Smallholder Adoption of Integrated Soil Fertility Management

Audio Transcript

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PRESENTERS

Julie MacCartee, USAID (Moderator)

Jerry Glover, USAID (Moderator)

Keith Moore, Virginia Tech

Ephraim Nkonya, International Food Policy Research Institute (IFPRI)

PRESENTATION

Julie MacCartee: All right, good morning everyone, thank you so much for joining us, both to the – our in-person audience and our extensive online audience. My name is Julie MacCartee and I'm a knowledge management specialist with the USAID Bureau for Food Security, and I'd like to welcome you all to the January edition of our ag sector council seminar series. For those of you who are not aware, ag sector council is a monthly seminar put on by the Bureau for Food Security and the Feed the Future initiative, and put on by our knowledge driven agricultural development mechanism, our excellent team who is mostly there in the back running the webinar.

We are always happy to focus on events that are of high relevance to our ag development practitioners, food security practitioners, our missions. And we're always open for new ideas, so my e-mail will be at the end of this presentation. If you have suggestions for future topics, highly pressing topics that you think would be good for this series, feel free to bring them to me.

For this particular seminar, we wanted to focus on soils because 2015 is the international year of soils. And our Agrilinks.org platform is going to be putting out a whole range of blog posts, of events and resources on the soils topic, and if you're on our Agrilinks mailing list, you will get notified of those.

So we have a lot to delve into today, so we'll get started in just a moment. I always like to remind people to please turn off your cell phones or silence them so that we don't interrupt the speakers. Also just to let you know, this seminar is being recorded for our online audience and for a resource that we'll post on Agrilinks.org. Partly because it's being recorded and partly for our online audience, when you ask a question, we'd like to pass the microphone around to you.

So generally please hold your questions until the end of the seminar, although if you have a burning clarification question, do feel free to raise your hand and we'll make sure to pass you a mic. And let's see, I think that that is about all for our housekeeping issues. So to introduce our speakers and to just give a very brief introduction to the soils topic, I'd like to pass the mic to Jerry Glover, who is an agricultural ecologist with the USAID Bureau for Food Security on our research team. Jerry.

Jerry Glover: Thank you. Good morning, and happy international year of soils. It's great – my background is primarily in soil science, so it's great to see the focus on soils. And in our research work, our development work in Africa, particularly in Africa but also in Asia, many of the biggest challenges we face are around soils. A lot of people don't really internalize the idea that when we're building flesh and

bones and tissue of humans and animals, those nutrients, magnesium, phosphorus, potassium, come from the soil.

And farmers trying to get those nutrients concentrated into plants and in a form that we can eat and consume and grow and be healthy is pretty challenging, especially in these challenging soils that we find in many parts of Africa and some parts of Asia.

So it was great to see these two gentlemen come in to talk about the difficulties that farmers often have in adopting best management practices for soils when they're also trying to, at least in the short term, produce the highest yields, get great economic returns without diverting too much of their resources to building the soil.

But of course, long term soil is very important. So there's often at least the appearance of tradeoffs between the long term soil health and short term economic returns, short term yields. So to look at those tradeoffs and discuss the complexities of it, I'm very pleased to introduce Dr. Ephraim Nkonya from the International Food Policy Research Institute. He's a senior research fellow there and he's done a lot of work on the economics of land degradation, both in Africa and Asia. He's worked on several USAID projects, so he's pretty familiar with our development community.

And then, of course, Dr. Keith Moore, who many of you may know from Virginia Tech and his longstanding work with the sustainable agriculture, natural resource management, CRISP, which is now the Innovation Lab. Keith did a lot of work on that, and actually, just to highlight some of his work, he had – he's the author of this wonderful piece, *The Sciences and Art of Adaptive Management*, looking at some of these tradeoff issues, and the behavior change necessary in small holder households.

I will also say Keith is now the executive director of the Office of International Research Education and Development there at Virginia Tech, so he oversees, helps manage, coordinate the various international programs, some of which are funded by USAID. So his work is very relevant as – so with that, I'll open it up for Keith Moore.

Keith Moore: Well, thank you, Jerry. I need to make a clarification in the interest of proper advertising and all. I'm not the author of the book, I'm the editor, and that is an important issue because it takes all of us working together to solve problems, and we'll probably come back to that topic later, as we move through this.

Let's see what we got on these – that's me *[laughter]*. That's Ephraim. That's the title of the presentation, *Technological Change in Soil Management Practice –*

Practices. Context and innovation, that's what we're going to talk about today. It's based on a 30-year review of the literature and observation of the uptake of soil management practices.

Agricultural in sub-Saharan Africa includes strain by degraded soil, limiting the productivity of small farmers who manage that land. Various practices have been suggested to improve soil fertility, yet despite the potential for soil management technologies to improve soil fertility, studies examining the uptake of these technologies have demonstrated no universally predictive factors influencing adoption.

So we just don't know what the silver bullet is. Integrated soil fertility management is a framework to understand and promote improved practices which will maintain sustainability and improve production. It's defined by Vanlauwe as a set of soil fertility management practices that necessarily include the use of fertilizer, organic inputs, and improved germ plasm combined with knowledge on how to adapt these practices to local conditions, aiming at maximum agronomic use efficiency of the applied nutrients and improving crop productivity. All inputs need to be managed following sound agronomic principles.

There are different parts to this definition that are worth noting. One is the underlining of this significance of local conditions and local context and the need for adaptation. Also integrated soil management – fertility management is not a simple technology, it's a complex one, and we'll come back to that complexity here later. The other part of this definition stresses the scientific nature of the practices.

Okay, so our objectives, how can we better understand what drives small farmer decision making, how can we leverage that understanding to foster innovation in agricultural practices. That's where we're going to go today. We're going to do this in two phases. First, in order to better understand farmer decision making, I'll analytically distinguish between two phases, the process of agricultural innovation leading to changes in soil management.

The first phase is framing the problem, satisfying this context and the consequence choices then that small farmers face. The second phase will address the consequent farmer decision making processes with respect to innovation diffusion and technological change.

Okay, after – we're going to frame the problem here in the first phase, we're going to talk about difference in perception, about what soil fertility is and means to the different actors, primarily those scientists and extension agents, and the farmers. We're going to take a look quickly at some economic factors affecting

the small holder enterprises, and then discuss a bit about faith-based framings of agricultural knowledge.

