



AGRILINKS WEBINAR: SOIL VARIATION AND WHY IT MATTERS

QUESTIONS AND ANSWERS AUDIO TRANSCRIPT

JUNE 29, 2017

PRESENTERS

Hope Michelson, University of Illinois Urbana-Champaign

Carolina Corral, Precision Agriculture for Development (PAD) Kenya

Emilia Tjernström, University of Wisconsin-Madison

Michael Carter, University of California-Davis

MODERATOR

Julie MacCartee, USAID Bureau for Food Safety

Carla Fernandez de Castro, USAID Knowledge-Driven Agricultural Development Program

Julie MacCartee: All right. Wonderful. Thank you very much. We've had a number of questions come in and so I'm gonna go ahead and run through a few questions for each of our presenters. I see you've got some extra slides here. Are these mostly for reference for our participants?

So to our participants, if you'd like to download the PowerPoint presentation, it is already posted on the Agro Links event page for this event. And I'll ask one of our KDAD team members here to post the link to the event page to make sure that you all know where to pick up the PDF of this PowerPoint presentation. All right.

So I'm gonna go ahead and jump into some of the questions that have come through. One interesting one that might be most targeted to Emilia or Hope came in from Odapa Asano. "To what extent is the soil variation attributed to natural differences and to what extent could it be attributed actually to managerial differences in either Kenya or Tanzania?" And also, he talked on which crops are most sensitive to the soil variations. But I think the crux is how much the managerial differences affect soil variability.

Hope Michelson: Emilia, do you wanna take a crack at that or ...

Emilia Tjernström: Sure. I'm happy to give it a shot. I can't speak to Tanzania but thanks Julie. So this is Emilia talking. So it really depends on which characteristics we look at. So certain like the cation exchange capacity are actually very, very difficult to alter and have much more to do with the soil type that you have. It's actually it's difficult to alter your CEC. For other things like pH and all the limiting nutrients, of course it varies a lot based on what types of fertilizers people have used in the past and so managerial practices will matter a lot.

And so basically, the answer is both[laughs]. In terms of which crops are most sensitive, this is – I'm not an expert on this so I will hope that somebody else is [laughs].

Hope Michelson: So I can add to the first part of the question. That's something that we're really interested in and that we're trying to understand actually. So we're pulling together data that includes management and also as I mentioned in the presentation, some of these ... easily available, observable characteristics. Right? So the slope, the soil texture and type, the altitude of the field. And what we're trying to do is to look at the variation within particularly geographic areas and see based on those kinds of observable pretty immutable characteristics, how much of the variation can we explain.

So the assumption would not necessarily be that anything unexplained would be based on management but a way to sort of start pulling out maybe how much of the variation can be explained locally based on some of those more structural characteristics. I will say we work really closely with soil scientists and I gave a version of this presentation to a room full of soil scientists [laughs] which was terrifying but interesting and their general assessment was for conditional on soil type, a lot of it, they think is management.

I don't think I'm misstating what they said but their assumption was this is actually due in large part to management. And when they say, "management," they're thinking broadly about that. So based on, for example, just years of continuous cultivation. So how long has the field been in continuous cultivation? So I think it's a really important question and it is one that we're trying to think about.

Julie MacCartee: Great. Thank you so much, Hope and Emilia. Hope, as long as you're on the line, another question had come in from you from – or for your from Donald Greenberg. "The financial return to increased fertilizer usage could be negative even with farm specific recommendations. Isn't that a more fundamental issue than the one time effects of a voucher subsidy?"

Hope Michelson: And that's a great, great question and I think one thing that was missing from our presentation, our analysis is thinking about those economic returns. Right? So [break in audio] done some work on this and looking at what the effects are after a subsidy concludes and what people continue to do. I do think that that's pretty instructive because people are making choices about what looks profitable to them and where it seems sensible to deploy their investments once a subsidy is gone but they may have learned about the _____. But maybe I'll let Michael address that given that he's got some research relevant to that topic.

Michael Carter: Would you like me to jump in and say just a word on that?

