Decode 6

DECODING CARBON AND ECOSYSTEM SERVICES

WHAT ARE THE CHALLENGES FOR MRV?

Featuring Dr. Jerry Hatfield

Agricultural Consultant

DJ May:

Welcome to the Decode 6 podcast where we take your questions about carbon and ecosystem services, and match them to the experts with the answers. I'm your host, DJ May. Today, we're tackling measurement reporting and verification, or is it's often called in the carbon market world, MRV. Specifically, what are the challenges for measuring, reporting, and verifying soil carbon sequestration?

Before we dig in, let's meet our expert Dr. Jerry Hatfield. Jerry was formerly a laboratory director and plant physiologist for the United States Department of Agriculture Agricultural Research Service. Now, in retirement, he's serving as an agricultural consultant. He is an expert in evaluating the dynamics of the soil plant atmosphere continuum to increase crop production efficiency, enhance soil health, and combat climate change, which is a mouthful.

All of that to say Jerry's the perfect person to talk about the challenges for measuring, reporting, and verifying soil carbon. Welcome, Jerry. Great to have me here.

Jerry Hatfield:

Well, thank you and it's a pleasure to be here with you as well to talk about carbon, one of my favorite topics and everything.

DJ May:

Well, you're the right guy for the job, but we can jump right in. Tell us what are the challenges for measuring, reporting, and verifying soil carbon?

Jerry Hatfield:

That's probably the $64,000 question of soil science today is how do you measure carbon? It's a challenge from this perspective and you have both a spatial component to it, and you've got a temporal component to it. We have the ultimate of space and time and space is a little bit more complex than just saying, "Well, if I sample from the bottom of the hill up to the top of the hill, I'm going to be something." We know that there's differences along that path.

Then, you got a spatial component that is really quite worrisome, is the fact that what's in the upper surface and then what's in the lower part of the soil profile. You've got those two dynamics, those multidimensional dynamics in terms of space. Then, you got time. You got time that's saying, "When do I best sample?" We know there's inputs and if we talk about a carbon balance within that soil, what's in this dynamic pool and what's in the more stable pool?

Our favorite measurement in soil carbon is soil organic matter. You look at it, and soil organic matter is the end point of a lot of things that's there because that, that's a piece that going into organic matter. It's a little bit more stable over time. The part of carbon that is probably the most

dynamic is how much biological activity is there? We have a lot of carbon that's tied up in very transient microbial systems and soil biological systems. We talk about soil as a living organism.

In that living part of that process, we're storing carbon, we're reducing, we're changing carbon, we're respiring, we got all these different pieces. A lot of measurement right now is focused on all these different facets. How much microbial activity is changing? How much organic matters changing, which tends to be fairly slow. Then you've got what's going into the inorganic pool that's being changed as well. All of a sudden, we went from this very simple saying of saying, "Well, let's look at soil organic matter content."

Everybody else is saying, "Whoa, there are a lot of things that are changing within this soil that are reflective of the carbon balance. How do we start looking at this? People are now saying, "Well, let's measure CO_2 respiration rate. Then, see how much that's changing. Let's look at different parts of this puzzle." All of these different components—and then let's not forget the inorganic part. That's why the whole measurement complex has really become a lot more confusing lately in saying, "What do I measure?"

Then you get into saying, "Well, when do I measure it? If you're talking about microbial activity, obviously in Iowa, measuring microbial activity during the dead of winter is probably not a good representation of what's going on it's probably sometime during the summer. Then, how often do you have to make these measurements to get a real representation and then you look at organic matter, the dynamics of that are really probably a lot more variable than what people think in all of this.

We know that as we improve soils, we do see a general trend upward, but if we sampled it once a month over a year, we'd see that number go fluctuate just because of different dynamics as well. That's why the measurement complex is there. I think it frustrates a lot of people saying, "How do I really calculate this?" Do I know that I'm headed towards the right way? You see all of these techniques coming in now.