After framing the problem, I'll turn the floor over to Ephraim, who will provide some concrete examples of the adoption of soil management practices, and then later I'll come back and discuss the paradigm or the changing paradigm of adoption, adaptation and innovation, and then we can discuss the implications for scaling up improved soil management practices.

Okay, farmer knowledge and perception of soil health and soil fertility often differs from that research scientists and extension agents. While scientists measure soil fertility through chemical analyses, farmers rely on visual assessment of crop performance, through chemical analyses, farmers rely on visual assessment of crop performance based on yield. Scientists are looking at the chemicals of the nitrogen, the phosphorus, the manganese and all those chemicals that Jerry mentioned that I can't keep track of, I'm sorry, and neither can the farmer, because they're looking at the output, the yield and the color of the soil, the presence of weeds.

Scientists and farmers have different objectives. While scientists focus on maximizing soil quality for improved production, farmers seek to optimize soil use in tradeoffs with other livelihood priorities.

This all leads to very different perspectives when scientists and farmers meet to discuss soil fertility. Agricultural scientists and extension agents frequently blame the practices of small holders for the degradation that occurs. And indeed, many adoption studies perceive a choice between the traditional perceived as an inferior technology the innovation, which is perceived as the superior technology, universal.

On the other hand, farmers feel their insights and their knowledge ignored in the process. Scientists and farmers, nevertheless, have the potential to enrich one another's knowledge of soil fertility and improve the capacity for innovation. But there are many challenges, as you can see in this confrontation of perspectives, to competent communication.

Okay. The economic context. Small farmers are operating small holdings which are mixed production and consumption units. Farmers’ economic framing of choices is driven by their perception of financial outcome, income stability and food security. Agricultural outputs are only on part of their economic concerns. The farm household's consumption and production activities are inseparable. Off-farm income is often necessary to supplement income and food from farm production.

This and other forms of diversification are measures to protect against livelihood risks. Investment tradeoffs are significantly more complex in a mixed production and consumption unit than in a farm that is viewed as purely a production unit. This creates uncertainty as to the validity of econometric analyses which view the farm as purely production unit. And there's growing but still insufficient research which examines the farm household through this mixed production-consumption lens.

Finally I'd like to take a look for a moment at the role of faith-based knowledge. The adoption of innovations is more than simply a matter of how knowledge is produced and validated in the biophysical and economic dimensions. It also involves farmers' broader attitudes, beliefs and practices. Spiritual and religious beliefs within the community significantly shape how choices are framed.

A person's religious belief help frame a worldview that influences farm management decisions and perceptions of agricultural problems. The promotion of conservation agriculture has tapped into this. Faith-based organizations, international donors and non-governmental organizations have been at the forefront of promoting conservation agriculture in sub-Saharan Africa, utilizing the Judeo-Christian ethic of environmental stewardship, citing biblical texts that place emphasis on caring for God's creation.

In fact, the example of Zimbabwe is rather interesting. The mole board plow, in fact, was first introduced as something to the Christian community as an improvement and a matter of promoting the Christian faith in the country. It was linked together in the process. By contrast, an ex-tobacco farmer who became a convert to Christianity in Zimbabwe developed conservation cultural practices based on a revelation he had.

He noted that in the world of – the natural world, there's no natural process that turns over the soil, that that's a purely artificial thing, so the natural process was to have a bed of leaves and branches and grasses to cover the soil and protect it, which he called God's blanket. And that has been the basis for a good deal of promotion of conservation agriculture across southern Africa.

Some of these practices have been adopted in situations where they were not agriculturally sound, but that's – the point is that religious faith and tying in with it the group nature of that can be very powerful in terms of scaling up production. Traditional beliefs also are an important frame of reference for agricultural decision making.

Okay, so what have we learned so far here? Farmers and scientists see the world differently with different lenses and different objectives. Economic factors shaping integrated soil fertility management choices extend beyond the field and

farm to include complex farm household livelihood systems. And finally, ideologies and religions can be mobilized to help frame integrated soil fertility management choices. Decision making cannot be isolated from its context. So I'd like to stop here, remembering we tried to set a context, and let Ephraim take over for a while. I'll pass you the baton.

Ephraim Nkonya: Okay, thank you. So let me show that we compared the ISFM where there is a combination of inorganic inputs – organic inputs and inorganic inputs, and that we looked at the variance of yields over time. And the first one, this was a study in Uganda and this is a cross-section. We looked at the farmers, the ones who are combining and the ones who are not and the ones who are just using inorganic fertilizer.

But you can see the graph is good, it's telling you that this is the log of yield, which is the strong line, this one, it first declines as this is the log of carbon, sold carbon. Look, it declines and then it climbs up, which is good. We need higher yields. Look at the risks. First of all, it increases, then it goes down. So somebody who has carbon at this level has both high yields and lower risks, which is good. Now let's go to this. This was the simulation, this simulation model, and we looked at different managing practices from the one which is 100 crop residues are retained in the plot. And this one, manure, 1.7 tons and 50 percent of crop residues are retained. And so on and so forth. As you go from left to right, the risk is declining, and this was a 30-year period of simulation, telling you that if you have more carbon in the soil, the yield or risks are reducing, and all those climate-related risks which are very frequent in – especially in dry areas, that's something which is good.

Now, we – you – we also look at the ISFM over long period of time, again, 30 years, this was a simulation, where the farmers are not applying anything over the 30 year period, the yields are changed, declined by over quite a lot. But as you increase the crop residues and manure, and this is manure, it is not showing, but manure plus the fertilizer here, you'll see that it's sustainable over a long period of time. The yields are not declining.

Again this is good new for ISFM that it increases yield, it also reduces the yield risks. All those things are very good. Now, Vanlauwe, who Keith has just defined, he was saying biological efficiency. But we economists are saying the ISFM is also optimal in economics. That you get more money when you combine the two. And look, now again move from left to right. This is all zero, they are not applying manure, they're not applying the organic input, anything, nothing.

And then you return 100 percent of the crop residues and you continue all the way to the right. You see the profit for both rice in the maize is increasing as you

move from left to right. Again, this was something which was done for only Nigeria, and it is only telling us that ISFM is more profitable than the land degrading management practices.

