rainfall is low enough that it can be concentrated in specific areas for much greater yields.

Rainwater harvesting doesn't just come in this form but there's a range of examples: the zai pits where farmers can concentrate the water and nutrients in a specific spot for each plant works. There's a range of options under this category.

Again, when you combine rainwater harvesting techniques together, using a range of them, you can get -- farmers often see, multiply the benefits. So in two different regions in Burkina Faso where they were looking at stone burns that were capturing water across larger areas of land, and then the zai pits which concentrate water in much smaller areas, you use those together and farmers see pretty dramatic rises. You'll notice that they -- levels of productivity are still around one ton per hectare, even when those full water management practices are combined. So in many regions we have to even go further and combine those with other fertilizer management practices to get to the levels of production needed to really reduce food insecurity.

Which brings us to the fourth strategy covered in the report -- and again I'm just covering some top level concepts, and I do encourage you to look at the report where many more details are provided. Integrated soil fertility management typically refers to a range of combinations of using inorganic fertilizers as well as organic fertilizers. In these poor soils it's often been seen if you use synthetic fertilizer alone, say urea or other blends of fertilizers without the addition or organic materials those fertilizers are used only inefficiently. Often more than 50 percent of the applied fertilizer is lost through rainwater running off the soil's surface or is leached below the root zones. If you add organic matter to the soil you can get much greater fertilizer use efficiencies. And of course that's reflected in yields.

Just as an example here is some data from, again, from Burkina Faso, showing the combination of integrated soil fertility management with some of those water harvesting techniques as well as agroforestry. So creating stone lines to capture water, that's a water harvesting technique. The farmer-managed natural regeneration, that's one form of agroforestry. The half-moons that we saw in the previous water-harvesting photo, is another type of water capture.

You'll see in all cases when you use either agroforestry or water harvesting techniques combined with integrated soil fertility management -- in this case specifically micro dosing, then you get benefits above those practices alone. Just to go back, in micro-dosing, in this picture you see a farmer applying small amounts of fertilizer to a -- it looks like a maize-based system that's intercropped

with legumes. So the legumes are providing some of the organic inputs to the system while the farmer is applying small amounts of inorganic fertilizers to get the full benefit that we see in these slides in these data.

Finally I just wanted to put a human face on the impact these strategies can have on real farmers. You see Rhoda Mignon from Malawi here in the photo. She and her granddaughter are sitting over a soil pit that was dug in her maize field. The trees there are those *faidherbia albida* trees I spoke about earlier but you can see the tree roots extending deep down, below the maize plants, breaking through some of the hard pans. Her soil was able to soak up and store much more water than her neighbors who did not use trees.

But she didn't just use agroforestry alone. She also used a form of conservation agriculture. In the picture on the right you'll see the maize residue from the previous season there on the soil surface. I found three years of accumulation of crop residues in between her maize rows. So that covers the soil, really provides a lot of weed suppression, a lot of organic material into the soil so that when the rain falls it soaks in very nicely and held in the soil. With this system, using conservation ag, integrated soil fertility, where she's adding her animal manures back to the field as well and agroforestry Rhoda essentially rehabilitated a very unproductive piece of land and is not food secure, economically secure and resilient during the frequent droughts they experience in that area. It also now allows her to use, purchase, improve cultivars and fertilizers to boost her yields even further. So she's reliably getting four to five tons per hectare.

So that just covers quite a range of different options for those four strategies we identified in our report. I do encourage you to look there for the references and for further details. Now the question is how do we scale this up? How do we get more farmers across broader landscapes adopting these practices and meeting these challenges that Mike laid out earlier? Robert Winterbottom will I believe take off from there and discuss some of the challenges of scaling up.

Robert Winterbottom: Thank you, Jerry, and good morning everyone, and good afternoon for those colleagues and others in sub-Saharan Africa and around the world. I realize we've been talking for a while but I do want to quickly go through a few additional points. I see already questions popping up about how these practices can go to scale, so that's what I'd like to dive into.

