

PaddockTrac: A web-based mobile application

I want to take a moment to remind participants that the use of training during and of our webinars is for information purposes only. Mention of trade names does not constitute a guarantee of the products by the USDA, nor does it imply endorsement by NRCS over comparable products not needed. With that, we will now begin. At this time I would like to welcome Kip, a national resources specialist who is responsible for the technology transfer of new innovations produced by these projects. You may now begin.

Thanks Jennifer. Hello everyone and welcome. The presentation today is part of the ongoing NRCS CIG new innovations webinar series. Since we started this new series, we have showcased many successful CIG projects. We record each of these, and you can go back and view any you may be interested in. The recordings are on the conservation webinar portal. To search for recordings click on the on-demand webinar link. Some of the past topics include water management, air quality, nutrient management, environmental markets and conservation finance. We are glad to have Kevin here, who has been a technical contact for multiple raising related CIG project like this one. Kevin received a bachelor of science degree from Huntington College in Huntington Indiana. He has worked as an NRCS technician, conservationist, district conservationist, and now he is the East regional grazing specialist located in the NRCS East national technology support Center in Greensboro North Carolina. He has been in the position since 2005. Kevin is a certified grass man professional and certified credit crop advisor. He enjoys training and working with NRCS staff, other AG advisory professionals and farmers on principles of good grazing management and how the benefits help all resources, including people. Kevin, I will hand it over to you.

Thank you Kip. We're in for a treat today as we hear about this PaddockTrac system. We have often heard the old saying, you can't manage what you don't measure. We're going to learn a lot about that today. We are very fortunate to have Doctor Robert column back with us, associate Dean and senior program director from the University of Missouri extension. Dr. Kallenbach is also responsible for day-to-day leadership including developing, implementation, evaluation of the campuses statewide agricultural and environment extension programs for Missouri. Dr. Kallenbach expertise is in forging grazing systems. He has next-generation sensors and technology, including the PaddockTrac system you will see today. Dr. Kallenbach completed his undergraduate degree at Missouri State University, his you masters at University Missouri and PhD in crop science at Texas Tech. He grew up on a diversified farm in Missouri. Dr. Kallenbach, I will turn it over to you.

Thank you very much for that introduction. Can everyone hear me? I hope so.

Yes.

Very good. A great introduction. I've always said about this project and program, how does it get better than working on conservation and innovation together? Today we're going to talk about those things with the PaddockTrac system. To set the stage about what technology could mean if conservation, innovation in this realm, I want you to watch this video. [Star Wars Theme] I don't know if everyone could hear the sound. As a presenter it was difficult. I could not hear it at all. I hope as participants you can hear that. Long story short, we want to talk about our vision with PaddockTrac and its value in conservation and one of those things I want to tell you about our program goals. The program goals we have as we develop the system really got down to the thing that we were interested in helping producers not only doing the job of past utilization, but we also have goals for producers around financial stability. Financial stability that gives us the opportunity to work with producers to achieve conservation outcomes like avoiding overgrazing and to be able to maintain landscapes like you see here. We work with a lot of people in Missouri and I will say that while we are interested in growing agriculture in the state, when we talk with producers, when we talk with the public even, it is landscapes like this that they want to protect or conserve as we go forward. As mentioned earlier, and I really appreciate the comments, is that we have this mantra, measure, monitor and manage. Peter Drucker, one of the great people who works in management over the years says you can't measure it, you can't manage it. often what we have found is that we are trying to often manage things that we don't have a lot of measures for. One of the things we know that is important as we improve the adoption of rotational across this country is not to achieve those conservation outcomes, we have to know what we are trying to manage. This graph, which comes from USDA information 2014 still says after all these years and all the work we have put into asking folks to adopt rotational stocking for a number of good reasons, we still have hit this limit of around 25% to 30% operations practicing that. We are trying to think of those next innovations and technologies that allow us to go from 25% to 30% adoption to something much greater, maybe 75% or 80% option. We really try to think a lot about the reasons that people do not adopt rotational stocking. If you look at the most recent work, there are two particular areas. It is the perception it costs money, and the perception it takes time. What we attempted to do with technology here is to work on both of those. Both economically viable, but also really takes less time for people. One of the things I want to

