## Podcast Cattle HQ Precision Management: Challenges and Opportunities

## Season 1, Episode 19

**[Music]**

**Robin Salverson**: Welcome to cattle HQ brought to you by South Dakota State University Extension, I am Robin Salverson cow calf field specialist based out of Lemon. I will be your host for this episode and Dr. Jamie Brennan will be our guest. Dr. Brennan is an assistant professor in the Department of Animal Science and our Livestock Grazing Extension Specialist for SDSU Extension.

During this Special Beef Day Episode, Dr. Brennan will discuss his research around precision livestock management on rangeland. Jamie, we often hear. The words precision technology and cropping but explain to the audience what precision livestock management means.

**Jameson Brennan**: Yeah thanks Robin, as you mentioned precision agriculture has been around for a while you're talking about it and livestock systems for probably about 30 years now, but really most of the advances we've seen precision has been limited cropping systems.

As they started to kind of make this pivot in this movement to incorporating that livestock systems we're looking at you know what are different technologies that we could use to measure animals, how many animals interact, you know with their environments and what technologies are available out there.

**Robin Salverson:** Do you have some goals when you're looking at precision technology.

**Jameson Brennan:** Well, we talked about precision livestock management system livestock technology, I really think it's just kind of incorporating new and different technologies, be able to manage measure and manage animals on the landscape. And part of that measuring process is measuring you know potential inefficiencies in the system and efficiencies you know either with the animals or with weather inputs that you're putting into that that animal to be able to want identify those inefficiencies, and also potentially correct for those and so you could have increased efficiency either. On our animal performance or level or you know increase management of your natural resource base, whatever it may be that your objectives are.

**Robin Salverson:** So the dairy industry has been very progressive and incorporating technology comparative to the beef industry. Why is the beef industry lagging behind.

**Jameson Brennan**: I think there's a lot of challenges that are kind of unique to the beef industry and, like you said, the dairy industry has for a number of years like robotic milkers. You know there's a pedometers that they put on animals leg and measure movement data and download that data off dairy cows. The smart tags that they've incorporated in the dairy systems where you can detect estrus and animals and so there's a lot of technology that's been incorporated within dairy systems.

And I think one of the reasons why it's been more successful with dairy systems, as compared to be systems is that you just have so much more interaction with your animals and those. You are bringing them in to barn every single day milking them working them and just provides a lot more opportunity to one put sensors on animals, but also be able to extract and get that data off those animals, every time they come in. And so, we've seen advancements within the beef industry but mostly has been limited to feedyards. Kind of similar systems like dairy where you can have much more opportunity to interact with her animals on regular basis and that really increases your opportunities to be able to collect more data on animals.

**Robin Salverson:** So I know you just mentioned the feedlot, but I know you focus most of your work around cows out on range or grass. We also know that our cell service and our wi fi isn't always up to par to be able to utilize this technology so what are some ways that technology is changing, so that we can start using them out on range.

**Jameson Brennan**: I think one of the like you highlighted there you know, one of the reasons why is this technology has been successful and dairies and potentially feedlots is that you have a lot more infrastructure that's available within a centralized location. Within those locations, we often have things like electricity Internet service wi fi you know all these things, help. To be able to transmit data from you know sensors or whatever it's located on animal to the centralized location. If you have animals like you said, out on extensive rangelands where you know, maybe in a 2000 acre pasture. You see them, maybe you go out there and check them every couple days or once a week but there's much less opportunities to one be able to collect that data off that day but also. You know just much less opportunities to interact those animals on the range. So some of the technologies are really is an advancement in communication technology over the past couple years for better able to transmit data out. And so, one example would be you know, looking at GPS tracking of animals, and if you can use what's called more frequency so low radio frequency data transmission and so you're. You know, from a device that is being worn on an animal it potentially be sending out data packets to a base station. With them, you know, maybe a 10-mile radius so if you have a space station that's able to collect that data field and then transmit that up to the cloud. You know, it helps closes up some of those issues that you've had in the past, how do you get data from an animal on an extensive systems out to you know a web application or cell phone apps so you could actually use that information. There is less limitation, our cell service is increasingly getting better in a lot of rural areas. So it's not uncommon now or to go to places, like your area of northwestern South Dakota where we can get one or two bars cell service unlike the past where you probably had nothing, so I think we're improving cell coverage on a lot of areas in the lands.

