## Managing Water with Soil Health

## Season 1, Episode 14

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**[introduction plays: John McMaine narrating]:**

**[transition music plays]**

**John McMaine:** The second part of our soil health and drainage discussion with Dr. Eileen Kladivko. I’ll let her reintroduce herself.

**Eileen Kladivko:** This is Eileen Kladivko. I’m a professor in the agronomy department at Purdue university.

**John McMaine:** And just as a reminder she is fortunately an expert in the two topics we’re discussing today; soil health and drainage, which is a really good combination. And if you missed part 1 last week, we encourage you to check it out. We discussed kind of the relationship between drainage and soil health and talked about kind of how water moves from the surface down through the soil profile, and we discussed water table issues and how to address those other issues potentially related to drainage. Today we’ll be discussing solutions to some of those issues, some newly studied aspects of soil health, potential benefits, and more. One of the things we talked about last week was this continuum from the natural system, our natural prairie, to the agricultural dominated system and some of the, I guess ecosystem services we may lose or gain as we move along that continuum. So, one of the questions I asked Eileen, this is kind of how we’ll kick things off for this episode, is ‘Is there a win-win-win situation for habitat, agronomic, and water quality aspects and this is what she had to say.

**Eileen Kladivko:** I think for sure drainage and soil health are very compatible and they help each other out and we’ve kind of talked about that. If you drain the soil then you can grow better crops, better cover crops, you can do no till better, you get more roots, the roots feed the organisms, the organisms build the soil, then the water moves in the soil better. So, it’s a circle that kind of helps each other. For habitat purposes, if you need crop residues, if you need growth of plants of some sort whether that be cover crops or food blocks, or cash crops. If you need drainage and you put drainage in, then you are going to get better growth of those plants. So, I think there is a win-win-win because you get better growth of the plants that you’re trying to get.

**John McMaine:** How far back to the natural system can we get with… while remaining within the agronomic system?

**Anthony Bly:** Yeah, I don’t know the real answer to that question John. I mean soil health can help drainage and drainage can help soil health, and any time we can filter water better and use that water better, it’s good for everything including, like she just mentioned, the residues on top of the soil for whatever that may be for growing pheasants or whatever. You know?

**John McMaine:** Yeah.

**Anthony Bly:** Other wildlife, other purposes that the soil life is benefiting from, having a more moderated soil-water regime. Not excessively wet and then dry, and then wet, and then dry, you know? It’s just more moderated. So, it just improves that cycle if you will.

**John McMaine:** Okay, what about ducks?

**Anthony Bly:** What about ducks, yeah! I mean we go back to like the last episode where maybe we talked about wetlands and their importance, and we just have to decide where we want to grow our food and where we don’t.

**John McMaine:** Sure.

**Anthony Bly:** And where we need those wetlands to filter water for lakes for whatever reason, or you know, water systems.

**John McMaine:** Yup.

**Anthony Bly:** Aquifers or whatever.

**John McMaine:** Right.

**Anthony Bly:** Then, you know, we have to decide where that is the most important.

**John McMaine:** And value that.

**Anthony Bly:** Right!

**John McMaine:** And keep it.

**Anthony Bly:** Keep that value, yeah.

**John McMaine:** Okay.

**Anthony Bly:** And recognize that, that that’s the reason that that is there.

**John McMaine:** Yeah.

**Anthony Bly:** That that wetland is in that place.

**John McMaine:** Yeah, alright.

**Anthony Bly:** Yeah, we just got to get there.

**John McMaine:** Right. So, you talk a lot about soil health to a lot of different people and there’s a lot of benefits.

**Anthony Bly:** Correct.

**John McMaine:** I would say.

**Anthony Bly:** Yup.

**John McMaine:** And there’s a lot of benefits, not just from an ecosystem services perspective but also from an agronomic productivity perspective. Be more resilient to extremes, you know, endless… well I wouldn’t say an endless list but a long list. So, one thing that has always… and this is again kind of getting back to the social science side. Which I’m not a social scientist unfortunately, but I am fortunate to work with some really good ones. But I wanted to hear Eileen’s opinion, and we’ll talk about this after we hear the clip, but with all these benefits, why are we not seeing more uptake of these practices? So, this is what she had to say.