Now, we tried to compare, too, and this is all the study which we did in these countries, Malawi, Uganda, Nigeria and Kenya. We looked and we compared two management practice, one which you're applying the recommended rate of 80 kilograms of nitrogen without putting organic inputs. And then we combine that with half of the rate, which is 40 kilograms of nitrogen, but you put 1.7 tons of manure. Now, look at the comparison.

In all cases, in all countries, the one that you're combining manure and the inorganic fertilizer at half the rate, recommended rate, is more profitable than the one where you are only applying the recommended rate of 80 kilogram of nitrogen without putting manure. This is very good and this is – you're not taking to account the benefit of the reduction of the yield variance.

Again, this is something which is very good, telling us that with ISFM, we can reduce the amount of fertilizer by half, which is very good. Now, look at the subsidies. I'm going to talk about the subsidies. They are not subsidizing their organic inputs, they're only subsidizing one thing: fertilizer. That's it.

This is what we call the unholy cross. Why? Because it is illogical. It should not be like this. We looked at – this was across LSM surveys and we looked at them and we looked at the adoption rate of ISFM. Now, the strange thing is that ISFM adoption rate which is in blue histogram is the lowest. But where the farmers who are applying, nothing, they are the majority. But look at the profit, which is the orange histogram, it is the highest here and it go down as you go this way.

Now why this unholy cross? It's unholy because it is illogical. There – it was supposed to – this – these lines were supposed to be actually parallel to each other, all of them rising, but that's not the case. Something is wrong. Why, why, why? This farmer is asking this question.

Now, we also did a study and this study was very interesting. We went to agriculture extension agents in Nigeria and Uganda. We asked them, what messages do you give to your farmers? The first message was improved seeds. The second one, inorganic fertilizer. The third one was agrochemicals. There as only one percent of the extension agents were saying anything about organic inputs.

So the teachers are ignorant. They are not telling the farmers the right thing to do. If they're not talking about organic inputs, that's something which should be

fixed. And we – maybe let me go back. There was no one who reported to tell the farmers anything about climate change. Again, the extension agent who are supposed to be educating the farmers need to be educated themselves. They are not – they don't have a clue of what's going on and what should be done, and the ISFM that we are talking about, it's something which is not very old. It's a new knowledge, and it's about 30 years old, and before that, there wasn't much talk about that.

So the people who went to school 20 years ago need to go back to school. A lot of things have changed. Climate change came, but this is a new thing, again, that again they don't know anything about that.

Now, the other problem is this: aside from the extension agent who don't give the knowledge to the farmers, it's also ISFM is also labor intensive when you are using manure, that one that we were using. That's also a problem that you have to haul the manure to the house, and then you put it in a plot. It requires animals to transport and also it requires a lot of labor.

That's something which is a problem, and there is a solution to that. In our analysis, we found out 50 percent of the cost of production and, for us, cost of production includes even the family labor which they are not paying but they are – there is opportunity cost of using your own labor, we took that into account. 50 percent of that was accounted for by labor. Meaning that ISFM is labor intensive when you're using manure as the organic input that we're talking about.

Now, okay, these are the results that we were just showing, and we also looked at the gender distribution of adoption rate. We found that women are more likely to adopt the organic inputs but less likely to adopt the inorganic fertilizer, for reasons that we know very well because of poverty and other things. Men are more likely to adopt the ISFM, are more likely to adopt inorganic fertilizer alone.

There is also lack of public investment into ISFM and organic inputs, and we looked at this fertilizer for these countries, it's Malawi, Zambia, Ghana, Tanzania and Nigeria. And they are spending quite a lot of money on this. Look a the subsidies, they are quite generous. This is 60 to 80 percent of the price, almost free, right? And it is only going to inorganic fertilizer, nothing about agroforestry or anything like that.

So this is a problem that our governments are also ignorant. Our governments who are supposed to be helping the farmers, they're also ignorant of the benefits that we have for ISFM. So what could be done to increase adoption of ISFM? And these are the things that will be very, very interesting. We did a study in Malawi, which is – gives the most generous subsidies, and we wanted to look at the incentives.

By the way, I'm an economist and I don't support subsidies, but I go by Francis who say that well, if you can't – God help me to accept things that I can't change and to change things that I can. So even for us economists, I'm now looking at the subsidies that can't tell the governments in Tanzania not to give them, but if they give them what can they do. And that's something which we did in this case. We looked at different – I'm sorry. I'll go back.

What we did, we did the voucher which is given on the condition that if you have planted agroforestry trees, then we are going to give you the voucher. This is something very good, because if they do that, meaning that Malawi now can cut by half the amount of money they're spending on subsidies, but still the yields are going to be higher than the yields they are currently giving, but they're only supporting inorganic fertilizer.

And we also looked at the rate for insurance and also giving them cash. The results are very interesting. The results show that first of all, there was no farmer who did not respond to this incentive. All the farmers said well, if you give me that condition, I'm going to plant the trees. That's very good news.

But one thing which was interesting is that look, compare this, the insurance and the subsidies, the majority of the farmers were actually going to this because of they are used to these subsidies and that's why you see that there's a lot of them who were choosing that.

And the key finding that the farmers were responding to all these incentives, and secondly, the cash payment was preferred even in the cases where insurance was – the premium from the insurance was better than the cash, so again, that's something which is telling us that those insurance and all those things, they are not yet internalized by the farmers. They still don't know them. So that's one of the reasons.

So in conclusion, we are saying that ISFM adoption could be increased by looking – offering the short term training to the agriculture extension agents about ISFM, climate changes and the other new changes. And farmers can strongly respond to these incentives, so we can change the subsidy program currently by giving them on condition that the farmers have planted agroforestry trees.

Now, I talked in the beginning that the ISFM is labor intensive. But agroforestry is not as labor intensive as the manure that I'm talking about. You plant the trees only one year, you're done. You're not going to be hauling manure again. So and the studies have been showing that you can cut by more than 50 percent if you plant what they call the fertilizer trees, the legume trees that fix a lot of nitrogen.

So this is something which is good, does – this is something that USAID, I'm talking to people who influence the policies in Africa, please prod those people to give the subsidy on the condition that there is some agroforestry and – or other organic inputs. It's going to be a lot of benefits in terms of reducing the risk, in terms of increasing the yields and also cutting down the amount of subsidies that they are currently giving. Thank you very much.

