A Tool for Prioritizing Climate-Smart Agriculture Investments

Audio Transcript

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Julie MacCartee: Good morning, afternoon, or evening, everyone. On behalf of Agrilinks team, I would like to welcome you to the June Ag Sector Council Webinar, which will showcase a tool for prioritizing climate smart agriculture investments. The monthly Ag Sector Council seminar series is a product of the USAID Bureau for Food Security, and is implemented by the Feed the Future Knowledge-Driven Agricultural Development Project, also known as KDAD. My name is Julie MacCartee, and I'm a knowledge management specialist with the USAID Bureau for Food Security.

So today, we're here to discuss the concept of climate smart agriculture, which is sometimes shorted to the acronym CSA, and how this approach might be applied by practitioners. We're going to showcase a tool called the Participatory Systems Dynamics Model and how the USAID Zambia mission uses it to prioritize CSA investment.

This webinar follows on the heels of a recent Feed the Future event called the Climate Smart Agriculture Global Learning and Evidence Exchange, or the CSA GLEE, which was held in March in Zambia. It expands on a session there called the Farms to Landscape session, and focuses on one of the key messages that climate smart agriculture is an approach, and not just a list of practices.

A great list of resources from that event can be found on Agrilinks and in that resources box that you see on the left of your screen. In addition, our webinar today stems from a February publication titled "Climate Smart Agriculture in Feed the Future Programs." This paper describes five areas of engagement to guide Feed the Future activities in integrating climate smart agriculture, and so we recommend that you take a look at that document, which is also available on Agrilinks and in that resources box on the left of your screen.

So we're going to get rolling now with the content, and so I would like to go ahead and introduce our three speakers. First up is Jerry Glover. Jerry is our senior sustainable agricultural systems advisor at the USAID Bureau for Food Security, as well as a National Geographic Society explorer. If you've attended any past Agrilinks webinars on soil management or sustainable intensification, you've probably heard Jerry's voice. He holds a PhD in soil science from Washington State University and has studied, among other things, native grasslands and farming systems, including no till, organic,

and integrated systems.

Second up will be Robert Richardson. Robert is an ecological economist at Michigan State University who's interested in the study of development and the environment, particularly the contribution of ecosystem services to socioeconomic wellbeing. His research and outreach program focuses primarily on sustainable development, and he uses a variety of methods from behavioral and social sciences to study decision making about the use of natural resources and conservation.

Finally, we will hear from Harry Ngoma. Harry is a food security specialist with the Economic Development Office at USAID Zambia. He provides technical backstopping to Feed the Future activities in Zambia, including a research and development program called the Zambia Economic Resilience Program for Improved Food Security, also known as the Mawa project.

And in addition, we have Mark Visocky online as featured contributor. He is our team lead at the Bureau for Food Security for climate smart agriculture, and so you'll see his name in the chat box and hear him during the Q&A session.

All right. Without further ado, let's jump into the content. Remember, you can post questions and comments in the chat box at any time, and we'll collect those for the Q&A session. All right, Jerry. You are up.

Jerry Glover: Well, thanks a lot, Julie. So nice to see everyone online. Good morning, good day, and good evening to everybody. Very happy to be here today to try and accomplish a couple of things, at least. One is to give a bit of an overview of USAID's climate smart agriculture framework and why we're focusing our investments where we are, and a little bit about the decision making process that we go through in determining what to invest in.

Of course, today one of the tools that we'll be talking about is that of the dynamics modeling approach, but it's useful to first get into a little bit of the perspective that USAID has on climate smart agriculture. I should say before we go on, I open up with this slide of a small farming community, and one thing to notice there that's very relevant to this topic, of course, is how farm fields, farms, fit into a larger landscape that includes natural areas, semi-natural areas, and so on. And when we do look at climate smart agriculture approaches, we do want to consider the broader impacts, the factors affecting the farm scale from the larger landscape, but also

how the activities on the farm affect that larger landscape. So we're working in fairly complex landscapes in general, so that makes decision making a little bit more challenging.

So just fundamentally, USAID's definition and use of climate smart agriculture is roughly the same as the FAO, the Food and Agriculture Organization. So we wish to sustainably increase agricultural production, provide farmers with the ability to adapt to climate change, build their resilience, reduce their risk, and also mitigate some of the effects of agriculture on climate change, along the lines of reducing greenhouse gas emissions.

We stress the part where appropriate, because we understand that many of the farmers that we work with certainly aren't responsible in large part for climate change, but where we can find opportunities to reduce the impact of smallholder farming systems on climate change, we'd certainly like to take advantage of those opportunities.

Now we have some principles for practice that have been identified. Here, you know, the bottom line really is that climate smart agriculture is not a single type of practice. It's not a single innovation. But really, it's a overall approach, and it's a process that's ongoing, so we really do want to take a systems approach, looking at not just a particular crop or even cropping system, but also look at how the farm operates overall, and in the context of a larger landscape.

Intentionality. On this one, we have many practices that actually produce benefits in terms of either improving adaptation to climate change or mitigating some of the impacts. But we don't want those just to be byproducts. We wish to develop strategic programs that really focus and maximize the impacts on both of those on and off the farm field.

We also look at the multiple benefits. We can't just rely on a few approaches that achieve some minor benefits, say on adaptation or productivity increases, but we really are striving to identify win/win/win situations, where we're able to accomplish multiple benefits through a better overall strategy.

And of course, we realize that it's not a sort of paint by numbers effort. You have to take into consideration the specific context that we're working. Often, these become very multi-layered. For example, you can be in nearly the same ecological environmental setting, but have very different socioeconomic or political factors

that really affect what is possible and the impacts that are achieved.

And the other thing is we're not just after climate smart approaches that have affects over the near term for the farmer, but really in a sense that laying the foundation for long term resilience and preparedness for farmers themselves, so really trying to set up our farming communities to better prepare themselves to make better decisions in the future.