As Mike has mentioned certainly there's challenges, and it's going to require a balancing act because there are many different aspects, many things need to happen in order to move forward with this menu of solutions. As Jerry has noted, we can do a lot more to shift for a much more efficient production systems that are higher-yielding and that mimic these natural systems and manages agro ecosystems and in the process addressing these land degradation challenges.

Globally WRI and IUCN has estimated that there's some two billion hectares of land that has been deforested and degraded around the world, and area twice the size of China. This could be made much more productive by scaling up a lot of these practices. Just in sub-Saharan Africa there's more than 65 percent of the land that has been degraded from the erosion, from the nutrient mining, the problems associated with these conventional practices Jerry was speaking of. So we see certainly a great need and an opportunity to scale up and bring to more farmers the benefits of these practices Jerry has just been talking about.

As you'll see in the map and the working paper, in sub-Saharan Africa if you look across this range of cropland in Africa where rainfall is about 400 to 1,000 millimeters that's very much the range of *faidherbia albida* and some of these other nitrogen-fixing legumes and agroforestry systems that could really boost yields. We estimate there's about 300 million hectares of cropland in this rainfall range outside of protected areas. If we had a fairly modest level of adoption of these practices on 25 percent of those 300 million hectares and yields were increased by 50 percent, which is quite a conservative estimate based on what farmers have done in some areas, that would produce an additional 22 million tons of food for sub-Saharan Africa. This is something that could have a very significant impact. That 22 million tons could translate to 615 kilocalories per person per day, enough to feed 285 million people.

We need to urgently think about how can we move ahead and see more in Niger where we have 5 million hectares of land that's been restored, that's been made much more productive. How can that be scaled up tenfold or more? Because the opportunity and the need is certainly there.

As we think about scaling strategies we've looked to how it's actually happened in other areas; what have been some of the key pathways or some of the key interventions that really has driven scaling, has led to widespread adoption by farmers of some of these improved practices. It seems that most often there are at least five elements, and these are detailed in the paper, and I'll just go through them briefly for you, but they come around to reinforcing communication,

making a stronger economic case, mapping the potential so that we know and can target where these practices have a high chance of being adopted, diagnosing needed policy reforms to reduce barriers through their adoption and supporting capacity building to really fuel and drive this adoption at a wide scale.

To come to this first key scaling strategy, which is reinforcing communication and outreach. This is an essential one because it really starts with just a much higher level of dialog. There are many farmers out there that are innovating that are responding to these issues of land degradation that are looking for ways to boost soil organic matter to recover and reduce rainfall runoff and to do these other things, and if we have a better understanding by talking, exploring, investigating what these farmers are doing and where and how and that is a first big insight into what can be done to get other farmers to be doing what they've already started to pioneer and innovate and do.

Another way to do that is to actually move the farmers themselves around, take those that have adopted these practices and are benefitting from them and have others come and see them because seeing is believing, helping them learn from one another, farmer to farmer visits has really played a key role in helping these practices to spread. They can also be documented through video documentaries and others. There's been relatively modest investment in doing that but if that's done on a larger scale and there's more effort to disseminate information about that we think that can play a key role. And recognizing the achievements -- the ministries can really sort of take note of this and award villages, highlight them through radio programs that reach even illiterate farmers and that have wide exposure. So there's multiple pathways. Again, the paper talks about all the different facets of communication and outreach. There's new web technologies there in information, communication technologies that help give greater voice to farmers, all of these things can be immobilized to really spread the word and enable and empower farmers to take note of what can be done and to move them forward in adopting these practices.

A second key area is making the economic case. Because especially from the perspective of farmers, they're going to adopt these practices when they see that it makes economic sense to them. It's not too risky and it provides benefits, particularly in the short-term, and it doesn't require a lot of resources that they cannot invest. And that's the case for many of these practices; they have a relatively low threshold of adoption in terms of external resources that are required; it's mainly access to knowledge and reducing some barriers we'll talk about in a minute.