emphasize at this point is that there are a lot of technologies out there right now and technologies, because they take extra managerial time and thought, they become a limitation to adoption because as producers they are not looking to do one more thing each day, they are looking for technologies to allow them to do one less thing. You may think about the person trying to spin 50 plates. For technology we have to be able to remove those plates that make it easier to manage. We have done a lot of work in terms of grazing systems about how to measure things and measure them both accurately and with speed. As much as we talked about using grazing sticks and technologies like the rising plate meter which does an incredible job in helping us manage many times, it is very time-consuming. There have been technologies like the units he may have seen that use a light bar to measure interception with a light emitter and receptor to measure across pastures. One of the limitations is that in [Indiscernible] country those units take a real beating and have difficulty being successful. The other thing that has been a limitation to technology is manual data entry. Again, one of the things that we want to do with technology is to speed things. Really if you about where we are and technology, where we are in innovation and where we need to be able to go with conservation is to use the power of computing right in our hands. This is a picture of a computer that sent people to the moon on the Apollo mission. Your smart phone that most of you have will have specifications at least as good as you see here, both in memory as well as computing power, which is about 250 million times more computing power than it took us to get to the moon. And so, the smart phone does provide one of the toolboxes, one of the new Swiss Army tools of data you might say. We have tried to bring that vision of what happens in pasture management with the PaddockTrac system. I want you to just for a moment think about how we built this model. It is a lot like FitBit. I wear the FitBit on my left wrist and it tells each step I take each day. It doesn't measure as many as I think you should, but that is part of the I guess truth piece of technology. What happened with that FitBit information is it goes through Bluetooth to my phone and for my phone to the Internet to cloud computing. I can look at and look at it. It is more or less real time. The steps that I had on their it were only the steps I had two weeks ago, it wouldn't be very motivating to me. So real-time data transmission is important. And so, the PaddockTrac system does something similar. I will explain the sensor in more depth in a moment. It is operating on the front of an ATV that measures the higher grass 50 times per second and as one drives across a pasture or grazing land, collecting the data via Bluetooth onto a phone, onto the app, those data are loaded into the cloud and provide information back to producers about their operations. You can see one of those outputs here. We do any mapping way where people have color-coded paddock and say there is too much grass here based on your criteria or too little. All the data is held in a secure website account what is neat about being able to keep all of that in the cloud is that we are able to then go back and look at management over time. I should've also mentioned that in the set up is geo-referencing using the Bluetooth inside the phone to measure where every single measurement came from in the past year. That information is used to help us not only know what management is being measured, but also to provide geo-referenced information that can be used in conservation planning as well. So maybe to explain what is happening with the PaddockTrac unit, my colleague Stacy Hamilton who I think is on the call with us today, they are demonstrating here this sensor. I will try to use the pointer here. This may be scary. We will see if we can do it. There you go. That sensor is a tiny little ultrasound. 50 times per second and send out a sound wave. It gets a return from the top of the canopy to the center. From that we can measure the height of the grass. It is connected via Bluetooth to one's phone. As one drives across the landscape, those geo-referenced readings are being collected. Once the ride is finished, the data uploads to the cloud and the producer then receives an email validation map that says here's where you drove around the farm and in this case you could see someone has gone through the various paddocks here. These red dots are in areas that are lanes are not part of the measurement that is being used. We do have calibrated yield estimates in Missouri. Prediction equation shows are squares in the mid to high 80s in most cases. Those data are then returned to the producer and what we call a grazing wedge, this particular one shows a number of paddocks, the red ones in this case have the most grass I should say it this way. Those the furthest to the left have the most forage. We have color-coded those. These are color coatings that producers tell us that they believe to be there grazing goals in terms of forage per acre. And then it ranks them. Too much grass, right within the target or overgrazed. Not only do we provide weekly pasture data in terms of how much is there, but in week over week measurements we can measure growth rate. The growth rate is really important because it allows us, as you can see here, to make very good predictions about pasture growth on spatial bases. What is helpful about that is that not only do we know how much is growing, but we can keep that in a cumulative way over the course of the year, but those measurements help us manage forage production. Those measurements help us optimize supplementation. If you will, we can forecast it to the future when we will run out of forage and how we can change management now so we can optimize output and optimize conservation resistance. It helps us optimize fertilization. There is no need to apply fertilizers when we have too much forage, and yet that happens often. These measurements can help us do that in a better way. It