Hope Michelson: Yeah. That would be fantastic if you're willing.

Michael Carter: Okay. Yeah. I've seen several comments on subsidies because they really jump out across these studies as playing a role. So Hope was just referring to a study that we did in

Mozambique where we followed farmers two years after a once off voucher coupon and sort of part of the idea was that if fertilizers aren't really profitable, farmers will adopt them when the fertilizer's basically free or highly subsidized.

But then once, once the subsidy goes away, you wouldn't imagine them keep doing it. In the particular case of Mozambique and since we're talking heterogeneity, I wanna emphasize the particular case. This was in the central region in Monique, a province of Mozambique. We actually found very strong and persistent effects that indeed individuals who received the voucher of treatment continued to use much higher levels of fertilizer and it was even the impact of the program were even visible in roughly 10 percent increases and household living standards two years after the voucher coupon intervention had taken place.

So I think it's a great question. I think Emilia showed us some [break in audio] was showing but I think she was showing us net profitability numbers and was showing that for, if I understood her figure correctly, was showing that for roughly half to two thirds of the farmers, the fertilizers, the estimated returns actually were such that they would be profitable. But for the other 40 percent or whatever it was, probably not. So I don't know if Emilia, maybe you wanna say a quick word on interpreting your results that you had in that sense.

Emilia Tjernström:

Yeah, sure. I think again, it depends a little bit on what characteristics you look at and so on but yeah, I would say that overall we find fairly low returns to fertilizer actually but that they do vary with characteristics and [break in audio] there's certainly a proportion. You interpreted the figure correctly for a portion of the sample and it looks like fertilizer is profitable and this is for just one kilogram of nitrogen. Right? So this is not speaking more broadly to perhaps other types of fertilizers.

So as Hope discussed, it may be the case that certain other nutrients are more limiting in which case just applying more nitrogen may not, um, make that big of a difference but yeah. There's a need. I would say that our results support this idea that type of fertilizer is going to matter for profitability and to speak a little bit more broadly to the question of profitability not only as subsidies but of soil testing and all of those things, there's a trade off there also temporally. Right?

If subsidies are such that you have to continue providing liquidity for farmers, then soil tests that provide farmers with better information about what types of nutrients they should applied could be more efficient. Right? Because the farmers can keep that information. I'm sure you need to update the soil test at some point but they may not

need them sort of forever. They may just need one soil test every X years versus at least the government of Kenya's providing fairly frequent and continuous subsidies as our other African countries.

So yeah. I think there's definitely a lot to think about and this is a really important discussion and a good question.

Hope Michelson:

I guess one sort of final note on this is in the context of our study, there's a dominant missing nutrient with sulfur. Right? That was really important. And so but the package that includes sulfur, sulfur ammonium, is actually cheaper for farmers than the recommended package by the government. Right? And so if you're thinking about the fact that its farmers are following the government recommendation, which granted, in our Tanzania example, they weren't, you could actually find some cost savings by recalibrating what the purchase is to better reflect what the specific nutrient deficiencies are of the farmers. But I think that's related to something that Emilia's suggesting.

Julie MacCartee:

Excellent. Thank you all for your responses and support to that question. A few questions came in during Caro's presentation as well and one I thought was interesting from Jennifer Seesay, "In the different contexts about what you spoke, Carolina, to what extent can the variation in yields be explained by soil heterogeneity in the absence of intervention? And perhaps another way of putting that is what assumptions can we make about soil variability when we observe yield differences?"

Carolina Corral:

Thank you for the question, Jennifer. So I don't remember on the top of my head but so when we run it, I think that soil differences in our first scenario were explaining up to 15 variation in the yield but don't take it from right there. I need to go back to look at the number. It was part of what was building the recommendations for us but it was pretty high. It was very in line of what Emilia was saying with the first CEC and it's just like we not use CEC. We're also using organic matter ... and we also were using things that Hope was saying.

Like for example, the slope, it's super important. We are working in a mountainous region also was super important. So and we could explain a lot of the yield variation. So going back to the questions that we had before, if that is true, that is actually more supportive of the idea of understanding these fertilizers recommendation better. I would like it not only allow urea.