Farmers will invest, but if we really want to bring around government to play the role they need to and the development community we do need to make a strong economic case, which involves fuller accounting of the benefits and then we need to support more research, more efforts to document and to understand, fill our knowledge gaps in terms of how these practices really do impact hydrology, affect water tables, how they contribute to resilience of climate change and so on.

The farmers aren't really waiting for more of these studies but it's important, we've seen, that studies, and making the economic case, can help other stakeholders, particular government and development and assistance to really play their role in scaling up.

A case in point is in Malawi. I was out there recently, talking to the Ministry of Agriculture. They're quite focused. They have a massive program to subsidize mineral fertilizers and they're thinking about different inputs they can provide. We talked to the Ministry of Forestry; they're very concerned about the remaining areas of natural forest and how to manage them better. But very few in the government now have kept track of what's been going on as a result of the conventional approaches and there has been a high level of land degradation, depletion of soil nutrients, the problems Jerry talked about from this focus on tobacco, on maize systems and not incorporating more resources conserving practices. Farmers are struggling to find enough manure, compost to replenish the soil, organic matter.

And as a result many of them have started to do things that we see in Mali, that we see in Burkina, that we see in Niger. Some of the same species, not just *faidherbia albida* but many of the other shrubs like *piliostigma*, *bauhinia*, the *combretums*, the *terminalias*, they're out there, actively protecting, regenerating these trees in their farm fields, increasing the density of the vegetation because they're recognizing that this is a very cost-effective way this farmer managed natural regeneration to begin to address those soil degradation things and in the process produced more fuel wood, produced the fodder they need and generate the other benefits to help them become more resilient and productive farmers, and that mimic the agro ecosystems and follow those principles that Jerry outlined earlier.

So it is under the radar and some of the extension messages don't fully support it yet. So that's, again, an important part is to make the case and convince people to sort of catch up to the farmers in some cases.

Another area is to build on this misunderstanding from that increased dialog and just sort of taking stock of what farmers are doing and why and to figure out where these practices are taking off, under what conditions. And then you're in a position to begin to map and target the high potential areas.

Here you see Gray Tappan, who's well-known for helping us to understand that this farmer managed natural regeneration has already taken off on some 500,000 hectares in the Sino Plains of Mali and he played a key role with some of his colleagues there in understanding the dynamics of the spread of the farmer-managed natural regeneration in Niger. Again, we're now getting a better understanding in the case of Burkina Faso.

For example, zais, the ones that have been championed by champion farmers like Yako Batsuodigo in the area of Wayiguya. This is now probably practiced on some 200,000 - 300,000 hectares, but we wanted to look at how suitable is the landscape for extending zai to a much larger area. So we've carefully looked at the characteristics of soils, whether it's sandy or clayey or hardpan or not, the rainfall ranges -- zai is particularly well-suited when the rainfalls in the area are 400 to 800 millimeters, land cover -- zais of course work well on the cropland, the farmer-managed natural regeneration, can even go on pasture land, population density, other sort of factors that sort of favor or make these areas more highly suitable for the adoption of some of these practices.

And then looking more closely and mapping out all these parameters at a national level, which can't be so easily done when one's looking at the scale of the whole continent one looks and finds that zai is highly suitable on some five million hectares in Burkina. Similarly for farmer-managed natural regeneration the same kind of close analysis of multiple factors led us to understand that maybe 7-1/2 million hectares of land farmer-managed natural regeneration could be extended out on these areas where you have sandier, deeper soils and 400 to 1,000 millimeters.

Given what Jerry was saying about the documented evidence for the boost in yields from these practices extending these practices out to something on the order of 500, 600, 700 million hectares would produce another 2.5 million tons of cereal in Niger -- in Burkina Faso. Again, quite a significant outcome and something we should think about, okay, so how can we make that happen, or facilitated and enable that?