Keith Moore: Okay. Let's try this again. We're going to shift gears again. This time we're going to talk about paradigms. We're going to try and do something on the order of 30 or 40 years, 50 years of transformation of how we look at the adoption of technological practices in agriculture.

So it's the second phase, the technological change that we're going to talk about here. The first phase was through – hmm, unlike the first phase, the second phase is perhaps more studied, and the study has been framed and shaped and the way we approach and thought about technological change in agriculture has been shaped by Everett Rogers more than anybody else.

He – I remember coming in here to USAID back in the '70s and seeing his models. It was – it's really shaped our mentality and our psyches tremendously and it advanced us and advanced him, and we'll see some of his progression through time, as well. It was a 1962 book that did that.

We're going to shift from that perspective to an innovation systems perspective that is 21st century, and we're going to do that, we're going to talk about the identity of actors and how our conception of who the actor is and how they're defined, how we characterize them changes. We're going to talk about the dynamics of time, to what extent is time a dimension in all this, and how do actors and innovations change over time. And finally, we're going to talk about innovation and whether innovation is an object or a process, and how – it's through those – considering those three different types of factors in the paradigms we'll see how we have evolved over time.

It's – this is going to be a necessarily really quick and superficial overview, but we'll try and – bear with me and we can talk about it later. Rogers' diffusion of innovations. Basically, the actors were identified by cuts underneath the bell curve. We had innovators, early adopters, early majority, late majority, laggards. That's how we characterized actors.

Based on the timeframe. Time is only relevant as its passing alters the percentage of the population that has adopted the technology. And innovations are seen as transferable static objects, unchanging. More dynamic models. They recognize change over time. The process – there's been more processes of adoption modeled in various econometric designs as well as others.

These approaches have emphasized changes occurring over time in learning and in market conditions. They recognize the influence of market networks and relative market positions and realize that early adopters change the landscape for later adopters. Isn't that the same situation anymore?

On drawing on agent-based models, technology diffusion could be modeled in a landscape over time. We've got some interesting stuff that's going on that really looks at landscapes and how the different parts of the landscape receive new practices.

However, most still assume that the innovation itself does not change. That's – the – that things are being adopted without adaptation. Adoption, adaptation, those are the two words we want in our heads and we want to lose the word – I did this at the Soil and Water Conservation Society at the beginning of the last phase of SANREM when we went to conservation agriculture, said we want to get rid of that word adoption, just forget it.

Adaptation, that's the word of the 21st century. Over time, we've come to learn about the importance of actor interactions and social learning. This alters our categorization of actors, from various classes of adopters to innovators and imitators. Those that are performing different roles. So the actor performs roles, it's not just a static thing that is cut off in a percentage of when something happened.

Heinrich, in 2001, explored this dynamic, arguing that biased cultural transmission was the predominant force for diffusion. And that is copying others who are perceived as role models. This could be because of prestige or similarity, charisma, there are a number of different factors that may be involved in a particular process.

Heinrich argues that the purely environmental learning, where decisions are based on something like cost-benefit analysis, you calculate it, you've got it, you've got the answer and so it's – creates an R-shaped curve, like you see on the right here. This R-shaped curve is – the inflection point is at the beginning. The rate of adoption, if you like, the frequency of the trait and the population increases rapidly at the beginning and then levels out.

Most situations, however, are best expressed by the S curve over here, which is the cumulative density function of the earlier shown bell curve. And this is because there's a long tail at the beginning. There's a slowness of initial adoption relative to the rate of – which individuals will imitate previous adopters, and then it accelerates later on, if it's going to pass through the entire population or through the population that it passes through.

As the frequency of a trait in the population grows, it becomes more valuable. Thus the prestige of the initial adopter can influence the popularity of an idea of practice. This also pertains to the influence of religious groups on small farmer adoption, as well.

The social network findings of Granabetter demonstrate that economic behavior is embedded in the network of interpersonal relations. So we're moving from the analysis just a simple adoption of innovation to some other factors, some other learnings that we've learned about the dynamics of interaction and social learning.

Successful adaptation of innovation practices appears to involve vast networks of relationships that reinforce certain sets of knowledge and beliefs and behaviors and not others. From these agent-based theories and models emerge the perspective where networks of farmers and other stakeholders interact and technological innovation arises from that interaction.

Here the concept of social move – learning moves beyond the idea that actors are influenced by one another to the notion of stakeholders coming together to collaborate for the purpose of technological or institutional innovation. This leads to the discussion of a broadened conception of what innovation is.

Recognizing that integrated soil fertility management is a complex technology, we can see the relevance of Rycroft and Kash's work on innovation systems in the 1990s when we're looking at industries in general and what constitutes innovation. It's huge literature out there to take advantage of. And one of the key things that they noted where the continuous innovation of complex technology can only be carried out by diverse groups and individuals that are parts of communities.

Some studies move beyond the studying of the diffusion of static innovation to the study of the innovation process itself, describing innovation as a reflective and continuous process in which actors seek to maintain equilibrium with a constantly changing environment.

They're doing contingent decision making, it's not a static moment that you can capture and model at that time. As things change, as climate changes, as the market changes, decision making must adjust and adapt.

Sarin Campbell described the process of innovation in terms of adaptive management and social learning, recognizing that knowledge is a fluid, constantly changing outcome of socio-material relations. Recent work has

applied this revised conception of innovation that comprises institutional and organizational change.

Okay, in exploring the second phase, we've identified a paradigm shift which offers new conception of actor identities, time dynamics, innovations and the relationships between them. There's a greater recognition of the role of actor interaction and social learning. A deeper analysis of time dynamics reveals that as time progresses, innovations themselves are adapted to fit changing needs and conditions. This has led to the shift in the perception of innovation as an unchanging, diffusible object to an ongoing, dynamic process. Within these processes, there is not a single moment of individual decision making, rather a continuous process of group negotiation and adaptation.

So soil management is in complex, adaptive systems, involves constant adaptation to changing climatic and – conditions and markets. All partners are learning and adapting simultaneously. It's an interacting network and system that's moving forward through time, changing as it moves.

We still recognize the farmers as the key actors that we want to focus on, but we take them in their context and the elements that shape their decision making. So how does this innovation system paradigm change our approach to fostering technological change in agricultural?

Innovation networks and platforms foster social learning and a collaborative, farmer-driven innovation process. They are the forum for negotiation between local and scientific knowledge, which allows innovation to become a result of the negotiation.