**Eileen Kladivko:** I usually talk about this in my Cover Crop Talks. I say, ‘man if this is such a good thing, why isn’t everybody doing it yet?’ So, I understand the question and there’s a couple of reasons. There’s probably many reasons, but a couple of the big ones are a lot of the soil health practices, for example cover crops; there’s a short term cost, but most of the time there’s not a short-term economic gain. So, it does cost you something to actually buy seed and seed cover crop. You might be able to get cost-share from NRCS or others. But then the improvements that occur in soils don’t occur immediately and so, you don’t see a short-term economic gain in many instances. Now, in some instances you do. I mean if you can graze the cover crop or if your soil was in really bad condition, you know? You plant a cover crop one year and you’re already going to see an economic benefit, but in a lot of cases you don’t see a short-term economic benefit. So, that’s one reason. Another reason is that there is a learning curve and a lot of folks either aren’t interested or are a little concerned; they’ve heard of somebody who did this, and it failed miserably. Well, a lot of times that is because they either didn’t do their homework or they didn’t get good advice, or they didn’t talk to other farmers, or other researchers, or other extension, or NRCS who have done it and who could say, ‘you’ve got to be careful about this particular thing.’ Right? So, if you’re just starting, maybe you should try this instead of that, and here’s the reasons why. So, there is a learning curve. And then of course there’s some psychology and sociology and if people are reasonably happy with what they’re doing then why should they put the extra management and extra time into trying something new? You know, some people thrive on trying something new every year. Other people are like, ‘I’ve got something that’s working for me, leave me alone.’ So, there’s a whole host of reasons. I do want to say the economics, the Soil Health Institute recently did some studies where they essentially did case studies where they interviewed 100 different farmers across the Midwest. South Dakota was one of them. I don’t know how many farmers were from South Dakota but they’re doing a webcast on their Soil Health Institutes Report on Economics, but I’m very curious to see, you know, what some of the individual states found. I know they found that there was a lot more economic gain then what most people were aware of. Of course, that’s with the people that they interviewed, but I think if enough of the farmers are out there showing where they have economic gain and that you don’t necessarily have to wait 10 years to see the economic gain, I think that may help more people decide to give it a try.

**John McMaine:** What do you think about that Anthony?

**Anthony Bly:** She’s spot on.

**John McMaine:** Yeah.

**Anthony Bly:** She’s explaining the socio-economic implications of adopting this.

**John McMaine:** Yeah.

**Anthony Bly:** And it’s about where everyone is at; how they think, they’re position in life, the time in life.

**John McMaine:** Yeah.

**Anthony Bly:** All of those things drive this adoption.

**John McMaine:** So, you work with, I would say, quite a few early adopters. What’s kind of been their conversation about this, of why they maybe tried something new?

**Anthony Bly:** I think the common thread is about long-term sustainability of their farm.

**John McMaine:** Okay.

**Anthony Bly:** They see the importance of paying it forward for their economic implications on their natural resources.

**John McMaine:** Okay.

**Anthony Bly:** And they see that that is probably going to come out sometime later and that’s why they’re investing in their farm with these types of practices.

**John McMaine:** Sure. What was their specific resource concern? Was it erosion or just, kind of general goodness for water quality and kind of the whole suite of potential improvements?

**Anthony Bly:** I think it’s the suite of building soil.

**John McMaine:** Okay.

**Anthony Bly:** Getting water in the ground, preventing water loss through evaporation, soil biology, nutrient cycling is improved, all of those things. I don’t think there’s any one reason.

**John McMaine:** Yeah. It does change the whole system and all those functions. One of the things is, going back to the economic piece, one thing I hear is economics is an easy reason to not do something, right? ‘Well, it doesn’t make me money, so why would I do it?’

**Anthony Bly:** Correct.

**John McMaine:** And of course, we can get into the discussion about the value of some of the ecosystem services like, right? A wetland doesn’t provide you any monetary value, but it provides a lot of good for society and environment. And downstream it provides economic benefit because, maybe there’s less flooding and less nutrient lost. Things like that. So, anyway, I hear economics used as an easy reason to not do something, but it’s not the only answer because there are some practices that I talk about that will make someone money. They will improve either resilience if it improves drainage or drainage water recycling, or whatever the case would be, but it’s not the only reason that somebody doesn’t implement something. Right? It’s an easy reason to not, but its positive economics isn’t always the driving force that would cause someone to do something.

**Anthony Bly:** We’re intro a system where the short-term economics drives the cart. I mean, if you have to borrow that money, if you have to pay interest on that money…

**John McMaine:** Sure.

**Anthony Bly:** You’re motivated by that annual return.

**John McMaine:** Sure.

**Anthony Bly:** And the long-term is how do you think about that if you’re not going to have the land or know that you’re going to have the land in 3 years or 5 years?

