

Field Day Podcast Ep. 12 Dr. Kevin King.mp3

Jordan: Welcome to episode 12 of the field day podcast brought to you by the Ohio Farm Bureau Federation. I am your host, Jordan Hoewischer, director of water quality and research for Farm Bureau. Today's conversations are with Dr. Kevin King from USDA ARS. Kevin essentially does the backbone of all data that is used for water quality so he takes the Edge of Field monitoring data off of fields around Ohio that has disseminated and used in all sorts of studies and conclusions about different farming practices. So a great conversation that I had with Kevin in his office and a little bit of something to get you through the winter. Enjoy.

Jordan: All right we'll get started here. So tell me who you are, what you do, where do you come from, what you're doing here. Tell me everything.

Dr. King: I'm Kevin King. I'm a research agricultural engineer and research leader for the soil drainage research unit of the U.S. Department of Agriculture Ag Research Service. My primary focus here over the last 10 to 15 years has been water quality. Drinking water, supplies, as well as water quality in Lake Erie and other inland water bodies.

Jordan: So as it pertains to farming one of your biggest projects is what we call field monitoring. Can you talk us through that project?

Dr. King: So the edge of field monitoring really started back again in early 2000s around 2003-2004 when we were asked to weigh in on Atrazine issues in the drinking water supply for the city of Columbus and so from there that's morphed into different things based on farm bill programs and based on the farm bill itself. In the 2005 farm bill, Congress appropriated dollars for different practices and different programs within NRCS but they also put a mandate on that. It said okay we're going to give you the money for these practices and programs we need to understand, do they work or do they not work and we need data to show that.

Dr. King: So that's how we really got involved in the field stuff back in 2005-2006 timeframe when we started looking at different practices. What came out of that was called the CEAT project the conservation effects assessment project. And so we started putting in edge of field instruments where we actually go out and tap into a tile that's on a field or we tap into the surface flow where we capture that concentrated flow area and then measure what's coming off of those fields. So that's where it really started. It morphed into now this issue where we have in the Grand Lake St. Marys and also in the western Lake Erie Basin. And so what we have in place right now is what we call a pair design. We need to understand what is the impact of a certain practice? And so in order to do that we use what we call a paired design and that paired design is when we go and we finally find a farmer that wants to work with us or will let us come on the land, we try to find two areas on the field or adjacent fields across the road across a drainage ditch or whatever that might be. What we do then is we'll go in and we'll put in a surface form or basically it's a control structure that allows us to measure the amount of water that runs off of that field. We also tap into the tile drain and that allows us to measure how much water is coming through the tile and what we when I talk about a paired design, we collect data then for a crop rotation and we call that our baseline period and then we take after that period we work with the producer or the farmer and we identify a practice that they might be interested in. But the one that we're also interested in from a research standpoint. Then

what they will do as business as usual in one field but then they'll make that change on the other field and then we'll measure that again for a crop rotation and then that allows us then using this before-after control impact design scientific term but it allows us to quantify the impacts of a specific practice, farming practice or crop production practice. So that's really what the edge of field is designed to do. We currently have within the state right now 20 paired fields is where we are. I think, I don't know the exact numbers off the top my head 13 or 14 of those are in the western Lake Erie Basin. Four of those are in the Grand Lake St. Marys watershed and the remainder in the what I'd say the upper Scioto watershed.

Jordan: So how often are you taking samples from these fields?

Dr. King: Yeah, good question. So if anyone has water flowing, we're taking samples. So on the tile, we look at tile drainage, we have to have drainage in the state and it's not an option it's a necessity. Tile drain for roughly anywhere from 200-250 days, let's say, some may drain up to 300 days, but generally in that range and if water's flowing, we're taking samples. The way we're doing it right now as we take us on what we call an aliquot water, small portion of that water and we put it into a sampling bottle and then those usually last for about a day or two days. So we get a representation of what's coming off that field the tile drainage on a daily basis or every two day basis. The surface flow, when we actually have surface runoff but when that does occur, we're taking those aliquot flow proportional amount coming off of that field. To date, I can't tell you exactly how many samples since we've started but 20,000 or more probably at least that we've been that we've been doing and that's just in the last four or five years.

Jordan: What's the avenue to let you get the samples and the actual information?