We're trying to go back and say, if we could measure with remote sensing how much biological activity above the soil surface that we're looking at? Can we estimate how much carbon is going into that soil? Then just do the simple measurements, I say simple in terms of what's happening in terms of the soil carbon balance out there. I think this will become our challenge. Then, let's not underestimate this spatial variation piece.

We can come in and start looking at fields and looking at this and subdividing that field and saying, "Let's look at the lower organic matter parts. Let's look at the higher organic matter. Let's look at spatial distribution." Typically, in soil science, we measure, we're very fond of the upper 18 to 24 inches. Most of the time the 18 inches is the depth that we go, but we got roots that go down we're talking about four or five feet. How much organic matter carbon gets down to that point?

How rapidly does that change to go out and start making four-foot profiles out there. There is a lot of curiosity in terms of how many times do we have to make that measurement? How stable is it, all of these different things. It's a pretty complex question that there's been a lot of different approaches on. I think that as one of the things that we have to do in this whole MRV approach, measurement, reporting and verification, is really start looking across methods and across time

and space saying, "Are there things that we're going to have to develop a new ways to looking at this?"

There are some aspects in terms of robotics now. Can you send little machines out in the field that would probe? We've done wonders with the Mars rover looking at soils. Can we have a whole set of Mars type of rovers for the Earth that sample our organic matter and saying, "What are we changing in the soil that we don't have to cart that whole field back to the lab for analyses as well?"

DJ May:

Well, what I'm hearing is it's not just like a one and done situation.

Jerry Hatfield:

It's not a one and done, DJ. I think that really becomes the part of this is that you can think about this as a lot of future opportunity for people that soil sample and labs that are soil sampling, and all of this. I see this as a real growth industry for agriculture, but at the same time, let's just not look at it from a carbon perspective, let's look at it in terms of soil health parameters.

Thus saying, "Are we really improving and enhancing our soul resource?" Let's just not be focused on one part of the puzzle let's look at it holistically and saying, "What's the best thing we can do to preserve and enhance our soul resource?"

DJ May:

Well, on that note, if I wanted to go get a baseline or start understanding what I have going on with my soil resource, what kind of tests would you recommend? How do you get a baseline?

Jerry Hatfield:

The baseline let's just take an example of 160-acre field. I would come in and look at the soil map for that field. The other piece that I would look at if I were a producer is look at my yield map and saying, "Are there parts of that field that have low productivity and other parts that have high productivity?" I would use that to gauge my soil sampling. You can always pull down soil maps from SSURGO and all the NRCS databases, but you can walk that field.

Then, I would pick parts of that field that I think a representative and I would geolocate them so I could come back to near that same spot time after time. I wouldn't do a random sampling, I would do a very stratified sampling. Then, I'd look at things like organic matter. I'd even get my own texture analysis done rather than relying on what's in the database. I'd look at the micronutrients and all. I'd do a very comprehensive baseline test of a lot of different parameters, even biological activity.

A lot of labs now do this in terms of routine analysis. Then I would say, "Where are we at with this? Where's it at spatially?" Then when we start thinking about changes that go into that. If you get into a program that says, "I want you to increase carbon content by reducing tillage or adding cover crops, are those systems that management practices we put in causing an impact in the

changes out there?" Things like wet aggregate stability, for example, we know really responds to microbial activity.

Just invest into tests that add value to your decision making and look at it from that perspective and spend a lot of time talking to other people who have made measurements and seen their changes in their soils. This is where I think that a lot of communication with people who've been there can help you determine what measurements you need to be making as well.

DJ May:

That's great. Chat with your friends and know that there's a lot of opportunity for growth in this area, even though it's a huge challenge right now.

Jerry Hatfield:

Yep.

DJ May:

Well, thank you so much, Jerry.

Jerry Hatfield:

Well, thank you. It's a pleasure to be here.

DJ May:

If you're looking for more information about carbon sequestration and measurement, reporting, and verification, check out the show notes for links to related research. If you're curious about carbon and ecosystem services or you have more questions that we should answer, come visit us at decode6.org to learn more.