Innovation networks emerge when different actors realize a mutual desire to improve a project or process. They're composed of farmers, farm organizations, extension, input suppliers, researchers, agencies, policymakers, and many others. Strong networks foster access to knowledge and physical inputs, increasing farmers' access to options. Strengthening network ties improves the flow of information between local actors.

Innovation networks may form organically or be deliberately constructed. Innovation platforms are deliberately formed innovation networks. Innovation platforms create an environment that fosters the process of innovation by assembling a variety of stakeholders to identify and resolve systematically interdependent issues in a production network.

Essential to innovation platforms is the role of the innovation broker. Innovation brokers are needed to catalyze the process of innovation. A broker is an individual, an organization with a neutral role in the system who fosters

collaboration. Innovation brokers are needed to listen, mediate, and coordinate various stakeholders. That is to help translate, help facilitate communication, to make communications competent. Okay.

As Ephraim was saying, the extension agents need to go back to school. Unfortunately it's not that simple. We need to start thinking about what we're talking about in school. I guess the critical thing is that agricultural extension agents are trained in conventional production practices in the first case, that's what Ephraim's point was, and that they're – the way they're taught, the way they're taught science is as a matter of facts that they memorize. The educational system is a memorization system so that science is something that you memorize and then you can tell people forever what it is, without it ever changing.

This is the core of the – this communication problem. We've got wonderful science of how we can prove soil fertility management. We've got farmers who are doing their best to survive on – with multiple economic demands and resources, and we're not really talking really well with each other.

So we need to develop agents who are skilled facilitators, negotiators, linguists, translators. What do they need to be doing? They tend to be formulating messages to influence stakeholders and that scientific knowledge needs to be credible, salient and legitimate. Listening is perhaps the most important skill. We've traditionally favored credibility and science. But is the message salient, is it relevant, does it answer a question that a farmer has.

Is it legitimate or fair, does it really take them into account and recognize them and what they know and build on that. Serious negotiation activities will involve translation and are required to assure the participation of multiple stakeholders from various audiences simultaneously.

Okay, so local context matters. At the beginning of the presentation, I proposed that small farmer decision making could be analytically differentiated into two phases. The first frames the problem, revealing the local context, local ecology, knowledge, household livelihood strategies, belief systems, networks, leadership each play a role. These factors, however, do not come together in any universal fashion, replicated from one situation to the next, as efforts to scale up technological fixes often assume.

In the second phase, I showed how our conception or paradigm of innovation and technological change in agriculture has evolved. Over the course of – since '62, that's over 50 years. This leads to a new understanding of innovation and a transformation of the meaning of adoption to that of adaptation. Because innovation is no simply an individual act, but part of a process of social learning, individual – involving a multitude of partners and adaptation to changing

circumstances. Support for building innovation platforms for integrated soil fertility management becomes self-evident. A challenge to implementing this lack is the lack of trained innovation brokers. Thank you.

[End of Audio]

Questions and Answers

Moderator: Thank you so much Keith and Ephraim. You said a lot of great information into your allotted time, didn't go even one minute over, so excellent job. And now we have about half an hour for questions, comments, discussion with our presenters from the audience, and we'll alternate between our in-person and our online audience for questions. And I see Laura has one right here. And please state your name and organization, if you will.

Laura Schrag: Good morning, Laura Schrag, USAID Bureau for Food Security, and thank you so much for the presentation. That was really interesting. So you talked a lot about the need to reeducate extension agents to sort of get integrated soil fertility management more accepted and adopted among small holder farmers. But I'm wondering, in the 30 years of work that you sort of explored, has this worked? Like when you educate extension agents, is it more adopted? Like what does the data say about that? And I ask that question because you merely put an emphasis on that, but it seems like there's a lot of value in reframing the question and thinking about if this is a free – if – that you talk a lot about organic matter and it's a free input. So what are the other constraints, then? It seems like small holder farmers could – should've like – they're smart and they want to get the most out of their effort, so it seems like there are a lot of incentives for them to figure that out and know the value of it already. So I think about like the example in Niger where what it really took was a change in the tree policy. Or maybe the organic matters just aren't – isn't really available. So even if you educate the extension agents, it might not solve the problem. So I'm just wondering your thoughts on that. Thank you.

Keith Moore: Okay, well I don't think that we've seriously addressed the question of reeducation of extension agents. Just – that's – I'm working currently, Virginia Tech has the Innovate project that works on education. It was the third of the three of this tripartite focus that it starts bringing back the whole idea of education, research and outreach in agriculture to USAID. I mean, this is a big movement that's just restarted at USAID, huh?

And it – the education one. The innovATE was the last of them. We don't find a lot of support amongst the missions to support agricultural education. But the essence of it is if you've every really been out there with farmers and extension

agents, you can see and feel the gap between them. They tell – the extension agent has an education, has higher status, and does not accept the value of the farmer and what the farmer has to say and brings to the table.

That gap is enormous, and what we've done is we've got educational systems throughout Africa, throughout the world, but particularly in Africa that is really based on memorization of facts, and we're telling them that's science. We're telling them from our programs back here that they're doing that and that the system of education is to read notes that they got from their professor 30, 40 years ago.

That's – so but it's a memorization system that's going on. We have to address that at the heart of the communication system. Science is not memorized facts, no matter how good those particular facts may be in a particular circumstance. It is an approach to investigation and discovery and testing of hypotheses. And that's where we need to be addressing things to, to transform whether the uptake of really good ideas that soil scientists have about how the soil works.

But they've got to be communicated and translated to the farming population, and currently we're – we don't have the types of people to do that.

Laura Schrag: Thank you, I think I'd agree with all the points that you just made, so maybe I didn't rephrase my question quite right. I guess my question is if you did the experiment where you educated the extension agents on integrated soil fertility management, and then they went out and you had a control group where they weren't educated, would you see much higher adoption of integrated soil fertility management, or would you not see very high adoption and is that more likely due to issues with policy and sort of the lack of the inputs that are necessary for the uptake of these great practices that you're recommending.

Keith: Short answer is that if we did – we do this experiment that you suggest, we could then actually test the policies in a – with an environment that was better controlled.

Ephraim: Maybe let me add some few lines. You talked very well about this memorization and stuff like that. There is also – okay, there is also a new approach to extension services. By the way, the word extension services is a one-way approach that there is a teacher and a student. The new approach is two-way. It's advisory services where there is learning from both the farmer themselves and the extension agent.