Now for this particular study, we're focusing on Zambia, and in Zambia, much of the Feed the Future investments on improving agriculture are focused in the eastern part of the country. And in that region, we've seen fairly successful examples of implementation of agri-forestry systems, such as this one pictured here. This is actually a farm in Malawi just across the border, but a very similar area as what we find in Eastern Zambia.

And evergreen agriculture uses perennial crops or shrubs or trees to really protect the soil and water resources over a much longer period of the year. We've found that they can – that these systems can help improve annual crop production, increasing maize yields two to threefold. We see often much better physical and biological conditions in the coil, and much better organic carbon input into the soil. And all this helps manage water better, water that strikes the soil surfaces better – it better infiltrates the soil, it's better stored and released better to the above ground plants.

You can see this by a picture of the below ground setting, where in this image this soil profile in a maize field in which faidherbia trees are planted. The faidherbia are nitrogen fixing, and they are also – have these very nice, robust root systems. They shed their leaves during the growing season for maize, so they don't compete for resources. You'll see that the maize there is growing right up next to the base of that faidherbia tree and producing high yields of maize. Below ground, though, you can see in the picture those large diameter tree roots punching down through a soil limiting layer that maize grown alone would not likely be able to penetrate, and so without the trees there, the maize roots would really be restricted to the soil volume above that root restricting layer.

So that has obvious benefits for adaptation and many other benefits, even unrelated to climate change. So we were interested to find out if these approach – if agri-forestry systems could help us mitigate climate change, in particular by reducing deforestation pressure off farm. More on that in a minute.

Another approach that we've seen successfully taken up in Eastern Zambia is conservation agriculture that operates by three basic principles. You want to minimize mechanical soil disturbance, so either using no till direct feeding systems or conservation tillage systems. You want to keep that soil covered with crop residues as much as possible. As you see in the picture, post-harvest, you have a lot of maize stalks that have built up from previous seasons, so that's a nicely protected soil surface. And then the use of diversification, typically through rotations, or even through inter-cropping strategies such as shown here, where ground nut is being grown inter-cropped with pigeon pea.

So minimum soil disturbance, good soil cover with crop residues, and diversification. And again, we see some real opportunities for adaptation and increased crop productivity. It's been successful in some areas, being adopted by farmers, so it has real potential.

So an interest here was, well, if farmers adopt this, improve their productivity significantly, and increase their ability to adapt to climate change, what would be the impacts on mitigation along the lines, again, of reducing pressures on deforestation?

So why is that important, this effort to reduce the pressure on deforestation? This is a satellite image of a natural preserve along the Zambia-Malawi border, and you can see the very sharp line going roughly down the middle of the image. On the right are heavily farmed landscapes, essentially without tree cover, and then on the left is the protected area.

And increasing pressure for charcoal production and on farm fuel wood use endangers those protected areas. Farmers go in there. It's very valuable, not just for the fuel wood and charcoal, but also for bush meat.

So how does adoption of agri-forestry and conservation ag, both of which seem to have clear adaption and productivity benefits, how do they contribute to the mitigation part of the equation by helping reduce pressures on surrounding forest lands?

While getting back to these principles for action, we wanted to have some decision making tool so that we could prioritize. For example, if agri-forestry systems proved much more – had much more impact in conservation ag, we would want to put our investments there. Vice versa, if conservation ag is clearly the winner, then that's where investment should go.

But again, going back to we want a continuous process that looks at these challenges over time and over space, both on and off the farm, and really trying to maximize the synergies and reduce the tradeoffs. Generally, there are tradeoffs, but we would like, again, to find those win/win/win scenarios. And of course, there are specific socioeconomic, political, cultural, and environmental factors that need to be considered, and then how to put that together is really one of our challenges. And again, taking the long term perspective.

So overall, where was the tool? How could we do this? And that was the big challenge facing us in our research investments there in Eastern Zambia, and that's when we began talking to Michigan State University team, with Robbie. So with that, that kind of introduces why we selected Robbie's team to take on this challenge, going to those principles for practice and our concepts around climate smart agriculture, and really assessing the value of agri-forestry systems or conservation agriculture in addressing all three of those climate smart agriculture approaches. And with that, I'll turn it over to Robbie.

Robert Richardson: Thank you, Jerry. Thank you, Julie. And good day to all of you who are participating in this session. It's a pleasure to see all of your names and home countries on the roster here.

And it's been a pleasure for me to be a part of this project, so I'm happy to discuss some of the outcomes with you in this webinar today. I've been involved in research projects related to agricultural and the environment in Zambia for about ten years now, and this project really allowed for an opportunity to explore some of the linkages between agricultural and the environment, its impacts on the environment.

Just as a brief overview of this discussion, I'm going to suggest here that the linkages between what happens on the farm and the impacts on landscape, the ecosystems, are not well understood, and we are often influenced by closely held but poorly examined assumptions that are used to guide development, investments, and priorities in the promotion of climate smart agriculture.

And then finally, I'm going to suggest that participatory system dynamics modeling as a tool can be effective in testing some of those closely held assumptions, which can help to determine priorities for development investment. I do want to emphasize here that this approach is very flexible and adaptable to other contexts. It's certainly not limited to, for example, relationships between

farm scale activities and deforestation.

I do want to acknowledge my colleagues, whose contributions to this project were invaluable.

The project itself focused on sustainable intensification and landscapes and livelihood. We called this the SILL project. And the main objective was really to examine the impact of sustainable intensification agricultural practices on the conservation of biodiversity in Zambia.

As Jerry mentioned, the pilot sites for this project were Eastern Province and Lusaka Province, which were part of the zone of influence for USAID activities in Zambia. And we conducted the activities related to this project in 2014 and into 2015.

To put this in some geographic and demographic context here, Zambia – relative to its neighbors, Zambia has relatively low levels of population density, roughly half the levels that we see all across the continent more generally. However, the population is growing rapidly from its present level of about 13.5 million people. It's projected to triple by 2050 to around 43 million, increasing 10 times over present levels by 2100. All of this of course implies changes in the demand for food and energy. Zambia is also a rapidly urbanizing country, and this of course has implications to how food and energy are distributed across the country.