So yes. No plant can survive without nitrogen but when we are talking about changes in use, we need to start talking about other inputs. And especially, Mexico was through the micronutrients, especially bottom and think, if I don't remember it correctly, they were explaining a lot of the variation yield. So and that's when we just start talking more with the environment. I don't know if that answer your question. Sorry.

Julie MacCartee:

No, thank you very much. Going back to Emilia, there was some discussion about what farmers know and what farmers are communicating to each other about soil variability. So a question came in. "How aware are farmers of local differences within the soil and do they have a sense of whose soils are similar to their and whose are different? It may actually not be that helpful to share information between farmers if there really is a ton of variability between different farmers' fields."

So in other words, could you dig into that a little bit more about how variability really affects spillover communication and explain a little bit more about what farmers really do know about their own fields.

Emilia Tjernström:

Yeah, certainly. So that's a great question and I love it. I find this fascinating. So it's my sense that farmers are quite aware of these differences. So in a social network study [break in audio] and it's specifically at the farmer's communications about a randomly introduced new technology and find that the extent which they're sort of willing to learn from other people's experiences varies with the amounts of heterogeneity in that village, so the quality of heterogeneity. Okay?

So that just first off, sort of suggests that they're quite aware of the amount, at least, of variability. Other things to support that are that as part of the social network study, I collected data on whose soils they think are most similar to their and I've yet to begin to – I'm trying to think of a good way to measure it actually but to think about exactly how to use their answer to that question. But interestingly, in villages where there was more soil equality, heterogeneity, farmers mentioned fewer other farmers as having similar soils to their. Okay?

And so that, it's still just suggestive but it does suggest that farmers have some awareness of whose soils are similar to theirs. Furthermore, we asked several questions about sort of observables, what type of soil do you have, how fertile is it, et cetera, a few different questions. And we can explain quite a lot of the variability in some soil characteristics, especially things that are – that change less over time. So CEC, that's one of the reasons I like it as a measure is because it stays fairly constant and it doesn't change in response to

management practices.

And so we can explain a lot, like almost 60 percent of the variation in measured cation exchange capacity with three or four different farmers stated questions about their soils. So that, to me, suggests that it's not a perfect prediction of course but it suggests that there's quite a lot of local knowledge about these issues. And so it does also suggest that if we wanted to sort of spread information via social networks, we should really only be trying to do that in places where people are similar enough to each other.

Because otherwise, either we'll spread the wrong because the median farmer recommendation is not appropriate for others or we won't spread anything at all because we're trying to get a bigger bang for our buck but farmers just won't learn anything from that information because they don't believe it, because they know that their soils are different. So great question.

Julie MacCartee: Thank you so much. And as long as I have you on the line, there was a quick clarifying question that came in from Dick Tinsley. "How readily is fertilizer in Tanzania and Kenya available? Do farmers have to get any extension approval to obtain fertilizer?" He was just wondering if there are any barriers in terms of approval.

Emilia Tjernström: There aren't any barriers, at least not in Kenya. You can buy it and in fact, I have a team in the field right now doing surveys with agro dealers and everyone in local areas who sell fertilizer. And during peak season, you can even obtain fertilizer at the super market and at the hardware store and just about everywhere which is terrible [break in audio] fertilizer survey because [laughs] a lot more observations, a lot more people to interview than I thought but it's super interesting.

So this differences, there may not be high quality fertilizer. There may not be the type of fertilizer or the manufacturer that you want. So there's – or as Caro mentioned, the appropriate micronutrients may not be in the fertilizer so there's a lot of different limitations but just strictly speaking, getting fertilizer is easy if you have no money.

Julie MacCartee: Very interesting.

Hope Michelson: This is Hope.

Julie MacCartee: Oh, go ahead, Hope.

