Checking in with CenUSA

Sustainable Production and Distribution of Bioenergy for the Central US

CenUSA Bioenergy is a multidisciplinary project funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). The goal of the project is to research the production and use of perennial grasses on marginal lands for use as alternative biofuels and bioproducts. Learn more about CenUSA at www.cenusa.iastate.edu.

In February 2019, Kevin Shinners[1], a professor of agricultural engineering at the University of Wisconsin-Madison, spoke about his work and experience with CenUSA as a co-project director in the area of feedstock logistics with CenUSA Communications Intern Tyler Worsham.[2] According to Shinners, optimizing bale density for transportation and creating a model that helped them harvest crops more effectively were some of the objective's greatest successes

Kevin Shinners

How did you initially get involved with CenUSA?

"They asked me to join. I got a call from Ken Moore, and he asked that I join the grant."

What made you the ideal candidate for your co-leadership position at CenUSA?

"Well, I've had a long history of engineering work in the area of hay forage and biomass, and I have a pretty good track record of publishing in this area. Honestly, there are not a lot of academics who are involved in that area. Wisconsin is also reasonably close to Iowa which was the center of the grant."

How did the project challenge and broaden your professional skillset?

"It's very hard to change that capital-intensive system that we have for harvesting, processing and storing biomass. The real challenge was in the funding level that we had to make changes in the area of feedstock logistics. It's kind of like trying to change the direction of an aircraft carrier. It can't be done very easily, and it takes a lot of effort. Some of the biggest progress that has been made in the area of feedstock logistics was made with multi-million-dollar funding activity that focused almost exclusively on logistics. Additionally there

[1] Learn more about Kevin Shinners at https://bse.wisc.edu/staff/shinners-kevin/

[2] All of the words and ideas expressed in this interview fairly and accurately represent the speaker. Some quotes may be paraphrased for brevity and clarity. The opinions expressed in herein do not necessarily reflect those of Iowa State University, USDA-NIFA, Purdue University, Ohio State University, USDA-ARS, the University of Minnesota, the University of Nebraska, Lincoln, the University of Vermont, or the University of Wisconsin.

would be very good industrial partners associated with these big grants, which helped facilitate machinery and logistics changes.

Sometimes it was kind of hard to make progress under the structure of the feedstock portion of CenUSA, but I think we found and attacked some niches in which we made some real progress. We produced some nice publications from our work, but it was a challenge to make a real, meaningful, industry-wide impact."

What new ideas and disciplines were you exposed to as a part of the experience?

"That's a good question. I suppose it was mainly in two areas; mainly how the agronomists were moving forward with the genetics of switchgrass, and how they were making progress on switchgrass yield. I think that was very nice development. I hope that they are making a commercial impact now with their 'Liberty' switchgrass. I think another part of this was that nobody in the group really had a great feel for what we were going to do with the material once we harvested and put it into storage. Often times, the end product was a lot of vapor. We had a lot of industry partners. Looking at how many of those industry partners are still ongoing, are any of them making any money off of this material?"

Did your team encounter any obstacles that you didn't foresee going into the project?

"Reducing the number of times that you handle the material is number one… The second thing we found is that reducing the size of the material at the time we harvest it rather than leave it in the long form is going to make a big difference in biomass logistics in the future." *Kevin Shinners*

"The first one was just getting enough acreage of grass produced in order to conduct experiments at our scale. People can sometimes work at a scale for which they are taking teaspoon material, working on that scale in a lab and getting publications out of it. We're not talking teaspoons or tablespoons, here. We're talking about tonnage in the type of work we were doing.

It was a real challenge to get enough acreage produced so that we could go out there and collect the kind of data we needed. Once we actually did that with the help of some of the agronomists, specifically Rob Mitchell who helped us get acreage established, we struggled to get rid of that material after we harvested it. We could hardly even give the harvested material away. There just wasn't a market for it in our area. We actually ended up composting some of the material because we couldn't get rid of it."

Have you worked in any other projects as large or well-funded as CenUSA?

“I was a part of a large corn stover harvesting and logistics project in the early 2000s. That was actually a little better funded and more focused on logistics than this CenUSA project. I would say that CenUSA was probably one of my biggest, so there aren’t many others beyond the corn stover project.”

Other than funding, in what other ways did these other projects differ from CenUSA?

“I guess we were focusing on the feedstock in our work. It was mainly perennial grass here, but most of my prior work was involved with corn stover. That was a unique thing here, both a fun and frustrating thing about the project. In the case of corn stover, we had a lot easier time finding utilization for this material given our proximity to large-scale livestock operations.”

What were some of the noteworthy discoveries and successes that you achieved through the project?