And then finally, Zambia presently has a good deal of forest cover, but suffers from high rates of deforestation. Estimates vary widely between 150,000 and roughly 300,000 hectares per year, but nevertheless, this is one of the leading contributes to greenhouse gas emissions for the country.

The implication of those trends, of course, are of interest to those of us who study food security, because of the implications for the demand for food in the country. And of course, this is related to the demand for crop land, and exactly the very issues that Jerry was describing in the introduction.

The sort of conditional wisdom here is that the practice of cultivating maize monoculture, maize being the staple crop of the region, cultivating this in a monoculture system depletes soil fertility, and farmers will want to them migrate to land abundant areas that would need to be cleared, so deforestation then would be driven largely by clearing land for agriculture, and there's some basis for this conventional wisdom. But this highlights problems

related to soil degradation in an environment when agriculture is one of the few livelihood activities.

So the dominant narrative here alluded to previously is that deforestation is largely driven by smallholder farmers facing weak yields and degraded soil environments who abandon their fields and clear new land, and so the hypothesis going into this project was that something like sustainable intensification practices that increased yields or produced … would reduce deforestation pressures. Jerry mentioned conservation agriculture. Increased yields from those kinds of practices would purportedly reduce the needs for clearing land. And then agri-forestry, to the extent that it can provide on farm fuel wood production, this would reduce demand for off farm forest resources.

This is a map of the country, and you can see Eastern Province shaded in orange to the right, and Lusaka Province shaded in purple in the center lower part of the map. These are very different provinces, and the Eastern Province is very rural with a good deal of forest cover and not a lot of urban pressures. And Lusaka Province is – contains a good deal of agriculture on the eastern side of the province, but it is of course a very urban province because of the location of the capital city.

We went to this project using an approach called systems dynamics modeling, which is a quantitative modeling tool that uses the kinds of systems approaches that Jerry mentioned in the introduction to analyze the impact of feedback loops in complex and dynamic systems. As I mentioned before, this is a very flexible tool that's been used in all kinds of applications ranging from health care to national defense and ecological modeling. We use this tool in a participatory way, meaning that we involve stakeholders and partners in the building of the model and its validation, and we used it in this way for this project to elicit stakeholders' views of the system, the agricultural environmental system, and how it operates. And we used that information to inform how the model was constructed, and I mentioned that it is also a very flexible and adaptable tool.

The approach that we took began with the identification of partners and stakeholders. I'll describe those groups in a moment. Those individuals were invited to an introductory workshop where they were invited to generate causal loop diagrams, and I'll give a couple of examples of what those look like in just a moment. In the meantime, our research team conducted a review of the academic literature and gray literature on the topic, and we collected an

immense amount of data that had been assembled by various organizations in Zambia, and we used these causal loop diagrams and data to build a national level model of deforestation in a software package called Vensim®. I'll mention that a version of Vensim® is available for download for free, and that's how we made this model available to some partners and stakeholders in Zambia.

We used this national level model in a participatory workshop where we refined the structure of the model and the parameters with this group, and we used that fully refined model to then dive down to build provincial level models, so models of the system for both Eastern Province and Lusaka Province, and used those models to develop the outcomes of what was provided in the final workshop and final report for the project. This took about 15 months from the beginning to completion.

The stakeholders and participants who worked closely with us throughout this project are listed on this slide, and they include local research organizations, several representatives from international agricultural research centers, University of Zambia, and several NGOs active in these two provinces and in the region generally.

This is an example of a causal loop diagram, a very simple one that demonstrates the kind of feedback loops that we see in complex systems, this one being that farmers use land that they plant in either staple crops or cash crops, and farm income then is generated either from surplus in staple crops or produce generated in cash crops. This increases household income, and ultimately household food supply, in an economic security kind of feedback loop.

A more complex feedback loop represented here shows how the increase in the desire for agricultural land contributes to deforestation, which has an impact on the total land available for, again, cultivating staple crops and cash crops for the generation of smallholder farmer income.

Just briefly, forest in Zambia, we began using land cover statistics that were provided by the integrated land use assessment that was supported by FAO a few years ago. That assessment has recently been updated, and we plan to use the newer assessment in a revision of this model.

We represented forests in two types in the model, one being

deciduous or evergreen forest, and secondly, the more dominant dry forest type represented by Miombo woodland. In Zambia, urban households, it may be worth pointing out, urban households largely depend on charcoal for an affordable cooking fuel, whereas rural households typically use firewood as a cooking fuel, because of the closer proximity to forest resources, charcoal being a processed resource that is lighter and easy to transport. So thus, because of this urban demand for charcoal, rural households may also engage in the production and selling of charcoal as a livelihood. The common sight in the region, trucks loaded with bags of charcoal moving into urban areas for the sale.

We're mentioning charcoal because it is an important source of deforestation, along with the others listed here, the clearing of land for agriculture, the gathering of firewood, construction of homes in the rural and urban areas, and then the commercial timber sector.

Okay. In terms of the results, this is just briefly the baseline model for the national level scale showing the decline – projected baseline decline in forest cover of these two forest types, deciduous on the left, and the more abundant Miombo woodland declining a bit more steeply on the right. Those are just based on business as usual levels of deforestation. This graph shows at the national scale the drivers of deforestation forecast from the baseline year of 2010, over 50 years, to 2060.

And it indicates here that in fact, the clearing and conversion of land for agriculture is a dominant driver of deforestation, represented in blue, but increasingly rapidly, just behind it, is deforestation for charcoal production in red. This highlights the rapid rates of urbanization that we see in Zambia and many other countries in the region, that urbanization being accompanied by an increase in the demand for charcoal as an affordable and reliable cooking fuel.

And then Miombo woodlands, we see similar trends, where the dominant driver of clearing is land conversion, but rapidly rising behind it is land clearly for charcoal production.

Okay. The results in terms of the two provincial level models we follow, the Eastern Province baseline, we'll see Eastern Province has a great deal of forest now, but is projected to decline over time, at rates not quite as rapid at the national level, but fairly rapid loss rate here.