Hope Michelson: I can chime in on that. Yeah. It's a little bit different, I think in Tanzania and there's, I think, two dimension to think about that are important. So the one is we had that – it's like a gradient of what nutrient limitations for the farmers. So if you need just nitrogen, you can get that almost anywhere. Even in Tanzania, which has a, I think, less sophisticated, less developed market system for inputs than Kenya, we've completed a big study and in tertiary markets year round, you can get urea and MPK.

Once you start needing things like sulfur blends for fertilizer, it looks like you have to go to the closest sort of regional capital. Maybe they'll suggest that. So you'd have to go to Morogoro or Ifakara. If you need something that's gonna address like a MPK S limitation, then you're gonna have to figure out how to get that from dar. Right? So the complexity of the blend is definitely ... harder to fill the further out you get in the rural area, at least in Morogoro.

And then the second to mention is, that Emilia just alluded to and she and I both have research ongoing on this, is the quality of the fertilizer which available in markets. Right? So it's a very interesting and I think, extremely important question about how good the fertilizer is that's available in those markets. Right? So whether or not it actually has the nutrient content that it's supposed to have based on the manufacturing standard.

And so Emilia and I are both doing work to assess that and to try to understand where are the failures of these systems happening, these marketing systems happening and why are we seeing these kinds of poor quality inputs in markets because we do see that there's a lot of missing nitrogen, for example, in the fertilizer that's being sold in markets. So I think thinking about the complexity of blend and the quality of what you can get is really critical. Not just thinking about where you can get an input.

Julie MacCartee: Great. Thank you.

Carolina Corral: I have one thing to add there, Hope.

Julie MacCartee: Go ahead, Caro.

Carolina Corall:

Can I add something more? Yes. So now that we are working for Kenya, I can tell you for the last two seasons, one of the things that we observed is true that fertilizer, we are expecting for them to be available but we were tracking on biweekly basis that _____ the aggregates that were working for us _____ who had a coupon to mention adoption and actually, we saw a lot of repletions. Like, for example, aggregates, they might run out of fertilizer for maybe four or five days and that happens on regular basis.

And because your interest in also in quality, the one farmers, they cannot buy _____ the aggregates because it's just _____. They will go with the vendors of the market. So vendors are like a small stall, a person with a bag of fertilizers and the way they were handling the fertilizer actually the back of nitrogens were remaining open for very long hours so it is suspected that even if the quality – let's assume the quality of the fertilizer was high when it went out of the factory, the way that there fertilizers are handling, yeah, you are expect that the amount of nitrogen, they could be low. Very, very low.

The other product that actually we had to – because we are working with soil activity in Kenya, so and we were trying farmers to adopt agricultural lime. We had to do all distributions on a sulfur aggregate because it's a product that it's not there. And the reason why the product is not there is not because it's expensive. Actually, it's because too cheap and the cost of pound for is very high but it could have important implications in the nutrient balance.

Because actually, helps your _____ and sulfur. Sorry. Those two comments.

Julie MacCartee:

Great. Thank you. And you can all see, we have a few polls on our screen. We ask that you fill those out to help us understand how this webinar benefited you and help us plan for future webinars. So thank you in advance for filling out our polls. We have about five minutes left for questions so I can just squeeze a few more in. One question came in from Timothy Russell perhaps most oriented towards Hope's presentation. "The soil testing kit looks interesting but how close are we to having precision ag technology based perhaps on remote sensing for mapping soil fertility variation in Africa? And can high definition satellite technology be used to help determine variability?" Do you have any insights on that?

Hope Michelson:

Yeah. I can say a little bit. I think that's a fantastic question. The other thing that people have been talking about, especially – so here at the University of Illinois, there's a

number of folks in the crop sciences department that are trying to do remote sensing based measures of yield. And so they're kind of backing into these questions of soil quality because they're trying to think about predicting yields, basically. Right?

And they're trying to do that for smallholder agriculture in Sub-Saharan Africa, which it's a hard problem. So they're thinking about that question and one thing that they've gotten excited about, and this could be a form of technological utopianism where it could have some real possibilities. I'm not really sure yet but it's using drones to gather data that would be a bit more ... have a finer geographic scale, I suppose, than sort of some of the broader satellite measures that we can currently get.