You know a lot of this information on data that's being transmitted you don't necessarily need 5g and the latest greatest cell coverage, to be able to get information out. And so that really opens up a lot of opportunities to be able to collect more data on the systems and get that information in real time, so you can make management decisions. And then kind of along those same lines as you start moving further and further West to bigger and more extensive range land systems. I think if you look at South Dakota the average forest service allotment is three or 4000 acre range unit, when you get out to Arizona or Nevada or some areas like that you might have pastures, upto 150,000 acre allotments. With no cell coverage whatsoever and so there's more and more coming online kind of new technologies, we have satellites up in space and sensors that are located on the animals are sensors that are located out pastures. Whatever you're measuring can actually transmit that data directly up to the satellite so you no longer need that cell coverage and you're basically able to deploy these things anywhere on earth.

And so really that's I think a potential game changer as start moving from precision livestock management from the field or animals concentrated in area, and you have good infrastructure to be able to collect information to truly being able send a transfer of data on some of the most rural landscapes, that we have.

**Robin Salverson:** Well, I know you guys have been incorporating and researching some of that precision livestock technology at our SDSU Cottonwood Range and livestock research station. Can you share some of what you guys have been doing there. I know you said, the range land creates some challenges So could you share some of that technology that you guys have been researching there at the station and then how that technology could be incorporated into a farm and ranch.

**Jameson Brennan:** Yeah so I guess one thing you mentioned as a challenge is the communication pieces. The other challenge to highlight when you think about precision ag and cropping systems, you know you have corn or whatever you're growing out there you have to combine it's able to go out there and harvesters nutrients off the land. You have any number of sensor technologies that you can mount on that tractor or that machine that you have there. It's quite different on the of animals that are actually out on extensive range land systems, because your animal was the harvester. The animal is the one having to go out there and capture those nutrients off the landscape and you'd have like we have throughout everywhere and kind of one range plans you have highly diverse landscapes, so you have differences and topography, differences in quality and quantity, differences of weather and climate exposure. These animals have a lot of different challenges in terms of one trying to measure your harvester which is your animal and how the animal interacts with your environment.

You know, at our cottonwood Research Station ever trying to hone down one try and measure as much as we possibly can, with this environment this landscape. And these animals and how they interact with it and then try and use that to identify you know what are ways that we could improve efficiency or improve our management on the landscape, based on these technologies and so some of the things like you mentioned. What we're looking at it at top would include like remote sensing so using things like satellite imagery your drones to be able to measure. You know plant communities and landscapes GPS tracking and accelerometers place on cattle would get location now where they are what they're doing in these locations. Smart scales we deploy these scales made by C lock technologies here in Rapid City were placed in front of your existing water tanks and essentially every time an animal steps up to get a drinker able to report a weight on that as a whole. Green feeders where you're able to measure and track methane emissions of the animals, and you know, last but not least is virtual fencing so improving our management.

Other technologies, looking at precision management technologies things like virtual fencing were able to you know. Not just measure monitor or this animals on the landscape actually control that animal movement on the landscape. As well as precision feeding technology, so it kind of sounds like a lot, we are not just limiting ourselves to one or two different technology really kind of throwing a whole gambit of different technologies at these animals on extensive range on systems. It's interesting and frustrating, at the same time, because animals don't always want to use technology, the way we want them to. I think we're able to capture and generate just tremendous amount of information and data that we've never been able to collect on animals before.

**Robin Salverson**: So for folks that maybe are not familiar where Cottonwood Research Station is here in South Dakota it is in western South Dakota, so it is range conditions. It is a working ranch, so just to give you an idea of where that technology is being used. So Tell me how this various technology you just mentioned, whether it's the virtual sensing or the GPS tracking, how can, how can this technology be beneficial producers and or os this technology to the point that it could start being incorporated into people's operations.