When we look at the rates of – the contributions to deforestation by

driver, we see that in Eastern Province, a very rural province, it is – the clearing of land for agriculture is the dominant driver of deforestation presently, but the clearly of land for charcoal production is increasing at a faster rate and overtakes or dominates the drivers of deforestation by around 2045. So charcoal becomes a greater problem in Eastern Province later on in the decade. And we see the same trend for Miombo woodlands, where presently, the dominant driver of clearing is in fact clearing of land for agriculture, but it is overtaken by clearing of land for charcoal production later on in the century.

We also ran a few scenarios, so going back to climate smart agriculture, we modeled the effects of a tripling of maize yields on trends in deforestation, leading back to the objective of the project, which was to examine a practice such a conservation agriculture, if it in fact led to increase yields, could this compel farmers to put less pressure on the soil?

And what you see here is potentially no effect on deforestation. The baseline projections of deforestation is represented in blue, and the effect of a tripling of maize yields is represented in red, which was hidden behind the blue, so you essentially no effect on deforestation.

Similarly, we tested a scenario of a recurring drought every 8 years and a more severe drought occurring every 40 years, and you see some rippling of that scenario in red behind the blue trend line, that essentially, the effect of drought has very little impact on increasing or slowing deforestation.

We tested another scenario which was full electrification across Eastern Province, and here, you do see some impact of slowing of deforestation. It certainly doesn't eliminate deforestation altogether in the projection. Certainly even the provision of full electrification throughout the province might not reduce its use altogether as a cooking fuel, in part because many households may not have access to electric cook stoves, and would therefore continue to need firewood for cooking fuel. As one participant just pointed out as well, electricity is quite expensive and out of reach for some households as well for the daily needs of preparation of food, such as cooking.

A final scenario we tested was the effect of fuel efficient charcoal stoves, and that would in fact reduce the use of charcoal and firewood … efficient stoves, but again, it has a slight effect reducing pressures on forest, more so on Miombo woodlands,

because of the greater use in charcoal production. But it certainly doesn't eliminate deforestation.

Move on to Lusaka Province, I mentioned before, this is a more urbanized province because it includes the national capital, and so the baseline projections of the two forest types first of all begin with a much lower baseline. We had something like two and three million hectares of … in Eastern Province, roughly – less than a third of that here. But they also are projected to decline more steeply, presumably because of their proximity to the City of Lusaka and its need for forest resources as the city continues to grow.

When we look at the drivers of deforestation by time in Lusaka Province, we see that already charcoal is the dominant driver, and it is projected to increase rapidly across the coming 50 years, overtaking all three – all four of the other drivers of deforestation combined.

Similarly, for Miombo woodlands, a more common forest type in this province, we still see charcoal being a dominant driver today, increasing exponentially, and well in excess of all four of the other drivers of deforestation combined.

Again, looking at the same scenarios that we ran before, the tripling of maize yields as a scenario did not appear to have any effect on reducing deforestation rates across the 50 year period, the scenario being represented in red hidden behind the baseline in blue.

Similarly to the previous model for Lusaka Province, the effects of drought were found to have a negligible effect, only in periodic years. We may see a slight increase in deforestation because farmers may turn to production of charcoal as a coping strategy during drought years, but overall, negligible effects on deforestation under drought scenarios.

Similarly as before, the effect of full electrification would have some measurable and in some ways considerable effect in slowing deforestation in Lusaka Province. This is perhaps because we may see greater access to electricity and electric cook stoves in Lusaka than we might have seen in Eastern Province. Both forest types show a slowing of deforestation under the scenario of full electrification.

And similarly, the scenario of widespread use of fuel efficient

stoves does appear to have some effect of slowing deforestation across both forest types in Lusaka Province.

So in terms of some conclusions here, remember that we went into this – the development of this model asking would it be likely that activities such as the adoption of conservation agriculture and/or agri-forestry, could they have some impact in slowing deforestation of the landscape. What we find in this model is that the production of charcoal and the clearing of land for agriculture are currently both important drivers of deforestation in Zambia, just very differently at the two provinces. Charcoal currently dominates as a driver of deforestation in Lusaka Province. The clearing of land for agriculture currently dominates as a driver of deforestation in Eastern Province. But charcoal is expected to dominate in both provinces in the future.

The clearing of land for agriculture in this model is really driven by rural population growth, not low yield, but low – I mean, high levels of land abandonment. We do see low yield and some land abandonment across the region, but it is the very high rates of rural population growth that result in the ensuing demand for land for farming and the resulting clearing of that land.

Charcoal production is largely driven by urban population growth and the related demand for energy in urban areas. So in both scenarios, charcoal and the clearing of land for agriculture, it is the very high rates of population growth that are largely impacting the system.

As a final concluding point, I want to emphasize that participatory system dynamics modeling as demonstrated in this project can be a useful tool for identifying the primary drivers of change in complex agri-ecological systems, and by identifying these primary drivers of change, this can allow donor organizations and development practitioners to focus on those primary drivers of change and prioritize development investment.

Final concluding point, these linkages that I spoke of in the beginning between what happens on farms and the impacts on ecosystems can be complex, and a tool like this one, a participatory systems dynamics model, can be very useful in identifying these primary drivers of change. And then as mentioned before, I want to emphasize again that this is approach is quite flexible and adaptable, and can easily be adapted to fit other complex systems. As I mentioned, it's been used in health, national defense, ecology, and many other contexts, depending on a particular mission's

issues, concerns, and priorities.

I'll stop there and express my thanks for your involvement in this webinar today, and I'd be happy to answer any questions ….

Julie MacCartee: So Robert, we had one question from Eric Crawford, who asked, did the lack of a linkage between maize yield and deforestation that you showed have an empirical basis, or was it modeled that way by assumption?

Robert Richardson: Thank you, Julie, and thank you, Eric, for the question. That's modeled in that way by assumption. Again, the way the model was designed, it begins with this assumption that Zambia meets all of its food and fuel needs off the landscape, and the landscape consists of various land types, these two forest types, savannah, agricultural land, and maybe a couple of more from the integrated land use ….