And this is they are calling it advisory services, and we come very close to your paradigm which is very interesting, that when you go to the farmers, you are

going to be learning a lot of things. They are – have a lot of things that they know about the environment that the extension agents didn't read in the books.

Now, we did – it was in that experiment that you are talking about, about extension agents. When we asked them the messages they give to the farmers, the following question was actually related to this ISFM, climate change and all the things about their knowledge and all that. They didn't know. That's the unfortunate thing.

So had they known that, they would have talked about it with the farmers, but now it happened that they didn't know. Then we asked the farmers, where do you get the – I mean, knowledge about climate change and all that. They said the radio. I know what they get from the radio is the weather tomorrow. It is not about the climate change that we're talking about. So there is a knowledge problem and when it is addressed, I believe that is going to address partly this problem.

You also cited the Niger case. This is my baby. I mean, it – the government didn't invest anything, but it provided incentive for the farmers to protect trees and plant trees. It happened. We saw that it grew throughout the Sahel. So it doesn't begin and stop at the extension, it also goes to the institutional changes that are also required to have this done.

Moderator: I can see there are lots of in-person responses to this, but we also want to make sure we throw it to our online audience, so we'll go there first and then come back here.

Male 1: Yeah, we've had a pretty lively discussion online with 120 people joining us for today's webinar. There's been a lot of discussion around agroforestry, and one of the first questions is we have Rachid Serraj would like to know are there resources and/or evidence for how integrated soil fertility management or agriforestry overcomes the labor constraints. And to kind of tack onto that, Woody Navin, a USAID advisor, was particularly concerned about factoring in labor costs for planting agroforestry trees.

Keith: I don't have anything particular. You address that first, go ahead.

Ephraim: Yeah, this is very good. Agroforestry, I believe it doesn't have a lot – planting a tree, it doesn't take a long time to do that. You can do it in one day. But getting the seeds, there is also a problem on market of the agriforest planting materials that that's something which is a bigger constraint than the problem of labor. You plant it and those are trees that they take a while, about three years, before you can even see the returns to those agriforest trees.

At the beginning, they can take away part of your land and you're not going to see the benefits maybe for about three years. So there is also a need to be providing incentives for the farmers to be able to plant those trees and wait for about three years before they can – they can benefit from that.

And that's why I think there is a need of having these incentives that they can be provided so that they can be able to invest in their agriforest trees. So the short answer is agriforest does not have a very serious labor problem, because you plant the trees, it's there, you're not going to be planting every year. But there is the problem of long term investment that is required at the first three years, you may not see the benefits of planting those trees, but you're going to see those benefits maybe three years after.

Male 1: Okay, a great question to add on to that would be Mary Allen from Practical Action wants to know how many years to the planted trees need to survive to get those cash vouchers?

Ephraim: The survival rate, again, it depends on the areas where you're planting the trees. For example, the Saharan region that Laura talked about, we – in our study that we saw, the survival of the trees was low, but in areas which are humid and sub humid, the survival rate is quite high, if you keep the animals away *[laughter]*.

Moderator: All right, we'll come back to our in person. We'll come here, I'll get you next.

Suzanne Poland: I'm Suzanne Poland from USAID, the Bureau of Food Security. I'd like to make a couple of comments. First of all, I agree with a lot of the things you said about needing for reeducation or in service maybe for a lot of extension agents.

I happen to be the AOR for the modernizing extension advisory services, which is the companion for the Innovate, which works with extension agents. And the ag innovation systems paradigm is exactly what is being promoted, and MEAS is coming up with a – through our – one of the consortium members, Catholic Relief Services, a group of pocket guides for extension agents to learn about how do you work with farmers in terms of adapting to climate change.

So this is on the radar screen as something that's coming up. I also would like to go back to my personal experience in terms of US adoption of soil conservation and other things. I think Laura's point, again, if you look at in the '60s and the monoculture, fencerow to fencerow, corn and soybeans. And some of the soil conservation services, not just extension agents, but the US had a soil conservation system with agents out there working with farmers to adopt soil conservation plans and watershed management.

I know even to this day in our family farm in Iowa, my father was one of the first, he was a soil conservationist and one of the first to adopt the terracing watershed management, the grassed waterways, all of the other good practices, and no till. Still one of the few in the watershed with those innovations. So I don't think it's just a matter of the extension agents.

Moderator: Keith has a quick reply.

Keith: I think that I probably misspoken to some extent by just talking about extension agent. Everything we've said, I think, is relevant to extension agent, but what I'm talking about are innovation brokers. And that's a broader category. The extension agent is a real big, important part, and I'm really happy with what MEAS is doing with that. We need to do more.

But I worry about the US example. The history of extension and the land grant system in the United States, if you look at back when it really got set up, it was really the sons and daughters of the farmers who went off to that local state college or university, that land grant school, and came back to help their parents' generation farm and then take over the farm themselves.

They were the same people. They were integrated into the rural environment and they talked the same language, status differentials were not existing to anywhere near the – particularly in Iowa, one of the most homogenous states in the union and maybe in the world. But it's – a lot of leaders came out of Iowa nationally for all sorts of things, so it's a really good thing, the Jeffersonian idea is not bad at all.

The problem in developing countries with small holders is that they are not monocropping farmers, number one. The economic basis and the economic decision making that all these wonderful models tell us about assumes that framework, and that's got to be a – thought through a lot more carefully. And a lot of the modeling does try and take that into account, but it's really tough modeling.

Because you're trying to objectify a lot of things that are contingent decisions on the part of a small holder, man or woman, who's managing their part of the household, and so that it's not the same dynamic that's going on. That you – the decision making that farmers make in the United States to adopt these practices, although it's been challenging too, is in the context of a monofarming.

The other thing I want to come back to real quickly and then I'll just stop talking for a while, is that the network I'm talking about is highly inclusive. We're talking about those policymakers, too. There's a good article came out, can't remember, I think in the American – no, *The Association of Extension* –

Agriculture Education and Extension, back last year or so, but in anyways, it talks about three different networks that are really critical. There's the local network amongst the farmers, there's a horizontal network that scales out the technology, and then there's a vertical network that works on the policy and linkages to the higher levels, generalized of the system.