helps us grow better quality forage in most cases as well. And those better management decisions that come from measuring forage help us convert forage two more bees, more milk, more economic output for producers, and they also help us to sustain natural resources. We have a number of producers across the state of Missouri who have been cooperators with us on this conservation innovation program. Without fail, while we have occasionally had technical things we have had to learn and work with them on, have all improved management because they know more about their operation than they ever have. So I will stop there with the presentation, but I am here and I believe Stacy is on the line as well. We're happy to answer any of your questions that you have.

Okay. Rob, I have got a couple questions that have come in. Does the sensor have to be mounted on a quad bike or could it be handheld or managed on some other mobile vehicle or whatever?

They have done a lot of it on the quad bikes. You might have noticed and perhaps the last slide before this one we mounted it to some of the U type bikes as well. Vehicles I should say. It would be very difficult to be able to mount that on a human or in a handheld way. What is important about holding it at a reasonably constant height. So it is not on the front of a bike or any sort of vehicle, we can get a reasonable value.

Handheld, Elysse have somebody that can hold it very steadily in terms of height would be at least difficult.

Okay. Another question was asked. Can you set the sensor or monitor for a certain grass height you are looking for in your pastures for management?

The sensor itself doesn't have the ability to look for a certain height. But it does have the ability to measure what the height is. Once you get that information, you can, as he said, set your goals about what you want forage to be when you enter a paddock and what you consider to be optimal utilization. And that way it kind of does -- I think what the question is about is in terms of saying, we are interested in having 3700 pounds of forage enter a paddock. By the way, that is too much in most cases, but just as an example. He can set that and use that guidance inside the grazing wedge to achieve what the question is about.

Okay. Great.

I also see a question here in the chat about rotation work with livestock other than cattle. Sheep, goats, llamas, so forth. Really the tool we have here is not species specific. A number of dairy farmers are using it with cows, but it would also be successful for small sheep, goats. We have not done any work with llamas or alpacas. We are not against it, we just haven't done it. What is important to understand is that the sensor is measuring forage. What you need to do inside of the grazing wedge website is to set the right goals in terms of how much forage you want in terms of when to enter the paddock and will want to exit. Pre-and post grazing. We can give you examples of good guidance, but it does vary between species.

Okay. I am trying to summarize some of these questions that are about the same thing. Here is a good one. How much of the paddock -- let's say you had a four acre paddock, how much of that needs to be covered by driving over it with the sensor to get an accurate idea of what the height of the grass is in the paddock?

Great question. Typically, you saw and one of the slides we had we were asking people to do a modified or zigzag across the pasture. I would just say you don't want a straight line, a single line across it. What you are really looking to do is zigzagging across pastures. -- Starcows. They often vary a lot and shape and size and how they are put together based on the landscapes. I would just say if you can spend five minutes driving around a paddock, in most cases, most size systems in the eastern USA will have more readings than you can possibly need. How about that?

Sounds good. That's a lot. Couple more questions, and these are good ones too. You may have mentioned this, though. Is there a maximum minimum speed. Let's say you are on a quad bike, a speed you need to achieve to remain accurate?