And then we begin with a sort of business as usual set of parameters, where we estimate the average maize consumed by a household, the average fuel wood consumed by a household, and so forth, and then combined with population projects that were provided by the UN Population Division, the United Nations Population Division, we used its median estimate for population growth, which is forecast both at the urban and rural scale.

So by simply modeling projected population growth across the demand for food and fuel from the landscape, it is that which led to the conclusion that rural population growth was the greater driver of the clearing of land, because of the demand for land for agriculture by new entrants into agriculture as the population grows.

Again, I want to emphasize that this is all based on a greater assumption of business as usual, and that would be that according to these population growth estimates, average rural households continue to produce and consume food at current rates, and consume wood fuel at current rates, and so forth. Similarly, at the urban scale, urban population growth consuming present levels of charcoal, consuming present levels of maize and other foods, this is really the structure of the model.

The tripling, the scenario of the tripling of maize yield, was just something that we kind of made up as a what if scenario, would producing higher levels of maize per hectare, based on the structure of the model, does it demonstrate any slowing of that – of

the rates of deforestation? And we essentially, as I mentioned, found no effect, mostly because of the lack of any kind of conceptual linkage, other than the hypothesized suggestion that farmers are abandoning the land because of low yield.

So hopefully, that answers Eric's question –

Jerry Glover: Actually, it was a response to a question by Pascal about whether from this is it better to invest in agro-forestry or CA. The answer is actually not so much whether it's better to invest in them, but to be clear about why we're investing in them. And I think this study shows that if we want a climate smart system, rather than just some climate smart agricultural practices, the – we'll have to look further afield to the energy sector, to some cultural issues around charcoal use, and so on.

But there are many good reasons otherwise to continue investing in agri-forestry and CA practices. So it's important to know why we're investing and to get to the bottom of some of those assumptions that Robbie outlined early on. We no longer should, in this region, at least, just assume that because we increase yields or produce more on farm fuel wood, that farmers will somehow be reducing deforestation pressures. We'll have to look elsewhere for that.

Julie MacCartee: Great. Thank you, Jerry. So we had a question about whether you included any farmer organizations or Zambian farmer representatives among your stakeholders, and also whether Food for Peace was part of the USAID group. Can you quickly answer that?

Robert Richardson: Yes, I can quickly answer in both cases the answer is no, and for the first point, including Zambian farmers or farmer organizations, I would suggest that in many ways, this was a shortcoming. This group of partners and stakeholders was largely experts, agricultural researchers, forestry researchers, economists, and so forth. We did stumble at times in understanding the way decisions are made about the allocation …, but we were able to get some clarification by connections with villagers … and so forth.

And then briefly, the answer to the second part about the Food for Peace, was they were not included with the partners and stakeholders, not by design. We reached out to partner organizations that the Zambian mission currently works closely with, and fund some activities on the ground in these two

provinces, and Harry may be able to speak to some of how the particular partner and stakeholder organizations were selected.

Julie MacCartee: Great. Thank you. And lastly, we had a question about whether the baseline model projections that you showed come from the system dynamics model. Does that make sense as a question?

Robert Richardson: No. Let's see. If I understand the question correctly, the baseline deforestation statistics that showed were a product of the systems dynamics model, but they were largely based on current and projected rates of deforestation across these two land cover types. So again, the baseline is based on business as usual rates of deforestation on the landscape. All of the other models are based on hypothetical or what if scenarios.

Jerry Glover: Very quick remark about some additional I guess co-products from this effort. Besides the conclusions that Robbie drew from the modeling process, there were also some very welcome outcomes just in terms of bringing those partners together and getting a clear overall picture of decision making, of opportunities, and so on. So that participatory part of the process was very useful, and will contribute to several other efforts moving forward.

It also, importantly, identified gaps in information knowledge. So we had some questions and we had assumed that there would be readily available answers to the many questions needed to build the model and so on, but that wasn't necessarily the case. And just the process of identifying where the information and data gaps were will prove I think very valuable moving forward into other regions and countries.

Harry Ngoma: Okay. Thank you. Yes. I'm just saying that – speaking from Lusaka, Zambia, to share with you how we used this participatory systems dynamics model to prioritize investments in Zambia.

As you heard from Jerry and Robert, this study was done in 2015. This was almost like midway through our Feed the Future program, as well as the Global Climate Change Program which Zambia is implementing. So in a way, we did not use it for these programs, but we have used the results from this model to start thinking in our teams in terms of how we move forward as a country.

To give you a little perspective of what I'm going to talk about, I'll just give you an overview of where we're operating from, which I think Jerry also mentioned, that we're in the eastern part of

Zambia, and the area that you see shaded, the ones which were covered … Feed the Future as well as the Global Climate Change.

I'm sure most of you know Zambia for its production, but did you also know that it is the third most forested country in Africa? So this has big implications in terms of contributing towards the environmental SDG of carbon dioxide, which is a big issue for global warming.

And Zambia is also surrounded by eight neighboring countries, and as such, we see Zambia becoming a very important player in terms of food security, especially in the impacts seen of the El Nino and climate change are bringing very serious food security situations in the sub-region where we are.

So because of these factors, USAID Zambia has been supporting the Zambian government to address its capacity to produce more food for both nutrition and … for neighboring countries. And in addition to that, we have also invested in building the capacity of Zambia to manage its forests and wildlife preserves, which are also important economic activities that the country can do.

So after my presentation, I hope you'll be able to learn how we have used our model, which we participated in to prioritize our investments.

So in introducing the model, as Robert indicated, we wanted to sort of understand what are the linkages between what farmers … are doing in terms of adopting technologies or systems that can increase their productivity in terms of yields, and how these relate to conservation of the environment, the forests, as well as the larger biodiversity, including wildlife. We wanted to understand that, because I think the fear is that what is deforestation was the inability of farmers to produce enough food, and hence, they tend to expand their fields to produce more food. So the model really was intended to give us that kind of framework to help us think … program. We do know generally that improving the integration between agriculture, forest, and … is important for sustainable management of our environment.