**John McMaine:** Sure.

**Anthony Bly:** Or even 2 years?

**John McMaine:** Yeah, it may not pay off for you if it’s not your land.

**Anthony Bly:** Correct. Right, so there is an issue with that. Yep.

**John McMaine:** You know, a lot of times I’m critical personally of incentive payments, or equip to put in cover crops, things like that; federal support, or state support, or support from Pheasants Forever, or whatever the case would be, because I don’t want a farmer to do something because they’re getting paid to do it, I want them to do it because it actually works for their operation and things like that, right? But the benefit of incentive payments is it helps you get over that hurdle. So, you don’t see a short-term economic hit and so then you can actually realize some long-term economic gains. And so, then you can get off the incentive payments because your long-term economic picture is good, you just need it to get through the short-term.

**Anthony Bly:** Sadly though, I think we’ve trained society or producers in general, to think that they need an incentive payment to do something.

**John McMaine:** Sure.

**Anthony Bly:** Because there is a monetary loss. So, do you see what I’m saying?

**John McMaine:** Yep.

**Anthony Bly:** ‘There must be a monetary loss because they’re giving me an incentive payment.’

**John McMaine:** Gotcha.

**Anthony Bly:** ‘If it was so great then I could just do it.’ And so, here’s this result that we get that people are expecting an incentive payment to do something. And so, while it was good to show them… give them a chance so that they could show them that they can do it… I think the unintended consequence was that they expect it.

**John McMaine:** Sure.

**Anthony Bly:** Or it implies that it’s going to cost money. ‘I can’t make money doing this’ and so that’s why they’re giving me the incentive payment to do it.

**John McMaine:** I hadn’t thought of that second point of the implication of getting money for it means, yeah, you have to offset a loss to do it, and so you have to have the incentive. That’s a tough one. Do you think we’ll ever get out of that cycle?’

**Anthony Bly:** Oh, I would love to see us get out of that cycle. You know, have folks realize that they can do it and it’s the right thing to do, but it’s just difficult.

**John McMaine:** So, we had a watershed meeting recently in the Willow Creek Watershed, and you were part of that. And we had a handful of farmers there that were involved with the project and one of the things they brought up, and you brought up too, was depending on where you’re at in your career. So, if you’re early in your career, your margins are a lot tighter. You’re probably renting land versus owning land, and it’s harder maybe for you to go too far out of your comfort zone. Would you say that that’s true?

**Anthony Bly:** I see the younger people more excited about alternative practices.

**John McMaine:** Interesting.

**Anthony Bly:** But they are more constrained by their economic position. I see older people as less excited, like, ‘I only have so many years left at this, why should I change?’ And so, it would be great to have the older folks fostering this change process. You know, seeing it as something that may be ‘ boy, if I would have known this maybe 35-40 years ago when I started in this, if I would have known this and done this, just think where I would be now.’

**John McMaine:** Sure.

**Anthony Bly:** That’s kind of the way it should be to really push that forward strongly enough.

**John McMaine:** Yeah, it’s harder for them to take a risk, because the implications of if that risk doesn’t pay off, I mean they could go out of business a lot more easily than someone who has the wealth or owns land, things like that.

**Anthony Bly:** Correct.

**John McMaine:** One of the other things that Eileen talked about was the learning curve.

**Anthony Bly:** So many folks look at soil health practices as a panacea or a, you know, it’s going to solve all their problems and actually it requires a lot more attention to detail.

**John McMaine:** So, will we ever get to the point where we can standardize soil health

recommendations would you say, or is it going to be case by case?

**Anthony Bly:** I hope we can. I talk about the transition between inorganic agronomy and organic agronomy, and I hope that realization someday comes true, because can we use our decision making based upon what we see in the soil as far as what the biology is doing.

**John McMaine:** Okay, so learning curve for the whole society.

**Anthony Bly:** Correct.

**John McMaine:** Can you explain what you mean by transition from inorganic to organic?

**Anthony Bly:** Well, basically, inorganic chemistry was developed hundreds of years ago with the discovery of the elements, with the basic elements.

**John McMaine:** Sure.

**Anthony Bly:** And so, science kind of focused on those, and that’s the inorganic side of what we do, and we learn to measure them in the soil, and we study the response of nitrogen application or phosphorus application, the response of crops to those, and soil tests. All along doing that while the soil biology was there doing its own thing. We knew it had an impact, but we couldn’t measure it. And now the organic side, that’s what I call the organic side, is knowing what that biology is going to do or how it’s going to react when we do a certain practice. So, that’s that transitioning that I’m trying to explain.