The answer is yes. Good question. We wouldn't want you to drive much slower than about 4 miles per hour. The reason is that if you want to know the physics of the bike or the vehicles, if you go slow, it changes the dynamics and how the sensor is sitting on the bike. Think about it this way, if you are sitting on a four wheeler and you hit the gas a lot, it rears back. The sensor is rearing back at the same time. So we like to be able to get to a constant speed no less than 4 miles per hour and really anything over about 15 or 20 gets us in trouble.

Okay. Here is a good question that came in. What would be the estimated cost if a farmer wanted to start doing this?

Great question. So far in this project we have been working with cooperators and customer leave billed to the units and provided it to the cooperators to understand how the data would work and to work out the kinks and to understand how best to use it. If we were to bring it to market I'm guessing the product would retail somewhere in the \$1500 range.

Okay.

Right now they are not on the market. But I would say we have a number people who have asked. We worked at the world dairy Expo last week. If I had 50 of them, I could have sold 50 of them. It was pretty

interesting. At this point we're sort of getting from where the science is in this particular field to the next step into commercialization and that takes a little bit of effort. That is the next step, though.

Right. Gosh, a lot of great questions here. Have you guys used it on range grasses like Blick blue STEM or Indian grass or anything like that?

We have had cooperators in the Western United States that have tall need of warm season grasses like you described. It is certainly possible to use the sensor to work with those forages. The challenge we have in range systems is that being able to mount the sensor at a height that allows it to be a little taller than the forage. So if you're working with what is common in Missouri, what you saw and how we mounted the unit makes sense. If you wanted to work with big blue STEM, you have to mount the sensor higher. It is possible, but it will work a lot better on a unit with something with some height to it. We have less data and experience in those kinds of ecosystems. We have some, it is certainly doable.

Okay. We have two or three questions that ask about where to get one or is it for sale. You kind of answered that.

One thing I would like to mention about that, we do have a project we are working on with her conservation districts here in Missouri to provide these units to look at conservation and grazing work across the state. In that case we are working with them to provide. I think we're a lot closer to commercialization because of that project.

Okay. Good. Here is a good question, this person was curious about what methods or how you went about connecting the producers so that you had a good sample number of producers using it and not just in one part of the state, but all over, as you mentioned. Can you talk about that for a little bit?

I can. When we first started the project, the CIG project, we spent time working with various groups that have in Missouri at least, we were working with the forage and grasping counsel that has connections across the state. We also took the technology to things like the state fair and other large venues and said if you're interested in working with this, here is what we want to do. And then we get a lot of people who would volunteer and look at that. Frankly at some point we had almost more volunteers and we could manage. We did wind up with most parts of the state that we were targeting at the beginning. We also worked a lot with our regional extension specialist in the state for the technology and said do you have a producer that you think would benefit from this. We made connections in that way as well. Sometimes we have the outreach we did ourselves that we would say, all right, if somebody is interested, we would connect the local extension specialist with them and they would work together on it. sometimes it was the opposite where they would meet somebody and send them our way. A lot of different methods. But a ton of just connecting people.

Right. Here's an interesting question. Have you ever tried it on a UAV or drone?

Great question. This particular sensor would not be a great candidate for a drone. Here is why. That sensor uses a single ultrasound wave to measure the distance from the sensor to the first thing it hits. If you know the height of the bike, if you know the height of the sensor, then you can compositionally figure out the height of the grass. The difficulty with the drone is that it is not a constant in altitude as it flies. They look like they are, but wind shifts they might go up or down a foot in the air, which makes the readings less useful. We have done some work in working with dual range ultrasound. It uses two sounds, soundwaves, to be able to fix the soil height and forage height. Those kinds of sensors probably do have value with drones, but not this particular one.

Okay. I think you kind of covered this in your presentation. A question about can it determine tons of dry per acre. That would go back to what you just said about how it is measuring the height and then that is tied back to density of the stand and that kind of thing. Anyway, I will let you go ahead and answer. KENNETT help the producer determine tons of dry per acre?