So what I can also tell you about Zambia is that despite this huge economic performance that the country has been experiencing in the last ten years, where the growth of domestic product has been in excess of five percent, we still have … with poverty. Eighty percent of the population is still living at below $1.05 per day, and in fact, half of that is living at about $0.68 per day. So this is really

deep poverty which we are trying to fight.

And in these rural areas, the majority, 80 percent, depend on agriculture, and this is … agriculture with no irrigated systems. And it's also with very little mechanization. So given the kind of climate change we're experiencing, where the rain flow is coming late, or there is drought in between the growing periods, it's very difficult for farmers, small scale farmers, to respond and ensure that they produce enough for their own consumption as well as for sale.

And I should also mention that Zambia is among the worst countries in Africa which is … stunting, where we have 45 to 50 percent of children under the age of 2 being stunted. And of course, this has implications in terms of potential development in later years. And we heard from Robert that although Zambia has got a low population density compared to other countries, we see the population going to really increase by 2100, by … 2100, as Robert indicated. And Zambia is also among some countries which are very high urban rate, over 40 percent. So this has big implications, as we heard in terms of food, and therefore in terms of energy, especially in the urban areas.

So what have we been doing as USAID Zambia to counter some of these challenges that Zambia is facing? USAID Zambia is actually implementing two initiatives, two US government initiatives, which we call – one is Feed the Future, which is a program of course funded by the US government to combat global hunger, and the nutrition, as well. We have four key areas which we are trying to address there. We want to help farmers increase their smallholder productivity, increase their yields, by encouraging crop diversification and the climate smart technologies.

We are also working around improving the access to markets as well as trade, and ensure that they are able to … with the involvement of the private sector, and ensuring that the environment for business is also conducive.

We're also investing in the improving the resilience of these variable households to ensure that they are able to produce enough through what they're growing. And the fourth one is cross-cutting, where we want to ensure that as the farmers produce whatever they're growing at their households, it should be environmentally friendly.

So we are focusing really on four key value chains like maize, and

then … growing maize with legumes, including soybeans and ground nuts, and then oil crops, and then the fourth one is horticulture.

So really, agriculture diversification is what we have been trying to promote, and we have a number of projects that have been doing that. We had the program that was looking at research to support the kind of technologies that farmers required to adapt for them to increase productivity, and a number of technologies were developed under the research program, for example, but we still have research gaps in terms of disseminating those technologies. We also have gaps around the … systems for these legumes, especially, in terms of how do you get these to be commercialized?

And we have obviously noted that it's not enough to just invest in research alone. You also require a way of disseminating some of these products that you develop under research.

It's also very, very important to have noted that – to have a … data system that is going to inform government to ensure that the decisions we make, whether it's with regard to subsidies of agriculture imports is based on proper evidence. And so we have invested quite a lot in creating a local think tank here through our ten years' of support, I think, to …, and now we do have an organization known as REPRI that is leading research and has become a strong voice, I think, which government listens to in terms of providing evidence in agriculture.

And economic resilience as well. … is … out, including gender mainstreaming, because we do realize that without changing the behavior of how households make decisions, adoption of these innovations and all these messages we're trying to take with us, whether it's nutrition messages or cultural messages, cannot really take off until people start changing their traditions and the way they believe they should be doing business.

The Global Climate Change Initiative actually is intended to build the capacity for Zambia. As I said … to ensure that they're able to reduce the emission of greenhouse gases into the environment. So number one, really, what we are looking at is trying to ensure that Zambia has the capacity to manage its natural resources sustainably, and we are doing that through working with the districts, governments offices as well as local communities, to ensure that at the end of the day, they can manage these resources profitably, and the resources – the … those are shared equally between them.

And we have a number of programs that are doing that. Basically, we are all contributing towards the reduced emissions from deforestation and forest degradation.

So in terms of lessons from the model which Robert talked about a great deal, how are we using those to inform our new sort of programs moving forward, just to recap, we did hear that the charcoal production and agriculture are both important drivers of deforestation in this country, and we see this from the picture there, which I got in yesterday's newspaper, one of our leading newspapers in Zambia, where the reporter just got a shot of … more than six bags of charcoal as a way of raising money to buy food, due to a number of reasons.

One, the reduced coal production because of the El Nino we have in Zambia is really becoming very, very important. We did hear that … Zambia where the Feed the Future program as well as the Global Climate Change programs are operating, the major driver for different … is agriculture, but here in Lusaka, it is charcoal. So indeed, understanding these two different drivers is very, very important in terms of us trying to design programs that are going to address these concerns in the two areas.

Looking forward, charcoal becomes a major driver in both provinces, I think, as you saw from the model, and we did also hear that the agricultural development … is really mainly through population growth. These are new families that are – because their fathers' land cannot be subdivided any further, they move out of those regions to go and start opening up… in areas which were normally forest areas. We see very little, of course, of people moving out of those areas because of the decline in ….

So … production in the urban areas is an issue that we really have to deal with, and this, we have learned that is mainly driven, of course, by the population growth.

So … that despite the kind of results which the model has shown us, that in urban areas, the driver of deforestation is charcoal, and in rural area, like Eastern Province, it's agriculture. And moving forward, charcoal is going to be the big issue. We cannot say let's start focusing on increasing productivity of agricultural land, because we do know that if these people do not have livelihoods, especially those people in rural areas, they will turn to charcoal as a very easy way of making money, so we have to continue investing in ensuring that people produce enough in the face of

climate variability.

We also now know that we need to have alternative energy sources for people in urban areas, because these are the one that drive the demand for charcoal. If a province is like …hours from Lusaka, and when driving out there, that's why you pass through the … Valley, which is an area for wildlife, as well as a lot of forest, and we see a lot of charcoal being harvested in those areas, again.

So yes, I was saying that … linkage between the … increased productivity … level, which are … intensification, are not so clear or obvious, as we heard from Robert, where the model is showing that if … actually threefold increase of maize yields, it basically has no effect on reducing deforestation. What we are saying here is that we cannot simply say that's the wrong investment we shouldn't go into, technologies that increase productivity, because they have no impact on deforestation, because obviously, as long as people don't produce enough food, they will turn to the forest to make their livelihood.