**Jameson Brennan:** yeah I think some of it, you know, like I said remote sensing and some of the one of the projects that we're looking at is kind of using big data analytics so looking at satellite imagery real time. Climate data to be able to make predictions for quantity and quality and real time for producers and so we're hoping to develop a web application where producers can go outline their pasture you can see what your forward quality and quantity is in real time. And that can inform things like stocking rates for your stocking rates are going to be dynamic, year after year, based on weather conditions so hope can have one approved management on the landscape, but also give more information to make decisions with GPS tracking. We had a presentation at range beef cow about GPS tracking and accelerometers. One of the things we touched on is with GPS tracking your more commercial operations out there, you can actually monitor your animals in real time so there's things like satellites, you can track your tags or collars using that Laura technology, but I had mentioned earlier, we could actually see where your animals are real time. A lot of producers are excited about that possibility, you know, one of the comments I have most of all, after that was If I could just know where my bulls are at any given time, that would be a huge improvement for me. So, even if you're limiting that maybe you're just putting those out those devices out on a small number of your animals say 10 bull that you have out there. Well now, you can have an alert to say, well, that bulls actually in the neighbors pasture I need to get it out of there before it breeds the neighbor’s cows. So I think that's you know, a direct benefit that a lot of users can kind of see and realize that some of that technology. Similar is he had an animal out of a cow that get up get out of a pasture or number of cows, you can have that kind of real time alert to say hey your animals out youneed to go and get that animal back in. But also being able to check animals remotely so maybe if you have leased land, for example, that's 60 miles away you could potentially save yourself a few trips, you know, to go out check animals by pulling up on a computer and say okay let's see all my animals are there in the pasture.

You know, maybe you could have some health metrics designed with the movement behaviors that you could say okay its appears that everything's acting normally, and you know gas prices, as we all know, right now, four bucks a gallon if you save a couple 120 mile round trip to your pasture. I mean that can translate in the actual economic dollars or you know actual money that you're saving, as well as that labor time spending on that as well. So let's just a few examples I think of how some of this technology can be incorporated into an operation. And also potentially benefit, you know producers now it's I think we're still kind of on the edge of a lot of this technology. It's still kind of overcoming some of the hiccups and limitations says it's being deployed, but I would say in three or five years, I think a lot of it will be fairly proven for ranch operations.

**Robin Salverson**: Well, I know drones are popular across the ag industry in general, but just the ability to go check all the water tanks to see if there's water in them. Or, to see if there is an animal off by itself, knowing that that's maybe an indication that there's maybe a health issue or something like that, and so you know drones are quite popular. I am always impressed when I get to see drones can do, so we don’t have to bounce across the pastures.

**Jameson Brennan:** If you have sciatica like me and middle of winter and just bouncing through pastures really takes a toll on your back. Sending a drone out there to go check your waters as much more attractive option and I think of that example, a lot of this, you know, none of those technologies ever going to replace the producer and replace that inherit now with the animals, how to work animals, how to you know properly manage the landscape. But there are a lot of kind of daily tasks like there might be a way to automate some more to be able to save labor and time which is often one of the biggest constraints for producers.

**Robin Salverson:** So you can kind of take that time that you're saving there and focus more on the business aspect again instead of the day to day tasks or chores that we all are have to do, but then we neglect the business side so.

**Jameson Brennan:** it's got a $10 an hour $700 an hour job.

**Robin Salverson:** Absolutely, so I know you guys also have precision feeders out there and they're on a project, right now, with some heifers. Could you share some information on that project and how those feeders have been working.

**Jameson Brennan:** yeah so i'm we had this projects that we started that's using with the C-Lock technology. The precision feeds links with the smart scale technologies that we have. So kind of the objective of, that is, you know for heifer calves if you're developing efficacy potentially um you know, generally speaking, if you're trying to target those individual weights to about 60% of your mature body weight when it comes to breeding. So if you had a 1400 pound cow and that's about 840 pounds that you're trying to be at a time of breeding. One of the challenges obviously when you're when you have a number of animals and you're supplementing animals as group or herd, is that you have ones that will be under consumers ones they'll be over consumers. So you might have this kind of wide range weights when it comes time to breeding in addition you're under consumers really aren't doing you any favors out there. Because they're eating forage, grass or hay but are not getting up to the weight you need.

Likewise you're over consumers are putting on too much weight might be over conditions and you're essentially wasting excess feed on those animals. So the hope with these precision feeds is where you could actually target how much supplements you deliver it to each individual animal. And so you might say, here's an animal that's got started off as calf at 530 pounds at post weaning, and another calf weighs 450 pounds. You might want to feed one more of a supplement ration and the other one kind of feed a lower supplement ration and so that they arrive at that 840 target weight.

When it comes down to feeding, we're trying to use this in a way where we're linking this feeding and precision feedings kind of targeting supplemented individual animals. With our precision scale data or collecting these daily weights on animals, and so we could actually kind of give an estimate every single day if we wanted to every week on what's their average daily gain as we're moving through the season. And then kind of can we dynamically adjust that feeding rations so if they need more or less you know, depending on if you have a cold snap or what have you to hit those target ways for those animals. And so it's really it's pretty amazing data when you start collecting that daily weight gain data on animals, you know and i'm pretty blown away by it, when I looked at plots and graphs and stuff like that.