I think we covered it pretty well. I will just say the calibration equation that we develop, and it is almost 10 years at this point, offer a way for us to accurately calculate tons of dry matter per acre. To calibrate those sensors over that period of time we have tons and tons of strips out of fields to be able to calibrate the sensor. It is that information over a period of time we have been able to use to make calibration equations.

Great. He also talked about how producers could use the data over multiple years for same paddock and same season. Any time there is multiple measurements being done, is that where they go back to the website?

All the data is held in the cloud. They can go back and look at the last time the measured, the last 10 times and things they measured five years ago . It is all there. I will say that year and data has been useful for producers who wanted to say, all right, I want to improve this system. Where is the forage weakest? Do I need to renovate that paddock? Is my fertilization not up to par? It has let them focus on those few units that really need it most. You want to change the species. You're growing the wrong thing in the wrong place.

Right. Okay. Here's a question about when forage is lodged. So it might have been 30 inches or more in height, but it has now fallen over. So you're getting the part of the plant that might be only 16 inches off the ground. Go ahead and answer that one.

I will tell you right up front that we can measure it, but it is imperfect. It will have more errors around it when it is like that. One of the saving things is that you're not only measuring the height, but the density. So many get forage that is lodged, it is actual density per unit height that is greater. We will pick that up with the sensor. I will also say our calibration equations often are not built on forage that was lodged when we harvested. So we will get close, but we will be as close in those kinds of situations as we would be otherwise.

Okay. Good answer. Have you guys thought about or compared it to satellite measurements or lidar measurements? How does it compare? Or did you do it convince Arison -- comparison is what they are asking.

Lidar or laser measurement will give you something very similar at the end of the day to what we're doing with ultrasound here. It is a reasonable way, reasonable other technology to achieve roughly the same result. That one is kind of easy. It works well. It is just a matter of being the right calibration. In terms of satellite data, we would love for that to work well. From what I have seen of satellite data across the country, really across the world is that if we're looking at something like spectral measures that come from satellite, there are a number of complications, whether they are cloud cover, changes in angle over the course of the year. There's a lot of reflective issues. We think there is potential in that area, but we also would say that the calibration data that goes along with that, the ground data that goes to satellite measurements at this time have such substantial errors we are uncomfortable using it in the long term. At least at present. We are working with some researchers across the country to use this unit to do a lot of ground tracing and then to look at -- frankly, you can use the Google Earth engine, to do a better job of measuring forage, being able to measure what happens in management from satellite. That is a cool thing, but I would say for some years we have been able to accomplish that.

Right.

But the data does get better every year. I will give the satellite folks credit. They are getting better, they just have a long way to go.

They do. The kind of satellite imagery available to the public. I know an ARS person who had access for a short amount of time to Department of Defense imagery, and that was very accurate. But I agree with you, with what is available to us, I think we are a little ways away. Here is a question. Might there be a synergy with PaddockTrac and other grazing tracking systems like pasture map or maybe even virtual fencing colors around the livestock. What are your comments on that?

I agree there is great opportunity for collaboration or integrating the products with either of those. I tell you in the case of pasture map. It is a tool you can figure out to figure out where you have had animals grazing on the landscape over time. It doesn't measure forage, but it manages how you measure rotation over time. They are very good. I think integrating this product really provides truths into that in terms of particularly for conservation outcomes. That would be really key. When it gets to the tracking kinds of things that one can use for virtual fencing, there's another great opportunity of integrating technology. I had a call recently with other folks that were looking at different innovations in grazing. GPS, you think about GPS and things like that, I think there is even some additional technologies we have been able to miniaturize on the backside of an ear tag that allow us to track reasonably where they are in the system. If you can bring that together in a virtual fencing situation, I think you have a real opportunity to integrate these technologies to be able to move the animals where they need to be based on the kinds of forage we have available, the animal needs and with some precision.