Yeah, so we have also learned that with this demand of energy … programs, that also address the energy requirements of people in the urban areas. And so one of the programs we have in Zambia, which we are part of now, is the Pan-Africa Initiative, and that this is incorporating a source of clean energy to help Zambia meet its energy demands, which, for example, this year, because of reduced rainfall, we have had challenges of generation of power through hydroelectric power plants.

And then with this population growth as a number one … long run, we need to start looking at the family planning as an important issue to incorporate, so as we are … our country's development cooperation strategy for the next five years, which is going to sort of like guide our investments for the next five years, we want to ensure that health programs that have the resources to go into issues of family planning are collocated with our country investments.

And then we also know that adoption of these technologies, whether it's energy, …, or indeed agricultural technologies, the adoption is really not that high, and we really need to start thinking about how can we change that behavior, bringing in social behavior kind of interventions, and see how we can tweak some of the kind of activities we are doing to ensure that maybe adoption of these technologies can increase and result in the kind of benefits we want to see in the long run.

And finally climate change, I think for people who are living in rural areas, it's seen as the biggest threat to their wellbeing, more than deforestation. For people in rural areas who depend on the environment and the land for their livelihood, they are looking at what are they going to eat today, so they really don't so much prioritize the issue of preserving forests. They have to survive for the day. So we really need to ensure that the livelihoods of people who live in those environments is accounted for to ensure that the conservation of the environment in the long run is achieved. Otherwise, we cannot just do one thing and forget the other one.

We – I did say that although the linkage between agricultural intensification or increased productivity and deforestation as demonstrated in the model was weak, we should not lose focus on addressing those food production requirements, given that the population will be growing, and that's definitely an important area we should continue working on.

And for Zambia, again, we have had this notion that we have tons of land. With only two people per hectare, farmers ought to have abundant land and to expand. But the key thing really here is that we do experience … some have been telling us they don't have any more land to expand, and this is really primarily based on the fact that a lot of them are located in along areas which have infrastructure, developed infrastructure, such as roads, where there are schools and things like that.

So in terms of looking in the long run to ensure that the environment is properly managed, we have to look at infrastructure development, and ensure that … in those areas is eased. We also need to look at the … system, which should enable people to easily get titles as well, because currently, it's only maybe the rich or elite who are able to process titles easily.

And we need to look at how land can be made more available to smallholder families in the long run by reviewing sort of our Land Act. And so, again, emphasizing that … agricultural growth in this economic environment where the population is likely to grow, it's still going to remain very, very important, and we still have to continue focusing on that. I think as we – in fact, for most African countries, a lot of people depend on agriculture.

So with the right investments and community-level level planning for conservation, … possible to come out of these areas in terms of tapping into the wildlife, tourism, fisheries, and livestock, and

that holds potential, but communities need to be managed, and these require sort of long term planning.

We also know that with the right community organization and provision of infrastructure, small scale farmers can also be very important players in the food value chain, ensuring that they contribute to the economic growth of the country. And we still think that small scale farmers will continue playing a very important role for conservation in Zambia. If they're able to remain fixed on their parcels of land without really invading on the larger landscape, but to do that, they really need to increase their productivity. They also need to … as well, and ensure that this can be passed on from generation to generation.

And finally the … change is going to be very, very important. What's the best way we are going to bring this change? Are we – should we be using maybe children as entry points? And in the long run, how do we engage the youth to ensure that they are interested still in agriculture, which – because currently, without mechanization, a lot of people just move away and go to town. And … good practice requires a very good … kind of approach, because you need to identify what is working and why, you know, farmers are not adopting those practices that they are not adopting.

So this is what I wanted to share. I hope that you've learned one or two things. Thank you very much.

Julie MacCartee: All right. We'll go ahead and ask a few more questions for our presenters before we wrap up today. We had a lot of great questions come in and great discussion in the chat box. Thank you very much. I think I will just jump in with a little bit of basic couple of questions about what CSA is. So this might be for Jerry and Mark. Uku Makino asked, do you consider changing of crops, in other words, less water consuming or adapted to saline crops, as moving – as climate forward agriculture? So changing to those kinds of crops, does that count as CSA? And also, does the climate smart agriculture discussion also apply to steps farther in the value chain, post-harvest, in the supply chain, particularly when crops have had to be changed due to change in climate conditions.

There's a lot of discussion on increase in production, but is there also a major issue in harvest, storage, and transport to be addressed in the CSA realm? If you can address that quickly?

Mark Visocky: Thanks for the question, and the question itself reflects what I think is good systems thinking. So indeed, we do take our thinking

about climate smart agriculture to that larger system, and including post-harvest and processing issues. And so it is that larger system. Now you asked about is a drought tolerant crop, is that considered climate smart agriculture. I think it's most properly considered as one part of a climate smart agriculture approach.

We have seen cases where a new, improved, drought tolerant crop is planted, but not managed properly, or is not accompanied by other climate smart agriculture approaches in terms of soil management, fertilizer management, and so on, that fail. I was in Malawi recently and looked at drought tolerant beans that were completely dead, and in part because they – the spacing was not right, and the tillage practices were not very well suited to the particular weather conditions of that year.

So it's a part of an overall climate smart agriculture approach, which more broadly does look at the food system overall. Of course, some parts of USAID focus more on those other parts of the food system, for example, roads, properly constructed, well-planned roads can be part of a climate smart food system that's usually outside the realm of the Bureau for Food Security investments focused on smallholder farmers. But we do try to coordinate and plan our climate smart agriculture activities within that larger food system.

Julie MacCartee: All right. We had a question about the applicability of the model that was presented today. How can other USAID Feed the Future missions use it, and at what level, CDCS versus the …? In addition, how can projects incorporate participatory systems when they are already mid-implementation, rather than at the beginning?