Another case of mapping out the potential is in Rwanda, where WRI and IUCN have been working to assess the opportunities for scaling up agroforestry. You think of agroforestry as already well-adopted but point in fact on sloping lands even more agroforestry or increased density of agroforestry species could be extended out to reduce erosion on flatlands to further boost its contribution to soil fertility and on pasture lands to add additional sources of production of fodder.

Again, this can be estimated and even talk about the economic benefits, which again, plays a key role in making the case to the government so that they provide the leadership and begin to address what's a fourth areas, which is diagnosing policy and institution reform. We've seen that the economic benefits really drive scaling from the perspective of the farmer but there's certain policy and institutional barriers that can really impede or slow down the widespread adoption of these practices. Some of you are familiar with that but they're out there, these factors that can work against it, whether it's insecure tenure or unclear management rights to trees on farms or a heavy-handed enforcement of regulations by a forest department or other things that impeded the market access and undercut what would have been the economic incentives that would drive adoption of these practices.

Here you see stakeholders and included some of these pioneering innovative farmers, the director of the forest service, members of government working on agriculture; they all came together in a workshop last year in Burkina Faso to consider what's been the experience with these practices, how important that is in terms of livelihoods and food security and resilience for farmers and what are some of the barriers as articulated by the farmers and others themselves and how can they be overcome, whether it's revising, making further revisions in the forest code or other things.

Another tool that can be used is something we're pioneering, having looked at key success factors based on restoration experiences, successful cases of large-scale restoration around the world. We recognize that there are lots of different

factors that can contribute to successful restoration. By systematically diagnosing them those factors that contribute to motivating the behavior change or enabling it or to actually implement the actions that help for scaling these things up you can see are they in place, indicated by a green on the right hand column? Or do they deserve some more attention, a yellow, or they're really a barrier now in place as indicated by the red, and something that urgently needs to be addressed if you want to successful scale things up. A lot to be done in the area of institutional analysis and reform.

A final one I'll mention before we go on to the discussion is to support capacity building. This circles back to some of those communication-related activities. It involves getting out and ensuring that there's sufficient support given to supporting peer to peer learning and training amongst farmers, sufficient support given to build the knowledge platform so that the knowledge is gained about the benefits and the effectiveness of these practices, or key things that trigger their adoption.

For example in the area of conservation agriculture Jerry alluded to this, that it's been widely now taken up in many developing or more industrialized countries we know there's certain constraints to it in sub-Saharan Africa but there are also systems where they're overcoming that through a variety of practices like the work of total land care in Malawi. So we can document how they've been able to do it, to get through the transition period, to break over some of those obstacles whether it's retaining crop residues for other practices we know something about how to move forward on this and increase the benefits further by integrating agroforestry and conservation agriculture.

A key factor too is a lot of these systems it comes down to managing the resource base not only on the farm field but in the large landscape and promoting approaches to integrated landscape management. Oftentimes that requires some strengthening of community-based organizations if you want to start to do a better job of controlling the access and use and farmers are going to be quite discouraged to do farmer-managed natural regeneration if they have no ability to make some rules and enforce some rules so the trees they regenerate on their farms aren't just lopped inadvertently by someone or harvested by another person or they run their cows through it, their livestock and degrade it and so on. That's an important thing as well, to build capacity at that local level for those building blocks, those community-based organizations and ensure that those institutions work well.

I'd like to also mention much of what we've learned about what can drive scaling comes from some of these stock-taking activities that have been carried out in Burkina and Niger and other countries and USAID has generally supported that in the past and it's important also to continue to build capacity so that this stock-taking and improved monitoring and assessment and analysis of what are some of the drivers, what can be done to implement things at scale that that's built in to the work of national institutions. We have NGOs that are in this are like Rizzo Marpe, there's national agencies as well. So that's an area of further capacity building so that on an ongoing basis we're doing a better job of catching some of these things that are now under the radar and bringing them out and bringing to the attention of national leaders and others.