“I think one of the big ones was that we showed that we could work with manufacturers and that we could get bale density to what we needed it to be in order to achieve the optimal transport weight. We also showed how much power it took to get there, as well as how much capital investment it was going to take to do that. Achieving weight limited transport by filling the volume and weight of a truck is critical to optimizing logistics. I think we did that with switchgrass and got a nice publication from that work.

Read the article in our BLADES newsletter

I think we also developed some new ways to treat that crop after it was cut to achieve a faster drying rate with intensive conditioning and tedding. I think we made some progress there. We then built a nice model that helped us explain how condtion-ing level and environmental conditions can alter the harvest progress throughout the fall. This was a model that was started by one of our undergraduate interns. She started the model and we built it up into something a little bigger after she left. We got a nice publication out of that too.

What we also showed with this research and the modeling work was that we might not want to focus too hard on the weather during cutting and on the adverse effects of rain on cut grasses. Perennial biomass

grasses are like forages for animals. It's a different material. Our model showed that we should be cutting that crop any time the weather allows us to be out in the field. I don't think it's that much of a concern if it rains on the crop. The model suggests that you should keep cutting as much as you can and get as much done with the smallest fleet of equipment as possible given the weather conditions across the upper Midwest. Those were the biggest discoveries and successes that we had there."

Could you go into further detail about how you came to develop that model?

"Well, we had some drying rate equations that we developed based on our intensive conditioning and tedding research work. Then we went into historical weather data for several locations across the upper Midwest. Knowing some environmental conditions like humidity, wind speed, rain fall and solar insulation, we could then predict how long it would take for each field of that material to dry. Then we said, 'Okay, in this particular area, if you have this many acres of switchgrass and these environmental and weather conditions, and if we want to get it harvested by this date, how much equipment and labor will you need?' I thought that was very nice work and a very nice publication that came out of that. It hasn't been cited very much, but I think it has been very useful information."

How might future advancements in harvesting methods and machinery continue to help farmers?

"I'm not sure that there's much there that can help farmers because I'm not exactly sure that I have a lot of confidence that we are going to see a lot more perennial grasses grown across the landscape given our economic situation. What we have done is take some of the models that we built through CenUSA and extend them into more traditional forage baling systems. Now we are sharing that with some of the producers to help them chose more economical baling systems, not necessarily for perennial grasses, but for traditional hay and forage."

CenUSA Bioenergy White Paper

Are there ways in which transportation can be improved that could help?

"Yes, there are two things, and it's easy. Reducing the number of times that you handle the material is number one. Don't handle the material, and you won't add cost. Every time you touch it, we'd like to get some value added to it. The second thing we found is that reducing the size of the material at the time we harvest it rather than leave it in the long form is going to make a big difference in biomass logistics in the future. I showed some things that would help in terms of density and productivity, but that's about it."

Could you talk more about the obstacles to improving biomass density and harvest capacity?

"We continue to work on things like bale density and things of that nature, but what it really comes down to is that we are really struggling to find an economic value enhancement. The cost that we are putting into doing some things don't seem to be giving us a sufficient payback to continue commercialization. The biggest obstacle is that the price for the material is too low to justify some of the things we are thinking about in terms of improving bale density and harvest capacity. It's just a real struggle to make money at this stage. If

I could be succinct about it, there are a lot more things that we could do if we could raise the price of this commodity, but there is just not much there at the current price. There's not much meat left on the bone."

So it's not a matter of throwing more research at it to solve the problem?

"Let's put it this way. More research will probably be needed for something that can utilize this material and that can add additional value to raise the price on the commodity coming out of the farm gate. A lot of people are really anxious to see this cost reduced, and I don't know that we will be able to achieve our goals with that low of a cost. Until we can see more added value, it will be hard to justify the cost of production. That's the most noteworthy thing."

How will you take your experience with CenUSA and put it to use in future projects?

"The biggest thing is that we will continue to work on ways to increase bale density, and we continue to work on ways to reduce the number of bales that need to be handled. We haven't given up on some of those things. That's the one avenue of research that I am continuing, but I am also nearing retirement, so there's a limited future there for me."

Kevin Shinners CenUSA Bioenergy Work Product

Extension and Outreach

- ✓ Project Overview: CenUSA Feedstock Logistics Innovative Systems for Harvest Transportation and Storage of Perennial Grass Biomass. **Kevin Shinners**, Univ. of Wisconsin & Susan Harlow, eXtension. 2017. https://cenusa.iastate.edu/files/cenusa_2019_002.pdf
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- ✓ Instructional Video: Optimizing Harvest of Perennial Grasses for Biofuel. **Kevin Shinners** & Pam Porter, Univ. of Wisconsin. 2013. (4:50). https://www.youtube.com/watch?v=NMt5Ct-65-Y

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Learn more about CenUSA at www.cenusa.iastate.edu

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