Okay. You have answered a lot of these already in summer questions for NRCS that I have to answer later. You talk about how it is not for sale yet. Any thoughts of doing that in the future?

Right? The answer is, the short answer is yes. We would like to get something to the marketplace that folks can use. The biggest areas we see for marketing the product, maybe this will help answer the question, is that we certainly see a use for it in management like we described. They manage their farm and understand the forage and what is going on in those types of things. But there is also a number of approaches to use the technology in verifying for carbon credits or other kinds of ecosystem services to say we can verify how much forage was there. We can verify groundcover. We can verify that in the third-party way. Those are the markets. We also realize there are going to be a lot of producers who will be interested in a non-touch way of doing those things, whether it is using satellite information that is corroborated and a neighbor is using this and we can at some point be able to capture other data to help people manage that it frankly takes less time. PaddockTrac probably has a space in that as well.

Okay. There are a couple of others here that are very interested in talking to you on a one-on-one basis. I can give you their contact information later on. But -- oh, we will call this the last question. I don't see any new ones. So you say it is an app, right? That can be used? By the producer?

Right. The PaddockTrac app is the app that connects to the sensor, keeps the data and becomes the intermediary area that uploads it to the website. That is the app part of it.

Okay.

It is available -- we have both Apple iPhone as well as android versions.

Okay. Good. That does it for the questions that have come in so far.

Those are great questions. I have to say, this is the most in-depth a set of questions I've had from any group about the technology. I appreciate them.

Good. I know you had a couple people that work with you a lot on this. Do you want to mention them or introduce them?

Sure. I think on the call with me today is Stacy Hamilton. She has worked for years in the pasture dairy industry. Instrumental in working with producers who have worked with PaddockTrac commercially. I will kids Stacy while on the call. Every time we had a bug and something, Stacy calls it really worked hard with the folks working with the computer programming folks to help them understand where we could get better. Really appreciated his work. And why a law, I'm not sure he was able to jump on the call today, we work together for almost 20 years now, actually a little over 20 years now if I stop to think about it. Ryan has been the person who has worked with producers across the state to help them set up units or understand the data or to take them through it the first time so there able to collect things on their own. None of this would have happened without Stacy or Ryan. It would not have happened without a lot of great support from other folks across the state and the NRCS partners and colleagues. We have a great relationship between NRCS and the state. We work together well. It is the key to this process.

Great. I may have missed a question here. I am trying to find that. Here's another one that came in. Who did your app development work on the project?

University of Missouri in-house we have a computing group. A couple of gentlemen over there worked with us day to day to get PaddockTrac developed.

All right. I think this may have been a question I missed. Have you had any producers talk to about using it in a [Indiscernible] grazing system?

Interesting question. We may have some folks with limited times of paddocks with several trees that may be more like forest grazing or something of that nature. I don't know that we worked with anybody who has really a well-planned silver pastor -- pasture technology. I have to think about that. Stacy, do you know of anyone working with it in that way?

Sorry, I had to get off me. Not that I am aware of. But I don't see any issue. It would work fine in that system. But I can't think of any of our folks using it right now that are.

Thank you Stacy.

Well, let me make sure other questions have not come in. I have been trying to look for ones I missed. I apologize out there to participants if I missed your question. I think that is it. I sure appreciate you and Stacy and Ryan sharing this technology with us today and what you have done with it. I really appreciate that. Thanks so much to all of you and I'm going to turn it back over to Jennifer Ryan.

Thank you Kevin. On behalf of the USDA and the natural resources conservation service, I wanted to say thank you to Rob, Kip and Kevin for providing an excellent presentation today on PaddockTrac, a web-based mobile application for managed grazing systems. Take you get to everyone for attending today's webinar. Participants, don't forget to provide your feedback about the webinar. If you want to earn CEUs, return to your opener browsing Windows to continue to process [Indiscernible]. This concludes the webinar presentation. [Event concluded]