And the people involved in those three networks are not necessarily the same. Unfortunately, the research is based on a Dutch example, so it may not be quite as appropriate, but the idea that there are different networks components that need to be managed, that it's not just at the farm level and the farmers that we need to focus on. It's everybody involved. They all gotta be on the same page.

Moderator: A question from online.

Male 1: From John Russell at – a principal at Eco Food Systems. He'd like to know can the speakers or any participants point to references on multilocation, multiyear studies on the profitability of integrated soil fertility management in small holder systems. I guess if not like a specific study, any examples?

Ephraim: The presentation did, they covered several countries and we are currently doing a study which is covering the whole globe, the economics of land degradation, and we did in Bhutan, we did it in Uzbekistan, quite a number of countries. We have 11 case study countries. In all the studies, the results are quite the same. So what I can send a site to this study that is coming. We're going to publish a book, middle of this year, it's going to come out and it's going to be published by Springer. All the case studies that we do have them in that book. So I'll point out the link to this study that we're doing.

Moderator: And along similar lines, if you are aware of any really useful resources, I forgot to put up the contact information, anything you'd like to highlight through our Agrilinks.org platform about soils or about ISFM or farmer behavior change, you can feel free to e-mail agrilinks@agrilinks.org or e-mail me and we'll make sure that it gets disseminated to our audience. I'll pass it over to you.

Michael Ketover: Thank you for the presentations, my name is Michael Ketover, I've had the privilege and the heartburn of managing the resiliency in northern Ghana program for the last few years, and it's not an agriculture focus, but it's Feed the Future funded. I've got three quick comments please.

First of all, I think every year should be year of the soil, so I just want to put my bias on the table. And that's based on the data and my own perceptions of what's worked in the field working at the field level. I was a bit bemused by the lack of focus on green manures, lab-lab and macuna that actually produced the biomass that we're really looking for. I think the manure limitation is something that we

know and we've had good experiences, especially in Central America, with the green manures. Managing it is another issue, but they can certainly produce the biomass, one.

Number two, with RING we are training again extension agents, and it's a modest component, on soil improvement before we give them the improved seeds, and that's a slow process and we're working with the poorest of the poor but we're also working on the way that the agents are interacting with their clients, on more of the supportive supervision. And we agree that they just don't have any concept of soil improvement, and we can – we have an opportunity there.

And the third thing is I went to a BFS Feed the Future conference in Senegal when I – a couple of years ago, and for the five days, there was virtually no mention of soil improvement, soil conservation. The focus, as we know, is on seeds and on the other inputs, and I don't think any of us in this room are anti-chemical fertilizer, but throwing it on organic soil that's rich we know produces a better product. So of the 500-plus indicators that Feed the Future is sharing with us, one would hope that there could be a stronger emphasis on this topic. Thanks.

Moderator: Thank you for your comments. All right, I think we – we'll throw it back to our online audience and then I'll come back over here.

Male 1: Okay, this question is from Elizabeth Dunn, directed towards Dr. Moore. Would you please talk a bit more about innovation brokers? Do you articulate them as external actors?

Keith: Innovation brokers. Innovation brokers are someone who has an opportunity to bring people together. And this is most important at the local level, but they operate at all levels. The social innovation people are good at this at multiple levels. What it needs to be – it could be an extension agent. It could be an NGO leader. It could – it's that champion that many of you have run into somewhere or other.

They have to be a little bit selfless, because they've got to be perceived as neutral. Because when they're not perceived as neutral, whatever they come from or whatever their agenda is according to how the locals see it will be seen and calculated into the way they're reacted to.

So innovation brokers need facilitation skills. They – it's the soft skills that we're learning more and more are required to do any job in the modern knowledge society. And what we're talking with a complex technology like integrated soil fertility management is a knowledge society type of technology.

It's complex, it requires information, it requires many different partners to be able to do this. The innovation broker is the one who can translate, who can move between different groups and find ways to bring them together at the table. There's the idea of someone how knows how to hold dinners. In fact, in the book that Jerry brought, we have a chapter on just how do you hold a dinner and how do you invited everyone into that.

Moderator: Jerry had a couple of follow up comments.

Jerry: Yeah, just a response. I appreciate your comments and the RING project is a great project in northern Ghana. But these issues, these complex issues of soil fertility management are challenging in both – from both the domestic political landscape, so to speak, and even with national governments. I think it's so much easier for people to grasp the idea of fertilizer and seeds, and so we often – that more industrial approach is often emphasized, because it's just very difficult oftentimes to convey how we're going to scale up or scale out, widen the adoption of integrated soil fertility management.

I mean, it's – I think that's one of the reasons that we see this. Initially when I came in, in often wondered well, this seems like a predominantly industrial approach that's often promoted, but yet when you talk to people individually within USAID, they acknowledge and appreciate the concerns that you raised about soil not being raised high enough, and I agree. It's not a commodity, it's not part of the – it's not seen as part of the value chain. It's much more difficult. It goes beyond people's preference for what they want to see and more how things are communicated oftentimes.

It's not always the case, but anyway, it's a challenging topic. Which may lead into the innovation platform idea that we are widely adopting in our more systems type of research, and you talked about these different networks of people, horizontal, vertical, all over the place, and I do think that that's a very interactive – it seems like. I'm hopeful it's a very interactive process to get away from this one-way interaction between extension agents and farmers. And the additional problem is not just having extension agents go back and maybe update their learning, but just having extension agents at all or extension agents with resources to reach the farmers.

So putting these innovation platforms together that focuses on enabling, empowering extension agents, and have – bringing them in with farmers on an equal footing rather than on a teacher-student type of basis. I think – I'm hopeful. So I'm wondering from your perspective, Keith, in terms of the scale of innovation platforms, does it need to be very local, regional, I mean, are there national innovation platforms, are – what's the direction there?

Keith: Innovation platforms, it's a really catchy – and they're at all levels. And indeed they should be. You need national innovation, you need people coming together to discuss these policy options and doing the research that is broader based to see what are the incentive systems that are going to kick in best.

You need – and this is the question that you ask earlier about will ISFM really be the thing that's adopted, if you actually set up an innovation network platform at the local level, maybe not, actually. Because maybe in the discussions between the farmers and the innovation brokers and their local market connections and input suppliers, they find out something else is really the problem that needs to be solved, and if you don't solve that problem, you're never going to get to the next one.