Dr. King: So what occurs is on a weekly basis, we have three to four support staff here at the U.S. Department of Ag, Ag Research Service that go out and they will collect those samples. They'll make sure all the instruments are working, they'll check the readings and make sure things are calibrated properly, they'll bring those samples back to our laboratory and then we will analyze those samples for nitrogen, we look at both total nitrogen and nitrate nitrogen and we look at phosphorus both the dissolved phosphorus and the total phosphorus.

Jordan: So what does something like this cost? I know you have 20 of them or 20 fields. What's a paired site cost you?

Dr. King: So the installation is the big outlay of dollars. When we started this and we tried to put some numbers to it to get a single sampling point installed is around \$25,000 and that's the labor and all the equipment that it takes to do that. So when you're talking about a paired site, four sampling points on an individual farm you've got \$100,000- \$120,000 wrapped up in that sampling equipment equipment installed. Then on an annual basis for each site to the labor to go collect those samples, the sample analysis, the maintenance on those instruments to make sure they're operational, we're talking generally around 6-7,000 dollars a year so when you start thinking that we have 80 of the sampling points out and about in Ohio that's \$500,000 a year just for maintenance, that's the infrastructure that we have sitting out there is roughly \$2½ million and then it takes another 400-500,000 thousand in that range on an annual basis to keep these operational.

Jordan: How is this project funded? I mean how do you put up the money for this?

Dr. King: It's you know, as any big project, and I hate to start listing people because I will forget some and so general but it's been a lot of different groups in our NRCS has been a big big player. We've worked with the commodity groups, we've worked with agribusiness, Ohio Farm Bureau, we've worked with the Nature Conservancy has been a portion, Beck's Hybrid and the College of Food Ag and Environmental Science at the university has been a partner. Again, I'm hesitant to name names because I know I'm going to leave someone out and that's not the intent here but it's a collective effort it's a big effort. There's a lot of different a lot of different players out there.

Jordan: Yeah I guess that's what I assumed I didn't know how many people were involved. It seems like information that everyone's interested in because it is the information right. That's what's happening on farm fields, that's kind of the missing link between how decisions are being made from a number of different facets. So how is that information used? What's the end game with all this information?

Dr. King: Our ultimate goal when we first started this was to identify practices that offer an ability to reduce nutrient loading to surface water bodies or polluted water bodies. So that was the primary goal and I think that still is the primary goal but there's different ways of getting at that. We cannot possibly go out and measure every field we have. Again, 40 fields, 20 paired sites as we just talked about that's a big undertaking in terms of dollars. It's impossible for us to go out and say let's do another 40 fields or another 100 fields or whatever that might be. So one of the ways that we can scale up if you will is using computer model simulation tools. And so a lot of this data is being shared right now with different folks at universities, different government agencies to actually develop models or test models and then if we can get those tested and we can calibrate and validate those models then we have a tool that we can actually project or look at what the implications of a more widespread adoption of these practices would be.

Jordan: So essentially use it as the backbone of the model to just use the best information available to create simulator situations.

Dr. King: Yeah absolutely. And you know there's a great visual that shows a triangle if you will and that triangle back in the 60s and the 70s the base of that triangle is all the field studies that occurred and we used to have a whole lot of field studies and that pointed to a model. That's when models and computers were just really coming out and hitting the ground running. We had all this field data that pointed to a single point to try to get to this model. If we will where we are today, it's because of the cost of collecting data. It's actually inverted itself. So now we have a point or two where we're collecting data but now we have all of these models that are going to save the world so to speak or be able to answer the question. So the models are absolutely important we have to have models but that model has to be grounded in data.

Jordan: Yeah and I guess as the years go on and the more fields that get into the testing phase the more acute the modeling results will be, more pinpoint they will be. I know people were a little leery about modeling right?