For us and research, we get more weights on our animals than most producers do. But it's not atypical for us to have maybe a weight at the beginning of our trials in November and then maybe if we work them somewhere in the middle of that catch another weight and then another way to at the end of the season. And so you really have only a few data points to be able to gauge that animal performance. With these you can see it's really pretty amazing how much information and data you're able to gain off those animals look at ones that are really kind of the over performers or the underperformers.

You know, maybe you had a cold snap and you could actually kind of see you know this big dip and performance and what's rebound associated with this so really there's a lot more information that we're gaining on these animals that I think will translate ultimately so how we recommend producers match.

**Robin Salverson:** I think it's really exciting in regards to the heifer development side just the influence of their performance during that development phase. So from weaning and until breeding breeding and how that influences there's like cyclicity and then also overall conception right to whether you do Ai or not or overall pregnancy rate. I am very excited as this research goes on to see that.

**Jameson Brennan:** Yeah you know we're talking to a colleague in our office when i'm just playing around plotting some of the data, the other week we're looking at what is called quantel regression. You can think of it like, if you take your new baby into a doctor's office and I measure its head and measure its height and they give me a percentile of you know it's in the 50th percentile or 98th percentile for weight. So we look at Individual animals and average daily gains, so you might have some heifers that are kind of bottom 10 percentile some that are in that top 90 percentile. Than I think about how does a producer having this information make management decisions. How can they use that to be able to track, you know which animals are in these different percentile groups and maybe that determines which ones are getting sold off as calves you're getting sold off as yearlings at this time of year which ones are you know, are going to go to be breed. Just how can we use this information to kind of inform management decisions to be able to get a better, more uniform group of animals.

**Robin Salverson:** If we have a more uniform group of animals, this equates to more dollars.

**Jameson Brennan:** Likewise, on the summer, as we're collecting this data on yearling steers during the summertime. You know, as your as your heavies kind of start topping off and slowing down on grass, can you after a month take those heavies and ship them off to the feedyard. Because essentially they're out there, eating a lot of grass forage but you're not necessarily seeing a lot of returns pounded on them. So by removing different groups of animals using this data, maybe you extend the grazing season for the other animals even longer, and so, those are just kind of some of the questions that we're looking at with some of this data that we're collecting.

**Robin Salverson:** I'm really excited as the research continues and reports come back and to hear , how all of it is working. Like you said, probably the biggest challenge with the technology is the animal itself and knowing that it's supposed to stay here, but yet it's bullheaded enough to go right through that virtual fence. I'm excited about the virtual fencing. I think i've mentioned this, maybe to you in the past that it would be awesome to be able to create virtual fences during breeding time where they continuously get moved up to the corrals when they're coming into heat. So my goal for you is to create animal or create a technology that determines estrus and then a virtual fence that just moves them up. That way I don't have to go gather.nnSo the technologies exist, I don't know if they remember combine them the technology.

**Jameson Brennan:** Yeah I think that's really interesting intersection of this is all going to be, I mean there's a lot of there's tons of technology. Well what's good what's not good, I think we still need to determine what's practical for ranch operations. But I think more than the individual technology itself is how do we integrate these different wants together So how do we integrate. You know, things like that remote sensing and that satellite imagery with your virtual fence technology to inform rotations or like you know with our feeding project, how do we integrate those scales that precision feeder to reach animal target weight gains. Looking at these as individual pieces of technology it's interesting, but I think, maybe the future might be, how do we integrate these different systems and pieces together to better inform our management.

**Robin Salverson:** I also know, obviously with precision technology it's opening up a lot of new fields for students. Could you share some share some more information on this and some new opportunities beyond the production side of things, but the technology development and opportunities there.

**Jameson Brennan:** yeah and so we've some of the conversations we've had for a while, was how do we kind of develop the next generation of animal science students that are that are coming on board. And so I think it's really important for students to be well rounded and a lot of you know, basic principles of feeding nutrition and animal husbandry a management, range land science. But, as these technologies become much more prevalent and much more in use, I think, training, students, that are also well versed in different software packages or students that are well versed and data science and data management. You know kind of going back to that let's say I have 60 animals, I get weight at the beginning of the trial and weight t at the end of the trial. That's 120 data points. Well now, if I'm getting multiple weights everyday you're now having thousands and thousands of data points that are generating with that than developing students that have the skills to be able to take that information on that increased level of precision and turn that into management recommendations. And turn that into some kind of knowledge as a producer could utilize. And so I think really are kind of talking about how do we train students so they're well-grounded in these background principles but also have an eye for the future. To be able to accommodate and adjust to kind of all these new technologies that are coming online and answer questions for producers that are interested in utilizing these technologies.