**John McMaine:** From just looking at the chemical side to including the biological side?

**Anthony Bly:** Yeah, and I hate to say chemical side because all of these things are from the Earth or our atmosphere, we’ve just learned how to concentrate them in forms that we can deliver and apply more efficiently.

**John McMaine:** Maybe I should say chemistry side rather than chemical side.

**Anthony Bly:** Right…

**John McMaine:** Chemical is a loaded word.

**Anthony Bly:** It is a loaded word and it’s got strong negative connotations that I don’t think it’s quite deserving of.

**John McMaine:** Sure.

**Anthony Bly:** But it has evolved that way.

**John McMaine:** So, kind of to summarize that… and I know we’ve talked about this issue on the podcast of ‘my conservation practice didn’t work. I wasted time and money.’ And now that becomes… that becomes their personal barrier to any further experimentation.

**Anthony Bly:** It’s tragic because you have to mentally overcome that to keep going in that direction that you want to go.

**John McMaine:** Yeah, to try new things.

**Anthony Bly:** Yeah.

**John McMaine:** So, I’m really glad Eileen brought up those potential barriers or reasons why people don’t implement these practices, and you’ve brought in some great discussion too Anthony about kind of the need for trustworthy mentors, the need for experimentation-type of mindset, as well as having the capacity to do that. And like you said, it can be a barrier for young farmers, or less established farms. So, I then had Eileen give her perspective on, kind of some of the things that are unknown, or newly studied in the realm of soil health.

**Eileen Kladivko:** Well, really, soil health, the new things that are happening in soil healthy are really more focused on the biology. But the biology can affect things like water relations as well. So, my favorite biological organism in the soil, the earthworms, if you have adequate drainage in the system… now I don’t know exactly in your area of South Dakota, what your earth worm population may be, because in many cases you’re too dry, but if you’re talking about drainage, you’re not necessarily too dry. So, biological populations like earthworms do better where there is adequate drainage and earthworms are very important for building soil porosity. The de-burrowing earthworms are important for getting water flow down deeper into the soil profile, for opening up channels that roots that can then follow, providing nutrients that the roots can then tap into. So, the biology can affect the physics, particularly with the fauna. And then, I would say there’s probably work related to the physical properties as effected by… it’s not brand new, but work on no-till or other reduced-till systems and work on cover crops and how they impact soil structure and soil permeability, and how quickly do those properties change, and what are some of the management changes that you might do with the cover and no-till that you might do in order to really accentuate that. That all feeds into the soil health, but I’d say the biology is probably the main focus of a lot of the soil health work.

**John McMaine:** Do you think we’re just at the tip of the iceberg for biology?

**Anthony Bly:** I do because they’re discovering new species almost daily, and if we talk about a billion microorganisms in a handful of soil, or however you describe that…

**John McMaine:** Right.

**Anthony Bly:** And they only know of about 1,000 or 100,000…

**John McMaine:** Right.

**Anthony Bly:** Let’s even stretch it to a 250,000.

**John McMaine:** Yeah.

**Anthony Bly:** You still have several million left to go, and how that corns sensing, and what signals they look for, and what’s important to have… we don’t know that and how that happens. That’s why I say we’re just transitioning from inorganic agronomy to organic agronomy.

**John McMaine:** So, here’s a question, and it may be a contentious question but how much do we need to know about that? And maybe that’s question one, and question two is will we ever get to the point of knowing enough about the system. Or will we rely on, kind of, machine learning and AI systems to tell us how they respond, without necessarily knowing how they work, if that makes sense?

**Anthony Bly:** Well, I know this gets away from drainage, but just the nutrient cycling aspect and drainage impacts that we know that very well. Can we divorce ourselves from reliance on nitrogen fertilizers? Can we use soil biology to just do that for us?

**John McMaine:** For nitrogen fixation and things like that?

**Anthony Bly:** Exactly.

**John McMaine:** Actually, optimize a system to fix nitrogen from the atmosphere… would you also incorporate different crop rotations into that or would you also, say, focus on the biology for corn and beans, or do you think it has to be a more complex system?

**Anthony Bly:** I think it has to be more diverse. I think it has to involve cover crops, it has to involve crop rotation, it has to involve all of that. But can we grow a corn crop 1 out of 4 years?