A final point is to make sure if we want to go to scale we're going to have to integrate attention to gender. As it is in many of these landscapes and rural communities women lack access to some of the rights and access to information so they need to be -- the special particular needs of promoting gender equality need to be taken into account and the communication strategies and the other scaling interventions. It's been estimated that agricultural yields could be boosted by over 20-25 percent if we just did a better job of making progress with general equality and making the access to the information and the other support more equitably available.

Let me close, then, with a few key takeaways, summarizing from all three of our presentations. We believe that success in increasing agricultural production's going to be dependent on addressing some of these land and water management issues. Right now some 6 million hectares of land are degraded each year in sub-Saharan Africa so we can't make progress if we're losing productive land faster than we're upgrading and restoring it so we've got to turn that around and shift to more productive and sustainable systems by giving more attention to renewing, replenishing soil, organic matter which has such a key role in increasing the efficiency of fertilizer use. Then it becomes more cost-effective for farmers to buy fertilizer and those soil value chains can start to function. Once you deal with some of these fundamental blocks like depletion of soil organic matter and high rates of rainfall runoff and so on. And these practices we've talked about are very cost-effective ways for doing that, increasing trees and perennials in the farming systems and so on.

Another key point is there is evidence -- we don't need to be skeptical about some of these practices. Farmers are starting to adopt them at scale, the evidence has been documented, we know not only are there good results from some of these practices for particularly when they're integrated and particularly when they're combined, particularly when they're mainstreamed, it's not an either/or situation but working it into the other things that we're doing whether it providing good germ plasm or doing other issues to strengthen the value chains and that these farmer-led improvements can be cost-effective and can make a real contribution to food security on a significant scale as well as to resilience and climate change adaptation and even reducing greenhouse gas emissions and that these practices are adding to the resilience because of diversifying incomes and helping farmers to secure their livelihoods.

We've got a lot of innovation and knowledge and progress to build on and there's very clear ways one can invest in scaling them up based on the experience we had and based on what's worked well in other places but we just need to spend more time and thought and effort in the communication and addressing the barriers and building the capacity and targeting these areas and moving forward to support the scaling up.

I'll close there and look forward to your questions.

Julie MacCartee:

Thank you so much, Mike, Jerry and Bob, three really excellent presentations with a lot of information. We have been recording this so if anyone missed any piece of it they can have the chance to go back and review various pieces.

QUESTIONS AND ANSWERS

Julie MacCartee: I want to thank all the participants for your robust comments and questions in the chat box. We've had a lot going by and we've done our best to track the questions as they've come in. I'd like to encourage any of the three presenters if you happen to have seen something in the chat box you thought was worth bringing up please feel to interrupt during this Q&A session and bring that to everyone's attention.

I thought it might be worth starting off with something that was raised by I think at least four participants and that was the issues of land tenure. I thought it would be worth addressing. In particular John Montgomery summed it up _____ advisor with USAID and the **doctor** bureau: "To what extent has this work on scaling thought about issues of land tenure, insecurity and communal use rights, particular for women _____ and disadvantaged groups."

Robert Winterbottom: I'd be happy to make a start. As we look at policy institution and barriers land tenure or security of land tenure is often a key one, and in the case of Niger for example I don't think we would have seen farmer-managed natural regeneration being adopted at scale on some 5 million hectares if USAID and others hadn't been working with the land tenure center over the years to invest in the rural code, which helped to deal with some of the differences between customary tenure and formal tenure. They developed many needed texts to sort of articulate in very clear ways that as farmers invested in land and brought back the productivity of it that that would be a way for them to secure rights to that land.

In addition to working on the rural code there were reforms in the forest code which helped to clarify that as farmers managed and protected trees on farms and they indeed did have the rights to harvest them and manage them and even whole wood markets emerged on these farm lands.

But it didn't necessarily require property titles and such; it's more perception from the farmers that as they invest in the land they are going to benefit from it. And as they start to see more trees on the land this is a source of income for them, it's going to boost their economic well-being.