Dr. King: They are and I would say you know to some degree it's warranted. I was a former modeler, I'd joke all the time that I'm a reformed modeler but you know when we think about models they are absolutely important. We have to have them as I said we cannot physically go out but we also have to understand that no model is correct but some

are more useful than others. Having said that my point is when we start talking about models when we start looking at results we need to understand how that model should be used. One of the ways the model should be used is for information and that is helping us guide the research and pointing to where we have research gaps. If we bring data back and we put it into an existing model then that helps us identify where we have gaps both in theory and in our applicable knowledge. Where I get scared with models is when we use them for policy because we're making a leap, a big leap and when we when we present this data to policy makers unfortunately they are spread so thin that they don't take the time to realize the uncertainty associated with this and you give them a model prediction and they take it as gospel unfortunately and with models, I can give you a number but that may be plus or minus 100 percent 200 percent depending on the condition. And so we absolutely have to have models. I think we rely on models for policy entirely too much.

Jordan: That makes sense to me because even with weather modeling and everyone has their jokes about the weatherman but they're using multiple different models to predict short very short and very long term weather patterns and they vary widely. I think it's hard for something to wrap their heads around but I think it is nice to always point in a general direction. There's a higher likelihood of this result because of this data.

Dr. King: If we look at them from a from a relative standpoint or a trend standpoint that absolutely makes sense. It's when we get down to the absolute that that I get concerned about.

Jordan: So as you have these fields and some have been around longer than others. What do you find in general? I mean I don't want you to have to throw out all this data but what's the general trends that we're finding on the field that you've turned on.

Dr. King: So I would say generally agriculture is doing pretty well. Now having said that, if we look at the projections, let's just look at the annex for recommendations right now out of that binational agreement with Canada and the United States. If we look at that as our measuring stick and we say, okay, we know that recommendation is for the outlet of the Maumee's or the different tributaries. If we take that projection and we divide that equally over all the acres out there it's going to be very difficult for agriculture to meet some of those goals.

Jordan: Just so people understand, that's the 40 percent reduction, that's 20 to 25 percent by 2020?

Dr. King: I think that's correct. So yes that's the annex for that I'm talking about 40 percent reduction. So when we divide that equally among all the acres it's going to be very difficult. As a matter of fact, I think our Edge of field data show that right now 60-70 percent of the producers are not meeting on the loading aspects of those. And I think it's 70 to 90 percent are not meeting on the concentration expectations there. It's going to be very difficult. Now what I will say though is if we look back in history and look at the publications and the data that existed 20 years ago, 30 years ago, 40 years ago, we don't see in terms of concentrations being that different. So what has changed? Farming has changed to some degree. Farms are getting bigger. We've reduced the fence rows. We've got a smaller opportunity for farmers to get out and apply nutrients so some of those things have changed. I think overall farms are doing the best they can.

Dr. King: Can they do better? Absolutely. One of voluntary programs started five -six

years ago is this four R program and when we look at our data as a whole and try to look at some of those practices, the right, rate source time and placement of nutrients, we do see that that has an impact. So we know if we can apply our soil test and then we adhere to those soil test recommendations based on at least tri state right now then we have a reduced potential to have a fighting chance exactly to meet those goals. And the same thing with the timing and the placement and placement is probably where we get the most bang for the buck right now. We know if we can get those nutrients incorporated or subsurface placed, get them in contact with the soil. That's probably one of the biggest bang for the bucks as well.

Jordan: So when people hear that how do you balance between solar disturbance and tillage and placement? How do you balance that?

Dr. King: That's a great question and I'm not sure we have the answer right now. There's a lot of toolbars out on the market for subsurface placement. There's a great example here in the state with the demonstration farms and one of those producers has invested in one of those subsurface placement units and they have been able to show the economics of that. You're talking about a 250 to 300 thousand dollar piece of equipment. It's hard for farmers to stomach that. And so you know that's the ideal. There are some alternatives. Incorporating those through a light disruption to a light disking or something is another mechanism. It's not the preferred but it does do OK. What we don't want to risk is another total phosphorus or sediment bound phosphorus issue by tilling. And so when we till we increase that potential and so that's not what our recommendation is but I would say it's better than just leaving it on the surface. It's a double edged sword so to speak but if you have to do that then let's try to cover crops in place you know do that fall application incorporated get a cover crop out there and get your buffer strips soon get your grassed waterways in so we reduce that potential for erosion.

Jordan: So you mentioned cover crop. What has been the general results of cover crops and some of the fields that you've been looking at?