Jerry Glover: And this is Jerry. Just to comment on how this might fit in mid-program level, I think it would fit in very well, and in fact, that's what we did there in Zambia. So we had activities going on. We had some questions about the assumptions that we were making about the investments that we had, specifically to what extent are these investments in agri-forestry and CA meeting our broader needs on the landscape level?

So it really did help pin down some of the details that we needed, identify some of the knowledge gaps, and has now affected our investments going forward. So I think it's very appropriate even midterm to do a – to do something like this. On the upside, for missions, you can actually midway identify greater impacts of your investments that you can then report and get out to others. I mean, those lessons learned from each mission can help guide the

investments for many others. So I think midway is fine.

I will say, Eric Felix asked the question, how much did this modeling study cost, and how long did it take? As Robbie pointed out, roughly 15 months, and the entire project had about a $350,000.00 budget. I should say, though, that it also included a biodiversity component that Robbie didn't comment on, and as a sort of prototype of this approach for assessing our climate smart agriculture approaches, it was undoubtedly more expensive than what it needs to be in the future, particularly I think for surrounded countries, countries where some of the situation – some of the characteristics would be similar to Zambia.

And so my hope is that we can get this down as – get the cost down to a level that we can use it as a diagnostic tool much more frequently, and use it either at the beginning of program design or even as a midway check for course correction and other things. Maybe Robbie has a comment on if we're looking at potentially significantly lower costs going forward for other similar situations.

Robert Richardson: Absolutely. Thank you, Jerry. I agreed with your point about this particular project, first of all, we – as you know, we didn't even spend the entire budget that we originally allocated for it, and the construction and development of this model had a steeper learning curve. To do something in a similar context, similar agriculture context and ecological context, I think would be much simpler. If the context were dramatically different, it could be somewhat less costly, but in a similar context, I think it could be much less.

Julie MacCartee: Thank you all. This is a question for Harry. In Zambia, did you see donor cooperation or is there donor cooperation around efforts to integrate investments in productivity and in preventing deforestation?

Harry Ngoma: Yes, we do have donor group meetings, I think one on agriculture, an environment where these issues are discussed, and USAID actually has been leading the donor group I think in the last three years.

Yeah, researchers are – in terms of budgets, in terms of what is being invested in, for example… productivity or management of natural resources, is all being shared, and I think the connection is moving in the right direction.

Julie MacCartee: Thank you, Harry. We have – there's a lot of questions asking coming in today, and so we'll ask a couple more. We'll run slightly

over time. But then we'll need to wrap up, but I promise that we will share all of the questions that came in today with our presenters and continue the conversation on the Agrilinks.org website.

All right. There was a question that came in during Robert's presentation saying that the absence of a clear demarcation between farm scale and landscape poses a problem of incompatible and even sometimes conflicting priorities. Are there any suggestions to address this problem?

Robert Richardson: Yes. I'll give a couple of examples of how that demarcation became problematic. As Jerry mentioned a couple of times, biodiversity was an important part of this project's objectives, and we hoped to look – to take that into account by looking at the impacts of what happened with the farm scale on wildlife. In this region, wildlife are abundant. There are a number of national parks nearby which have species that are valued both for bush meat and also for export products. This is all illegal.

And so the issue was raised several times, some of this wildlife and biodiversity, the habitat is in so-called game management areas adjacent to national parks, where many smallholder farming households live and grow food, and this leads to some conflict, such as say elephants trampling through crops and leading to crop losses from these damages. That's one example of where you start to see some conflict between multiple objectives of say promoting climate smart agriculture and promoting biodiversity conservation in the same region, when in fact maybe those two activities are incompatible or at least not well-aligned.

Julie MacCartee: Excellent. Thank you. And I think we'll perhaps just ask one more question, because we are coming up on the end of our time today. Is it fair or possible to actually choose between adaptation or mitigation efforts in the context of a Feed the Future activity, bearing in mind limited resources and often a five year activity or intervention time?

Jerry Glover: Yeah, sometimes we do have to make those difficult decisions, and one thing that can make it easy is that sometimes our funding streams are specifically designated for adaptation or mitigation, not always both. So in some cases, we do prioritize mitigation activities for a particular region.

For a Feed the Future initiative, we would generally prioritize adaptation, because we really are focused on the impacts on

smallholder farmer livelihoods, and realizing that the burden on mitigating climate change is really on us in the developed world, and that's why in the climate smart agriculture objectives for USAID, we emphasize mitigation where appropriate. So overall, I think that we do prioritize adaptation strategies that directly benefit smallholder farmers, but we really do want to take advantage of the opportunities where we can help farmers mitigate their overall impact on the environment.

Mark Visocky: It's a good summary, and Jerry is completely right, is that our funding streams sometimes don't allow both. But in a lot of cases, I think if the mission looks really hard, sometimes we can find areas that are win/win, both for adaptation and mitigation. And we may not be able to measure both, but we'd be able to at least get some activities that can cover both of those areas. For us, mitigation is pretty much about emissions, more than anything else, and we do work a lot more at Feed the Future on adaptation, because it's a little bit closer to what kind of work we do. Mitigation has a lot more history in our Global Climate Change office, and how they attack that problem as well.

But both Jerry and I and the office of Global Climate Change are working and talking together, and see where we can cooperate a lot more between our projects.

Jerry Glover: And I do believe we are getting much better at getting those win/win – taking advantage of those win/win opportunities, and working with the missions and bureaus here in Washington, DC, to ensure that mitigation funds complement adaptation activities and adaptation funds complement and support mitigation strategies. So overall, I think that we're getting better, and in part, because we're using tools like that that Dr. Richardson used to really get to the heart of some of the assumptions that we often had, but didn't have the – we didn't – we hadn't yet really questioned those assumptions. So as we question the assumptions as we've done here, and expand our knowledge base, I think we are getting better at achieving the triple wins of climate smart agriculture.

Julie MacCartee: Wonderful. Well, I would like to extend a sincere thank you to our presenters, Jerry, Robert, and Harry, and of course Mark Visocky for chiming in as well. And thank you also to the entire Agrilinks team for continuing to run this webinar series. So thank you very much, and we'll see you at future events.

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