Julie MacCartee: Thank you Bob for that answer.

Another question that came in during Jerry's presentation: Steve Lynn, who is in Brattleboro, Vermont who is an independent agribusiness consultant mentioned that *faidherbia albida* is a special case due to its counter-seasonality and just asks what about acacias and other legumes. Also he pointed out many farmers demand trees that yield food or market product. Do you have any comments about that?

Jerry Glover: That's a great question. *Faidherbia* is somewhat special in its reverse phenology but there are quite a range of trees that meet other needs that fall into the fertilizer tree category. For example, that last slide I showed of Rhoda's farm, she used five different tree species. Some were very fast-growing but shorter-lived, some were more medium in growth rate but provided great fodder for her animals. Of course the *faidherbia* are much slower-growing, so they were a longer term solution that also provides fuel wood and livestock fodder. So the right tree for the right function and in the right place I think is a key element.

So doing a stock taking of the full range of trees or shrubby legumes that we often use as well, seeing which ones will grow in which location, doing some of the modeling, as Bob pointed out, to look at possible places for interventions, that's all a great way to not see *faidherbia's* special characteristics as a limitation but just one more tool in the overall toolbox that we have to identify where these trees fit in.

Julie MacCartee: Thank you, Jerry.

A question came in that I believe Moffat Ngugi, who's in the room, may be able to speak to, and that is how well to speakers feel that Feed the Future programs have addressed strengthening of local institutions?

Moffat Ngugi: Yeah, I thought I can respond to this one because there's a couple things that may be relevant in the context of what we're talking about today. It particularly touches more on human capacity building. I think through the innovations labs the formal collaborative research programs there are a lot of core ____ and other research capacities that go towards national agricultural research institutes in

various countries. More importantly to ones of institutional capacity-building there's a new emphasis with USAID Forward toward local institutions. I think with fixed obligation grants that various missions are supporting we are seeing that capacities are improving based on -- from research as well as local resources. An example I think is in Zambia.

I think those are two ways that Feed the Future is specifically addressing local institution capacity-building as well as the whole question with sort of a country-led emphasis. So Feed the Future has implemented addressing key national country priorities. So they may not necessarily translate to local priorities but by and large the multi-year strategies were developed to respond to what countries have identified as issues. One of the key issues, of course is institutional capacity-building. That's a quick overview of some ways Feed the Future addresses that.

Julie MacCartee

We had a question come in from Michelle Jennings with the USAID Africa bureau. She asked does anybody know of a dream agricultural policy that promotes evergreening ag and longer-term solutions? What countries are at the forefront in these areas? We've already heard about Malawi, Zambia, Burkina and others that are exemplary. She would love a bit of extrapolation on this.

[Off mic conversation]

Robert Winterbottom: Thanks very much for that question. Fortunately we have Dennis Garrity in the room with us who's been a champion for evergreen agriculture and working at the country level to help some 20 different countries in Africa shift to have a more favorable environment for scaling up some of these practices.

I'd just add that as we move forward and see these restoration opportunities a number of governments have come together and subscribed to what we call the bond challenge where Rwanda's among them, where the national leadership there has said, "Yes, we can practically do border to border restoration and have committed to restoring millions of hectares. A number of countries, I think Niger is probably poised to do this as well. So that top level political commitment is one thing.

Then diving in to say what needs to change if we want to make progress accelerate and make it even easier, enable the farmers to do these practices, there's some key barriers we can reduce. The work in Burkina Faso, for example, that had the leadership of the forest service involved and others. They made some progress but more progress is needed because as was mentioned earlier _____ particularly for women. And even now there's land use where the government on the one hand is saying yes, there are ways we'd like to expand agricultural production and giving out large land grants to people that are in there knocking down trees and taking a step backwards, and other farmers that have invested in farmer-managed natural regeneration agroforestry systems are sometimes losing their land as cities expand and others.

But let me pass it on to Dennis and he maybe wants to speak more directly to that.