Dr. King: It depends on the resource concern and cover crops were fantastic scavengers of nitrogen, not so much for phosphorus, we see very little benefit. The primary benefit to phosphorus. Let me clarify that one. When we look at the cover crops that in the four or five fields where we have them where we're testing that we see the nitrogen losses coming out of the tile drains the nitrate nitrogen significantly reduced. And I think that's consistent with a lot of other studies across the Midwest or other areas where cover crops have been studied. With phosphorus, we don't see any benefit whatsoever immediately. Now where I think we do get some benefit which is secondary, would be with the increase in water storage capacity so or you get that evapotranspiration from the cover crops or you don't have that water leaving the stream. So it's not a direct uptake by the plant itself but it's secondarily we're not losing as much water and therefore not as many nutrients.

Jordan: Yeah because I guess I've always been a little confused on some of the cover account management where you're not taking the material off.

Dr. King: That's right. So you know a lot of this is just a transformation .We are going from an inorganic to an organic. And so when that biomass is dropped back on there has to be a conversion. And so it's not it's not it's not in a soluble form. I mean when we think about nitrogen is going to be mineralized phosphorus it will be mineralized we'll get it back to a plant available form. But it takes time to do that. So those nutrients aren't immediate. It's

almost like a time release fertilizer if you will.

Jordan: So you look at the four R's, we have the right source, right rate, right time, right place. Placement is probably a number one. Not enough say we need to rank them per se, but I would say rate is probably second in terms of using your soil test to determine the right rate as accommodation with tri state like you said and then source you don't really have a lot of wiggle room on.

Dr. King: Well I don't know about wiggle room in terms of if you've used it and it depends on what you have available. What I will say that in this state there's been a lot of uproar a lot of finger pointing at organics manures and we do have a side by side study in one of our Edge of field sites that points to nutrient source is the issue nutrient rate is the issue of that source. So what I am going to talk about here is we put an exact amount of map and an exact amount of liquid dairy manure on a side by side field and we've measured that for two years afterwards. And there is no difference in the concentrations or the loadings coming off of those fields based on that source. So that leads us to say when we talk about organics and I've not looked at the poultry and have not looked at the swine manures there's different nutrients with those but if we put those on at the same rate we should expect that what we see coming off will not be different.

Jordan: That is interesting and I think it will be surprising to a lot of people and what the manure does to the moisture, the amount of water that comes with that concentration, does that help or hurt or change anything? I would think it would be it would accelerate the loss if anything.

Dr. King: It could, depends on what the conditions are when they apply. That's the reason one of the legislative pieces here in the state, that's why we have the different you know the half inch versus inch whether you're putting on manure or not.

Jordan: So basically what you're saying with manure versus fertilizer is if you if you place at the right rate the source is irrelevant.

Dr. King: That's our preliminary findings right now. We probably need to do some more testing. I said we've got one paired field we need to get replicated. But yes that's the direction that that's taking us right now.

Jordan: So and then the last one is timing. So do we have any information at all for spring or during growing crops?

Dr. King: No we don't have the data right now we've got some studies going on where we've looked at the fall versus spring but its but it's preliminary right now I don't have that data about. In general though I will say that the closer we apply things to the time that the crop needs it probably the better it is. That's not saying that fall application is not okay. I think it depends on the situation and it depends on how it's applied.

Jordan: How long do you think this project will be carried out. Until the money runs out or until we solve the issue or what's the ideal?

Dr. King: That's a great question and I don't know the answer to that. I mean my hope is that I think the farmers are on board. So we've invested a lot, we have this instrumentation out there. I hope as long as we're learning something that we're allowed to keep this going

and the funding will be there to keep it going. Now is that you know right now we're in treatment phases I think on all except for maybe two of the farms we're in the treatment phases. Three or four of the farms we're in the second year or second round of treatment. I'm hoping you know this is another 10 to 15 years. Now is it going to solve the problem? I don't know. But as a researcher I'm all about search for truth. Search for finding out what what is making a difference and so whether we solve the problem in Lake Erie or not, what we learn from this edge of field work is going to be critical for moving agriculture forward in terms of recommendations on practices. I like to think of it that we're collecting data in some respects for questions that haven't even been formulated yet.

Jordan: More of a database to look back and say well what did happen in the last 10-20 years. So I mean you've worked with all these farmers, you are you're the guy that's knocking on the door to say, Hey can I take all this data on your farm and share it with everybody. What's been your general relationship with farmers and what's been the response to this type of testing?