**John McMaine:** Sure.

**Anthony Bly:** That’s just a number I’m throwing out today.

**John McMaine:** Right.

**Anthony Bly:** There’s nothing hard and fast, but if we could grow a corn crop 1 out of 4 years without any nitrogen inputs, where would that put us as far as our environment, as far as our economics? I mean, that puts us at the top of the list there. That’s a pretty impressive achievement.

**John McMaine:** I would be impressed. So, thinking about the natural prairie or native prairie, that was not a leaky system. Or, I shouldn’t say it wasn’t a leaky system, the leakage out the bottom for nutrients was much less.

**Anthony Bly:** The leakage was contained.

**John McMaine:** So, in essence we had a balance and there was no addition, right? Well, I shouldn’t say that because there was an addition through livestock integrate.

**Anthony Bly:** Well, bison came along, and they added.

**John McMaine:** Right.

**Anthony Bly:** Yeah, and they also caused that productivity to go up because that grazing caused a response, right?

**John McMaine:** Yeah, so, okay we don’t have the bison across the landscape and… okay this is a very big digression, but my brother lives in Tanzania. I went to Tanzania; I was very fortunate to go and see the Serengeti. And you go out on the Serengeti and there’s thousands of wildebeests, and it made me very excited but also very sad because that is a site. That is probably what the bison looked like across the great plains, and we’ll probably never see that.

**Anthony Bly:** Sixty million, that’s what they think, right? Is that the number?

**John McMaine:** Yeah.

**Anthony Bly:** Okay.

**John McMaine:** Anyway, that was the digression, but going back, if we look at a natural system that had a balance of nutrients, and then we look at an agronomic system. If we’re optimizing microbes to provide nutrients, is that natural? And is it okay if it’s not natural? Does that question make sense?

**Anthony Bly:** Sure, it does. I think that’s way out on the…

**John McMaine:** This is very philosophical.

**Anthony Bly:** This is very fringe thinking.

**John McMaine:** Yeah.

**Anthony Bly:** That’s way out there and those are questions we’ve got to ask. Some would say, ‘didn’t the prairie function that way?’ Where did it get its nitrogen, did it all come from the bison that passed through? Or did it have those microorganisms that produced their own nitrogen that they needed from the rest of the herd in the soil, because we have to have that balance between carbon and nitrogen, and did that happen there?

**John McMaine:** Right.

**Anthony Bly:** And we’ve slowly taken that away by tilling the soil, or “growing an agronomic crop”.

**John McMaine:** Yeah, for listeners Anthony was doing air quotes there.

**[Anthony laughs]**

**Anthony Bly:** Farming!

**John McMaine:** Right, changing the system from…

**Anthony Bly:** Changing the system.

**John McMaine:** From native prairie to a agronomic system. So, there’s potential that it is actually the natural cycle or natural system, but we just don’t know it, or we weren’t around. And pardon my ignorance, but there are probably people that are studying this, evolutionary biologists, and things like that.

**Anthony Bly:** We can’t keep track of it all John.

**John McMaine:** I guess. Wouldn’t you love to? So, there is potential that yes, optimizing biological activity to better cycle them, for the needs of whatever is growing there, that could be a natural system. We just don’t know that because we don’t have the systems in place now.

**Anthony Bly:** Well, we know it’s there, it’s possible because in some of our agronomic work we’ve grown big yields with no inputs. So, it does happen, but why it happens and when it’s going to happen, we can’t necessarily predict.

**John McMaine:** Gotcha.

**Anthony Bly:** We know where it comes from but what triggers it and when it’s going to happen, we can’t be for certain.

**John McMaine:** Gotcha.

**Anthony Bly:** And that’s one of the big quests of the folks working with nitrogen.

**John McMaine:** So, the last question I asked Eileen was kind of what she’s excited about when looking into the future of soil health, and some of the innovative projects that she’s seen or worked on, and this is what she had to say.