Dennis Garrity:

Thank you, Bob. Yes, very briefly I think as you know we've been doing a lot of thinking about dream policies for evergreen agriculture and the scaling up of these great practices in the partnership to create an evergreen agriculture in Africa. I've been thinking about two things as this discussion has gone forward.

One is that part of our dream policy, of course, is the great efforts of many countries now to develop their own national strategies for scaling up evergreen agriculture. Tanzania, Ethiopia, Kenya, Niger, a number of others on the drawing boards. So that mobilizes government attention at the highest levels and it cascades downwards. I think that's one very big opportunity for us. There's a lot of sharing now of these policies.

Secondly, as we talk about capacity-building I think what's riveting our attention more and more is the need to develop a cadre of train the trainers, people at the international, national and local levels throughout the continent because the big problem now is that there's a tremendous amount of real national awareness of these opportunities, but at the national and local levels there is a need for capacity to actually do these concrete facilitation roles at the ground level, and that's our next big challenge.

Julie MacCartee

Thank you so much for stepping in without advanced notice. We appreciate your comments.

We've got a lot of robust questions coming in to the chat box. If we're not able to answer all of them today we will definitely share the chat box transcript with the presenters and see if we can keep a conversation going via Agrilinks and make sure all your questions are addressed.

I thought an interesting question came in also from Jamie Montgomery, climate change advisor in Washington with USAID who said, "I don't see much discussion of how impacts of climate change should be considered when discussing the needs to scale up certain agricultural practices. Will the practices you've all been mentioning be robust under future climate change scenarios and what is the potential for expanding practices that while good in the near-term may be maladaptive in the longer-term?"

Jerry Glover:

That's a great question because in some regions we're seeing the effects of climate change to the extent that farming systems have had to change already. In general -- it's not true in exactly every case but in general the approaches that we outlined give farmers an advantage, a leg up in the face of more radical weather patterns, including increased rainfall events, more intense rainfall events as well as the extended droughts that are often associated with climate change.

In agroforestry, for example, a robust study covering West Africa, East and Southern Africa looking at the effects of evergreen agriculture on yield stability. The stability of yields to farmers is almost as important as overall high yields. So the use of agroforestry, these evergreen agriculture systems stabilized yields, especially in times when there was excessive rainfall.

We can map out to a limited degree now what types of impacts climate change will have on specific areas. But I think the approaches that we've outlined they are I believe robust and in the face of uncertainty about the specific impacts of climate change they over perhaps the surest route to resilience over the long-term. Then as we get more information and are able to refine our predictions and mapping ability of the impacts of climate change we can further adapt each one of those strategies. So overall I think it really does present the most robust, best

bet route to meeting the unknowns of climate change as well as some of the knowns.

Julie MacCartee

Thank you very much, Jerry. We have time for perhaps one more question or so. Please flag it for me if there's something that seems particularly interesting. Go ahead, Jerry.

Jerry Glover:

Yeah, I saw Jeremy Chevalier's question: can wild edible drought-resistant grains be considered for future cropping under climate change scenarios? Certainly the use of some wild species or races of plants is very important in plant-breeding programs. I can think of two cases in particular that USAID funds. One is on chick peas. The investigators went to the centers of origin of chick pea and looked at some of the drought-tolerant traits, some of the disease resistant traits of wild relatives of our crop chick peas, and those can be through plant breeding introduced into our crop varieties to meet the changes expected under climate change.

Another program we're looking at and funding is the breeding of perennial types of sorghum, particularly for West Africa and including Ethiopia as well. So a perennial type of sorghum with deeper roots, more resilient to drought and better protector of the soil all could have great impacts on resilience to climate change.

Julie MacCartee

I also notice that although there was a great deal of enthusiasm in the chat box for the methods you presented there was some concern about labor-intensivity and also a lack of market return for input dealers or other private actors as there is with improved seeds or purchase inputs. Didn't know if it would be useful to address some of those types of concerns.