Dr. King: For the most part it's been pretty good. I will say that that farmers are very hesitant to some degree and rightly so of putting their data out there for public consumption. If it's going to be used against them. And so one of the things when we start talking to farmers, it's their data. We share the data with them. We also share it with as I've talked about different groups and to the public but when we do that we do it in an anonymous way. It's not identifiable back to that producer. For the most part they've been very receptive. There is no doubt some hesitation in the back of their minds with us with us doing that. But at the same time they recognize the issues that we have and the importance of solving them. And agriculture has always stepped up to the plate in this country. It doesn't matter if you look back at the dust bowl and what came out of that and the movement toward conservation practices and tillage, agriculture answered the call. Agriculture will answer the call here as well and I think farmers recognize that and they want to be part of the solution. Therefore they're willing to let us do that even with that risk that exists here.

Jordan: What's the easiest thing a farmer can change? I know that's kind of a murky question but what's the low hanging fruit, to not be so cliché, but what's low hanging fruit of what farmers could change to reduce nutrients coming off their farm?

Dr. King: First and foremost I think soil testing. I think every producer ought to be soil testing and I know the 590 standards allow that to be at 25 acres, you know one sample for every 25 acres. I would highly encourage producers to sample at least on a five acre type of grid and apply accordingly. I mean its one thing to take the soil sample, it's another to look at that soil sample and base your application on that soil sample and too many times I think we have producers collecting a small sample but then saying boy you know what I'm implying I'm going to make 250 bushels this year. You know I've got to apply for that when in fact if you look at their long term average it might be 180. And so you know I think we need to be more realistic about what our expectations are so when we soil test looking at that application, don't plan on the 250, let's plan on the 180. There's enough soil or enough phosphorus generally in our soils background levels to carry that. If conditions are correct for a good growing season, we'll still get there.

Jordan: This year was evident of that, right? We had in a lot of parts of the state, we had near perfect conditions throughout the growing season with steady rains, not too much and we had a lot of fields that had really high yields that I am assuming that a lot of those

farmers were not fertilizing to that number.

Dr. King: I'm assuming they wouldn't be. I think the other thing, just convince yourself as a farmer it's money in your pocket not to throw phosphorus out there. I've talked to different producers and I'm not saying we can do it for a long time but as you're applying fertilizer, turn off the hopper for two, three, four hundred yards, do a little testing on your own. You have a yield monitor in your combine, you'll go over that area, and you'll know whether it made a difference or not. And I think you can convince yourself that you don't need as much fertilizer as you think. Now is that something that's sustainable for 50 years? Probably not but that's why we soil test. I think you know we've probably got enough background phosphorus in our soils just due to our management over the last 20, 30, 40 years that we can probably grow crops for 10 years or so without having a lot of phosphorous. Really if you look back on the four Rs if you don't soil test or you haven't in a long time, placement is going to be hard if you're choosing to do subsurface or whatever then your rates are going to be hard because you're going off of no data or old data.

Dr. King: That's right.

Jordan: So really it's tough to figure out two of those four R's if you're trying to make a change without doing that soil testing. What is the hardest thing that your data showing the farmers could do to reduce nutrients that is maybe the least attainable or maybe the hardest hurdle for farmers to get over?

Dr. King: Boy that's a good question. A farmer has at their disposal I think a lot of nutrient management and that's the thing that farmers can control a lot. I guess the hardest thing but I think as important and maybe not more important is water management and you know a lot of farmers don't want to necessarily invest in that side of things. But I think as we move forward water management is going to be as critical as if not more so than nutrient management. I'm not saying we need control structures or drainage water management type structures on every tile. That's not practical. But there are other mechanisms whether we look at the surface inlands and some of the the low lying depression areas and fields we put blind inlets in those. Maybe it's looking at this idea of storing as much water as you can coming off the field maybe it's taking a little land out of production to build a detention retention basin and then you can use that to irrigate later.

Dr. King: Maybe it is using cover crops to get your organic matter up to store more water in the field with that organic matter. So I think those are things that maybe farmers aren't used to. That maybe they're not ready to move in that direction yet. But what I think we definitely need to be moving in.