**Eileen Kladivko:** Well, I’m really focused, pretty heavily on the whole cover crop area and although cover crops, in some ways, have been around for a long, long time, we have new interests in cover crops now than what we’ve had, you know, 30, 50, or 100 years ago. So, trying to determine which cover crops and which cultivars can do which things for us, that’s both species-wise, as well as variety-wise. And it’s a little overwhelming from one standpoint, right? There’s lots of different varieties, and they all do, they all behave just slightly differently, even for the same species. But I think one of my colleagues used to call it ‘designer cover crops’, right? Trying to find the cover crop to meet the need that… the particular need that you have for a particular field, and that fits within your climatic zone as well. I think that’s pretty exciting, as well as the whole thing with mixes. There’s a lot of hype about mixes as far as being good and in theory, the greater diversity of plant species, the better. But from the practical standpoint whether 3 different species is just as good as 6, or 8, or 10, we don’t really have a good feel for it. So, I think there’s a lot of possibilities for that. And, if I might just kind of include a little bit of the new technology… this is not something that I do but there’s a lot of people that are working on this. It’s the seeding technologies to get seeding to occur at all different times of the year, not just after harvest. One of the constraints to greater adoptions of cover crops is that if you don’t see them until after harvest, it’s too late for many of the, what I might call the more interesting cover crops, right? About the only thing that’s left a lot of the time is cereal rye and cereal rye is great. It has a lot of uses, but there’s a lot of more interesting cover crops. But they have to be seeded earlier and have an earlier growth period, so some of the new technologies that are coming up… I mean the airplane, aerial seeding has been around for awhile but some of these highboy-like seeders that can go through standing corn crop that’s right before being ready to be harvested, or some of the seeding technology that’ll go into corn when it’s at the 6-leaf stage, or something like that. Finding the right cultivar that won’t get shaded out and won’t compete. Or maybe getting it seeded a little bit earlier with robots that go through the almost mature corn, or drones, you know? So, there’s people that are trying all different kinds of technologies to occur earlier and to get termination to be a little bit easier to handle in the spring, right? When, if the soil is really wet in the spring, getting it terminated on a timely basis is also a challenge that worries a lot of farmers. So, I think there’s a lot of technologies that are being developed that will allow us to do those kinds of things better, and then that opens up all kinds of things for us, I think.

**John McMaine:** So, what do you see in that response as something that is a potential for South Dakota, or otherwise?

**Anthony Bly:** As far as cover crops go, I mean, we’re constantly learning. When you talked to the more seasoned producers that grow cover crops, they’re adapting, and changing, and thinking, and learning from other producers, and trying new things, and we don’t know those types of answers.

**John McMaine:** Sure.

**Anthony Bly:** You know, you could see the same cover crop blend 5 years in a row and see 5 different results, and why that is happening because of temperature and moisture, and things like that, we don’t know.

**John McMaine:** Well, when you think about mixes, what’s your thought on I guess, species diversity and things like that?

**Anthony Bly:** I think it is important.

**John McMaine:** Okay.

**Anthony Bly:** I always think of the famous study from Mandan, North Dakota where they had single species cover crop seeded and then a blend. And they had a drought occurrence, and the single species were struggling to non-existent, and the blend was happy. Since we don’t know exactly…

**John McMaine:** Yeah.

**Anthony Bly:** I just think we’ve got to be smart about these things.

**John McMaine:** Yeah. So, then thinking about the, I guess, seeding applications, I guess do you see that as a potential game changer if we can do better at getting cover crop see in the ground prior to harvest?

**Anthony Bly:** Absolutely, I do. We’ve got to figure out… it’s the transition and the overlap of the cash crop and the cover crop. That’s what we’re trying to learn about.

**John McMaine:** Right, because if you do it too early you get competition. Too much competition would you say?

**Anthony Bly:** Well, we’ve found out that later competition… in fact I think the insurance companies now realize that that later competition isn’t a big deal.

**John McMaine:** Okay. So, maybe just going back real quick to this question about, okay these systems are complex, will we ever get to the point where we understand it? Or will we just have to be content with managing it in a way that works best for our objectives?

**Anthony Bly:** I think we’re going to learn to manage it first, and then we’ll learn to understand it.

**John McMaine:** Gotcha.

**Anthony Bly:** I think that’s going to be the transition, and that kind of goes along with my inorganic to organic agronomy thing. And maybe it’s not real right now, maybe it’s too early to talk about it, maybe it’s 100 years from now. I don’t know. It’s just a hidden world that’s right under our feet.

**John McMaine:** Well Anthony I think that’s a good place to stop our discussion for today. We discussed again the relationship between drainage and soil health, some potential issues, some potential benefits, and then kind of some ways we can think about overcoming hurdles. So, if you the listener would like to learn more about soil health or drainage, find us on the SDSU extension website, but for now I’m John McMaine.

**Anthony Bly:** And I’m Anthony Bly.

**John McMaine:** And we’ll catch you next time on Streamlines, your source for water knowledge.

**[Music]**