And so you might end up filling in the serve measure level that we're missing between the field level or the village level test in the satellite measure. So one thing that we're doing is we're actually taking our measures that we have at the field level and we're trying to see how they correspond to existing publically available data that's based on remote sensing data. Right? And the correspondence is not great at this time and that's for a number of different reasons.

And so I would say at this point, we would need some additional kind of input to improve the precision – the sort of remotely based precision tools that are available if that makes any sense. But I'm sure that's gonna improve.

Michael Carter:

Yeah. This is Michael Carter and just to chime in on that, we've just started working with a very high resolution imagery that we got from Funat Labs. So it's roughly – it it's 2 meter by 2 meter resolution from their sort of fleet of little satellites. And it's definitely possible to pick up nutrient deficiencies in growing plants. We have not yet thought about – we had not yet thought about tracing that down to the underlying soil. I guess you probably could do that especially in areas where management is not particularly interfering, at least in the short term.

So we'd been using it for yield prediction but I think you could also more in the spirit of precision agriculture, you know, you can certainly pick up nutrient deficiencies. So obviously, it would depend on the soil and then what management practices are being thing. But I like what you're suggesting, Hope, that you should look into this.

Funat Labs did have an agreement with USAID and they also have an academic wing, which they will make some of their heart – this 2 meter by 2 meter imagery available for academic research purposes and they seem quite happy to be helpful when it comes to working in Sub-Saharan Africa.

Hope Michelson: Great. That's really exciting, actually.

Julie MacCartee: And lastly, Michael, I know you wanted to quickly touch on taking into account the fact that vouchers played a major role in take up or seemed to. Is there a sense of whether this is due to liquidity constraints versus a fear of the risks associated with the unknown?

Michael Carter: Yeah. I think that's a great question and I briefly mentioned this project in Mozambique and we had actually combined the voucher invention which again, was just a short term thing and someone from Miramar had chimed in about that being a good way to do it. They're looking at it there and I agree with that point. But we also matched it with a savings and improved up savings intervention so people had better access to safe savings with positive rates of return.

And we thought those two interventions would be complimentary. And what we actually see is that farmers that got both the voucher coupon and the access to improve savings, actually after the dust settled and they were working, moving forward with what they had learned from the intervention, farmers that got both things actually saved a lot of money and farmers that only got the voucher interventions were nothing more their money and fertilizer but were actually, as I mentioned before, they had to hire mean consumption but not surprisingly, they made their consumption more variable.

And the folks that were given a good savings tool, which is a way to self-insure yourself, invested some in fertilizer but much more so in kind of self-insurance. So I think in the end, what I take away from that full range of that study is that in response to the question, I think it's exactly right. I think vouchers are partly taking away some risk, at least temporarily but if we really want people to sustain it, a lot of farmers are dealing with very large amounts of uninsured risk.

And I guess, to make my final comment, I sort of suggested at the beginning, why this sort of African exceptionalism, the soil issues may be one. Another one may be the heavy dependence on rain-fed and highly variable rain-fed agriculture and highly variable rain. And so maybe it's the combination of these things, which perhaps explain the low uptake of these technologies, which at least, in some places, appear to be profitable.

Julie MacCartee: Thanks, Michael. All right. I think we are out of time for our webinar today. We'd like to end as close to on time as we can but thank you so much to everyone who participated

today. We really appreciated the excellent questions, comments and resources that you all shared in the chat box. We really appreciate that. The Agro Links webinars are really about the participants so thank you very much for joining us today.

And of course, thank you also to our excellent presenters from the See The Future Innovation Lab for assets and market access. We are really excited to be able to share this new research on soils and soil variability and we look forward to much more from you all in the next couple of months. I'm interested to see everything that you share. And also, thank you very much to the KDAD and Agro Links teams who put on these webinars for us every month. So we hope to see all of you back for future Agro Links webinars and I think that will complete our event for today.

So thank you very much. We'll send out via email the recording and other resources from this event so keep your eyes open for that. Thank you very much.

[End of Audio]