Likewise, I think, just having you know students that could help bridge that gap sometimes between engineers and practitioners. Not to knock engineers, but you might have some engineers, that design some kind of precision livestock technology that really don't have any knowledge of ranch operations or any knowledge really about animals. They are very effective at creating the technology, but they don't always have the background and livestock production to say hey that's going to work or hey there's no way that's going to be put on an animal it will be destroyed. You know, and so I think having students that are able to communicate effectively between these different worlds, is going to be very important.

**Robin Salverson:** Absolutely, thank you Jamie. Thank you Jamie for being here on this episode is there anything that we didn't cover that you want to share with the audience.

**Jameson Brennan**: I don't know if we really got into virtual fencing all that much.

**Robin Salverson:** let's talk about virtual fencing then.

**Jameson Brennan:** I guess the hot topic that I probably get most questions about his virtual fencing and the most interest on that. So we deployed at our Cottonwood Research Station this virtual fence technology this past year, so we're looking, this will be our second year that we're having that implemented. So how those work is basically a collar that you place on each animal within your herd in this collar communicates with the base station. And that base station communicated state of the cloud and so you know, users able to go in there, you know potentially draw where their pasture boundaries where they want them. Those pasture boundaries are going to get sent from that base station to those collars and those colors using GPS technology are able to know where they are in relation to those virtual fences that you created. Those animals started approaching the virtual fence boundary within their early kind of first get an auditory queue of hey you're coming to a virtual boundary. As they proceed kind of further and further into that virtual fence boundary they'll get an electrical stimuli similar to an electric wire fence. With the objective will kind of turning that animal around and keeping them within your management, so if you have there so essentially it's it's not all that different from I guess how you can train a dog to an electric fence. There is an auditory Q and, eventually, they just start associating that auditory Q with turning around so you don't need that electrical stimuli. And really just opens up tremendous opportunity, I think, to be able to manage animals on the landscape in ways that really weren't possible before. You could configure this even at a simple example of just setting up a rotational grazing schedule within a pasture and you can basically outline that, for your entire summer. I'm going to turn this fence, on this day this one off on this day and dynamically rotate your animals around without actually having to install you know physical fence out there, or have the time of going out. We just turn it on.

**Robin Salverson:** A similar opportunity to do more targeted grazing. So if you do have a pasture that is predominantly cool season introduced in the spring, but then a part of it is also, more native grasslands, maybe trying to target them in that area of introduced so that way you're not having a big impact on that native range at that time.

**Jameson Brennan:** yeah so you can like you said graze heavily early in the spring those native grasses maybe delay grazing on some of those. I believe I said something wrong there.

**Robin Salverson**: Yes, you did.

**Jameson Brennan**: sound like something you'd recommend. But yeah it's a target you're grazing like you said on those basic cool season grasses maybe hit those hard early in season. And then move on to your native grass, they have more time to grow and develop and get more growing degrees on there. I think there's just a lot of applications for you know how do we manage environmentally sensitive areas like riparian areas are always a concern. For water quality, and so you can virtually fence out animals from you know riparian areas were naturally attracted to you and increase you know your stream bed or increase water quality, on your operation. Certain there's probably a lot of folks that are looking at you know applications for managing wildlife from the habitat so like sage grouse is a big species are concerned in the West. There's been some research that shows that you know, depending on the time of grazing your cattle could either improve or negatively impact sage grouse habitat so just having that ability to time that grazing to improve your wildlife habitat through cattle. I think it really this opens up a lot of different opportunities for managing your animals on the landscape.

**Robin Salverson:** Excellent well, thank you Jamie for joining us for this episode. We look forward to visiting again sometime I'm sure there's lots more that we can share as that research develops and we get more data points back and you guys are able to create some of those Apps and various things like that that you're hoping to do through this research. Once again, this has been cattle HQ brought to you by SDSU Extension headquarters for all things beef cattle visit extension that extension.sdstate.edu for the latest beef information until our next episode remember at is attitude is everything pick a good one.

**[Music]**