And when we come in from the outside with our solution, it may not be the problem that is relevant that needs to be solved. And the – so that the importance of this is we've got to have the messages on integrated soil fertility management, emphasize the soil, that's got to be one of the key roles that's brought to the table in these innovation platforms, that expertise. But it has to be done by listening to where it's relevant and how you're going to get there from here. Not how you're just going to get there, but how are you going to get there from here, and that's around the table that that discussion occurs.

Sanrem, S-A-N-R-E-M is – you put that into your search engine and you'll find the Sanrem website, and it has quite a bit of references. The last five-year phase was on conservation agriculture, there were projects in seven countries around the world. You've got some of the comparative work that's done there to take a look at, for those who are looking for those references. Okay.

Moderator: Can't be able to get to all of our questions today, we have about six or seven minutes left, but we'll try and squeeze in as many as we can, and feel free to stick around for additional networking.

Curt Reintsma: Excuse me, hi, Curt Reintsma. I particularly appreciate this discussion and thank Laura for kicking of a lot of these questions, and appreciate the understanding of the complexities of a household decision making process that goes into all of this.

It just occurs to me that getting the message right and bolstering retraining public sector extension services may indeed be helpful, but to the extent that the basic incentive structure for those agents themselves is a problem, lack of resources, lack of incentives, lack of accountability, all of those sorts of things.

I'm just wondering in your experience, have you ever had the opportunity to compare private company delivered extension services vis-à-vis public sector extension services, and I'm not – where the incentive structure might be different

for the agents themselves. And I'm not advocating that we abandon public sector extension by any means. So just that caveat.

Keith: I think that the work on that, and that latter question, a comparison of public and private extension services, to make it simple, can be elaborated in a lot of different ways. I don't know of any particular studies as such, and – but I've not studied that in particular. But what I've seen and heard is that certainly I've seen with the NGOs they are much more motivated when they're paid better.

They have some of the similar types of top-down sort of perspectives, and that's where we need to work on that attitude, but the motivations, the incentive systems are superior. The problem is systemic, though. To what extent can we afford to finance these externally supported. I mean, the NGO, the private sector, if the private sector is self-supporting locally, we've got it made. That's the real solution. There's lots of things to work out, there's lots of interpersonal relationships and developing those – the networks and strong innovation systems within that, because each of the partners are going to come to the table trying to improve their own situation, and that's reasonable. And that's part of the reason to have a broker in sorting that out.

But then – that's sustainable. The difficulty is that governments have not been able to sustain extension services, at any level. I mean, it's – they've just sort of disappeared. Some countries still have extension services. But basically, it's unsupportable. Private sector has moved in and that's part of why you sell seeds, because there's a value added that you can start to pay for these extra services.

What a lot of the marketing and the value chain stuff seems to be finding though is that when you pull out that middle man, the value chain can collapse very quickly. And so to the extent that we're setting up projects in ways that the middle man is a project supported private sector middle man, we're in trouble. It's got to be articulated into the system where the system is paying for it. Putting in intermediaries that are project supported, that are sunsetted at the end of the project, it's just not sustainable. And where is the line? How do you create that? That's some of the devil's in the details of doing that. But that's certainly one of the issue areas that we need to be exploring with our projects.

Ephraim: We did a study in Uganda and Nigeria, again, extension agents, and we were looking at the incentives and the affiliation of the extension agents, and we found the extension agents are affiliated with the government. We are offering more traditional knowledge, I mean, there's improved seeds and all that, but the ones associated to NGOs were giving more messages about the environment and other things on ISFM.

The interesting thing was this: we also compared the incentive – have the extension agents motivated and we compared many extension agents and female extension – guess what? Women were more incentivized to work, even though their resource that they have, the amount of wear time they have, the motorbikes and all that, were less than the men. So very interesting.

So if you want in – I mean, invest into women extension agents. They are more effective than the men extension agents.

Keith: I want to just second that on a study in Senegal that we conducted years ago and found, indeed, that that's the case. The messages that went through, there weren't that many women extension agents, but those that were, they went to the women, they got to the household. The men and women in those households that were served by women extension agents were much better informed than those served only by male extension agents.

Moderator: We'll cap it off with an online question and then wrap up.

Male 1: Yeah, the conversation online has been really great. We have a lot of questions pouring in from all over the world. Of course, not going to have time to answer all of the questions, so maybe, not making promises, at some point we can e-mail the questions to the speaker and ask for feedback. But this last one's from Gital Mbure from World Vision DC. Apologize if I mispronounced the name. It's for Ephraim. Did the study find that farmers who apply ISFM understand the importance of getting the mix right? For example, balancing the ratio of organic versus inorganic fertilizers?

Ephraim: Well, they did and in this case, we're looking at how much they apply, we found that the application rate of both the organic and inorganic fertilizer were less than the recommended rates, but again, that's understandable.

The ones who were applying the organic inputs were more likely to have livestock than the ones who don't, and in terms of the innovative fertilizer, they rates that they were applying were – was less. But in terms of knowledge, I think they were a lot more knowledgeable, the farmers who were applying ISFM, they were likely to be closer to the market and also to have access to other resources of information, marketing aspects.

Moderator: All right, we have the final closing comment that I'll send over to Moffat for metrics.

Moffat: Hi, my name is Moffat, working with the Bureau for Food Security, Climate Change and Environment Portfolio. I wanted to top off basically on the metrics question. This I think we really struggled with. When you think of sort of

integrated soil fertility management, as well as a lot of NRM and climate change kinds of metrics, we really struggled with this. We tried at the beginning to incorporate those things and we couldn't quite get it. Missions really came back saying this is very difficult to track and so on.

So I want to encourage all online participants as well as everybody here if you have good ideas on metrics and so on, please engage with us. I think this is a discussion that's ongoing, we know the focus is going to be happening on climate smart agriculture and so on, so we want to be able to see what has worked. Output indicators, sort of impact indicators, as well as out – sort of output impact and impact.

So all – at whatever level, please engage with us on Agrilinks and other venues so that we see where we go with this. Thank you.

Moderator: Thank you, Moffat. I'm sorry we couldn't get to all questions, but we hope that the speakers will follow up as needed. I really appreciate all of your attendance. Thank you on behalf of Feed the Future, BFS and the KDAD project. We'll see you for our next seminar.

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