Jordan: We all want to have a field trip down downs like rice the rice fields in the south try to see how they do things. I'm not sure if we touched on it too much but how is water influenced the type of nutrients coming off farms or the pace of nutrients coming off farms for the last however many years?

Dr. King: There's two portions to nutrient movement. It's the nutrient source, the source has to be there and the transport mechanism has to be there. We can have a we're going to have a field that sitting at 1000 parts per million soil test phosphorus and we don't have any water leaving, doesn't matter, it's fine.

Jordan: So we have to we have to look at both of those I think in an equal manner and

with water we know looking at our Edge of field or collectively I don't know what we've looked at now 7-8,000 rainfall events across the sites and what we see is 60 to 65 percent of the nutrient loss in the surface comes from the top 20 percent of events. So those are events that are an inch and a half or two inches or greater are transporting the largest portion of our nutrients. So we know there is there are things happening there we know that the intensity of rainfall is increasing. We know that the timing of some of those rainfall events is changing. We get more in the spring maybe than what we used to and get more in the summer than we than we used to as well.

Dr. King: When I talk about water management, how do we store another inch and a half or two inches of water in our landscape. And and I think the things that I've laid out there, whether it be drainage water management, whether it's putting in blind inlets to slow the water going down, whether it be organic matter in the soil through cover crops whether it be retention detention basins. There are some things that we can do ourselves and I think as a society there's things that we can look at in terms of we've got a ditch network in the western Lake Erie Basin 14,000 miles plus of agricultural ditches. There's a lot of storage capacity out there. It's going to take lot of engineering to figure out how to maybe utilize that to our advantage but there's a lot of opportunity.

Jordan: It's like shifting the focus on not reducing tile or banning tile but more using it as a weapon or using it as a tool as polarizing as climate change is. There has been a dramatic increase and heavy rain events to a certain degree.

Dr. King: I think you know with the climate change question, you're right it's a very polarizing question. I think what's the question we should be asking though is yes climate is changing. I think where the polarization comes in and I'm going to diverge from it but is it is it human induced? And I think that's where the debate lies. And you know whether you believe it or not we know that things are changing now. But we also have to look at this. This area that we're talking about the glaciers once laid there. It was also a swamp at one time. So it ebbs and flows so. So where are we right now? I don't know but we definitely have to understand that. And a farmer because his livelihood is made on those rainfalls knows that these are changing. The intensity of changing the timing of those rainfalls are changing the volumes of those rainfall are changing. You can go back in just in Ohio and you can look back 30, 40, 50 years ago and you can see some of the same trends though. This is not unprecedented by any means. We have to learn to adapt. And one of the things that we can do is some of these water management strategies.

Jordan: Yeah I think it's a good point. I think you just have to mitigate for it regardless of who you think is at fault, you have to mitigate because it affects your business and your livelihood no matter what. Well I think that's all I got for you, do you have any other things I might have missed that would be important issues for you?

Dr. King: Not at this time, Jordan. Thank you for the opportunity to share. The ag community I think is doing a great job. I really do. Can they do better? Absolutely. We can we can all do better. I think as a society though we have to ask at what cost? It's always that last 3, 4 or 5 percent that cost the money. How much is society willing to pay for that? Why should that be put on agriculture's shoulders when you know society is reaping the benefits from that producer? Every time they sit down to a meal. So why is it on the burden of the farmer to reduce that to that extent? And maybe as a society especially here in the United States we have grown too accustomed to I guess perfection to some degree. Instead of Lake Erie or Grand Lake St. Mary or any other water body maybe being pristine,

90-95 percent of the year, maybe it's 80 or 85 percent of the year. It's something as we grow as a society we have to be willing to adapt to that as well. We asked the farmer to adapt to different things, as a member of society we have to be willing to adapt as well. So my two cents worth.

Jordan: I think that's all I have. Appreciate it.

Jordan: That was Dr. Kevin King from USDA ARS. If you have any questions about the episode 12 or even any of the previous 11 episodes prior to, please let me know. Give me a shout out. jhoewischer@ofbf.org. Or if you want to get to know a little bit more about Farm Bureau or look up any articles or just get general information about Farm Bureau, please visit ofbf.org. Thank you!