Jerry Glover:

This is Jerry Glover. Just for my part I think what we've seen in many cases -- well when farmers adopt some of these practices over millions of hectares I think it's pretty clear that the economics were in favor of these approaches. But in the development community we often look to solutions such as improved crop cultivars, improved access and availability of mineral fertilizers, and that's certainly very needed and great. But those often come at a great economic risk to farmers when they use them without these improved land and water management practices. So by putting in place better management of soil and water the farmers actually reap more economic benefits from these purchased inputs: more

efficient use of the fertilizers; that's been shown in numerous studies, and more effective capture of the benefits of improved crop varieties. If your soil holds more water your drought-tolerant maize variety is going to do even better. It's not that they do only -- they produce only under very dry conditions but they actually can do better under moderately moist conditions. So the extent to which these land and water management practices that we've outlined are employed farmers often harvest economic benefits in the form of more effective use of their purchased inputs.

Julie MacCartee

Thank you, Jerry, that was a really great summary of the response to that question. I think we have one more question we'd like to address which is the one at the end from Thomas Summerhalter and we thought perhaps might be able to address the question of livestock's role in farming systems, and how to integrate livestock in some of what's been addressed today.

Mike:

Thank you for the good question. I'm not an expert on this so I think maybe some of the others can chime in as well. The question had to do with integrating livestock into farming systems, where you have the question will you be using residue to do some of the things that Jerry had talked about in conserving moisture and in building up soil organic matter. Sometimes there's tension in that the livestock itself is a consumer of the crop residue. And as Thomas says, livestock is a provider of manure. So they provide soil fertility by recycling some of the residue.

So in the farmers that we've talked with there is tension. Many of them like to keep residue on their fields and they do, and then they try to find other ways of feeding livestock.

One option that a number of farmers use is to use trees. A lot of trees -- Jerry talked about the multiple use of trees. One of the major use of trees is high-quality forage, or high-quality browse. So taking some of the pressure off crop residue to incorporating trees into your production system gives you multiple benefits: you conserve some of the residue. But you also increase the quality of the browse, particularly during the dry season.

I think I'll stop there. Maybe there are some of the others that would like to contribute to this question.

Julie MacCartee

We've got time for just a comment or so.

Jerry Glover:

Just very briefly, places in the world like sub-Saharan Africa, many in those communities need to consume more meat as very concentrated nutrients. Where will that extra food for those livestock come from in the future? I think it's pretty clear that relying only on crop residues from our staple food crops is going to be a big problem. Some of those residues, very important for soil and for other uses. So as Mike just pointed, introducing more perennial-based systems, perennial approaches that can relieve the burden of the crop residues to feed those livestock it's going to provide important food security as well as economic security for farmers to diversify out of sole crop focus.

Livestock typically are much more valuable than the crops that are produced, so it's actually a development pathway out of poverty in many cases to step into livestock enterprises. The only way we're going to do that in many cases is to introduce new sources of feed that are much more resilient to climate change and much more sustainable in terms of land and water health. So I think that many of these solutions outlined today will allow opportunities for much more livestock production, actually.

Julie MacCartee

Thank you so much, Jerry. Well we are running up on the end of our time. If anyone would like to make any final comments feel free. But I think that you've done a really great job at addressing a lot of questions that have come in. Thank you all to our participants for challenging our speakers today.

And I just wanted to quickly draw your attention to a impact seminar that is coming up tomorrow also relating to the topic of scaling entitled, "Overcoming barriers of scale to reach the poor". I just put that link in the chat box in case anyone would like to join that seminar and webinar tomorrow.

But I'd like to send out a huge thank you to Craig, Jerry, Bob, Moffat, Mike and a few other special guests we had here in our webinar control room today. Thank you all for helping us pull off this webinar and thanks especially to our audience; we really appreciate our loyal Ag Sector Council participants and we hope to see you in February on the 26th. So thank you all and we will go ahead and sign off.

[End of Audio]