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.

Cathy Kling[1], formerly of Iowa State University and now a Tisch University Professor of Environmental, Energy, and Resource Economics at Cornell University, and the Faculty Director of Cornell's David R. Atkinson Center for a Sustainable Future, spoke in March 2019 about her work and experience in the area of system performance as a CenUSA co-project director with CenUSA Communications Intern Tyler Worsham.[2] One particular area of emphasis was her focus on using her skills as an economist to examine policies intended to ensure water quality and combat water pollution.

Cathy Kling

How did you initially get involved in CenUSA?

"I have been working on-and-off with some of the other Principle Investigators on issues related to soil carbon sequestration, water quality and second-generation biofuels, so when that project came around, it seemed like a natural fit for us to team up. They invited me in, and I was delighted to participate."

What made you an ideal candidate for your co-project leader position?

"The areas I brought to the project were an important piece. I am an economist, so thinking about some of these issues as an economist is certainly an important component. More importantly, I am an economist who studies the environmental aspects of many policies and market failure situations, including water quality and water pollution.

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

"Yeah, at the same time that CenUSA was ongoing, there was another kind of CAP (Coordinated Agricultural Project) at Iowa State University. This one was a corn-focused CAP that was run by Lois Wright Morton out

[1] Learn more about Cathy Kling at https://dyson.cornell.edu/faculty-research/faculty/clk228/

[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.

of (the Department of) Sociology. I was on that team as well. It was very similar as well. It had many of the same kind of challenges and successes that CenUSA had."

How did these other projects differ from CenUSA?

"Most of my other research projects are not as large and collaborative as CenUSA, and frankly, they were not as ambitious as CenUSA to address problems of either that kind of magnitude or scale on which they were focused. The ambitiousness of the overall effort was incredibly unique, to rethink and develop alternative ways to farm agricultural land and to think about applying it on such a scale at which CenUSA was thinking. It was really, really unique."

What new ideas and disciplines were you exposed to as a part of your experience with CenUSA?

"I think I worked and learned more about agronomy, particularly about perennial feedstocks, in a much more substantive way than I have ever learned before. I learned a lot about what those types of plants need to survive and what kind of environmental benefits they bring. It was really fascinating to work directly with those who were growing and improving that feedstock, to learn about how that happens and what they can do for the landscape."

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Could you go into further detail about what those environmental benefits are?

"The main distinction between these perennial feedstocks, or perennials of any sort, and those annual row crops that we grow in commercial agriculture in the U.S. with respect to the environment is that perennials are year-round land cover by definition. They have roots in the soil year-round. There's contact with the soil year-round, at any point at which the soil is warm enough, there is processing between the plant and the surrounding soil. All of that fundamentally changes the environmental aspects of that land.

They were studying perennials, miscanthus in particular, but switchgrass as well. They have incredibly long root systems that store carbon under the ground within those root systems. They also retain soil through storms, wind and from erosion in a way that annual crops do not.

Consequently, they have very large benefits for water quality because they keep nutrients in the land and process it through plants and the biological processes. With annual crops, any excess nutrients that are not taken up and used by the crops work their way through the soils, either through the surface or groundwater,

into the waterways and water systems. Some of it is also evaporated into the atmosphere as well. It's really fascinating to learn what a major change that a perennial on the landscape has on carbon storage in soils, soil-organic matter, resulting water quality and pollution impact."

Did you and your team encounter any unforeseen challenges in your research?

"Well, there was probably nothing unforeseen. You just know that there are going to be snafus with data, finding that there aren't models that you thought would be developed, and that some aren't quite doing what you expect or hope that they will do. There are always snafus, but nothing unexpected."

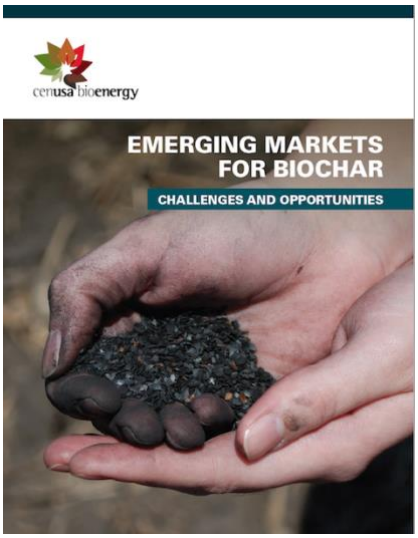
What obstacles did you expect going into the project?

"I expected that it would take a lot of time and energy to work with such a large group of people, and that was true. I expected that the modeling developments and improvements that my team wanted to do and did do would probably take longer than we expected or hoped, that we would be slower to deliver on some of the things we hoped to deliver. I suppose I would have to admit that that was also probably true.

There are also always communication challenges across teams. I happily wasn't the lead and didn't have to deal with that in this project. That fell upon leaders like Ken (Moore) and others, and they did a fantastic job. They were a great leadership team. That's kind of standard fare when you have been at this for a while."

What were some noteworthy discoveries and successes that you achieved in your work with CenUSA?

"I think the work that we did in water quality was pretty exciting. We were able to show through large-scale modelling efforts that if we were to get extensive coverage of switchgrass and perennials on marginal lands across the Midwest, this could have major improvements on water quality, on nitrogen and phosphorus.



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These are the key components of both local stream and lake-water pollutants from agriculture, as well as on the downstream impacts in the Gulf of Mexico on the hypoxic zone."

How did you determine the environmental impacts of switchgrass establishment and production?

"I learned by working with the agronomists and by working with models. Of course, we didn't see the large scale planting, so it's not something one can do observationally, but by using large, integrated models that integrate both the hydrology with detailed land use analysis, one can do what-if scenarios where one has a model calibrated to the current land use and landscape and does a counter-factual. Let's pretend in this model world that we remove corn and soybean production in these marginal lands and instead have switchgrass on them. What does the model predict will happen to water quality? That's the methodological approach."

The dead zone in the Gulf of Mexico is an important environmental concern. Can planting switchgrass on marginal land in the Corn Belt help reduce the size of the dead zone?"

> We were able to show through large-scale modelling efforts that if we were to get extensive coverage of switchgrass and perennials on marginal lands across the Midwest, this could have major improvements on water quality, on nitrogen and phosphorus.

"Yes, there is no question about it. A large proportion of the nitrogen and phosphorus that seeds that dead zone comes from the upper Midwest. Iowa and Illinois are heavy contributors in particular. If we can prevent the amount of export in nitrogen and phosphorus from that region, down the Mississippi River and into the Gulf, significant progress can be made toward the reduction in the size of the dead zone.

CenUSA leadership can really help perform. As researchers, we get pretty enamored with our research and forget about taking the next step of getting it to relevant users by producing outreach materials as they did in CenUSA. There was a large Extension and Outreach component of that project. That is the main way that many of our results get out there."

What will be the greatest benefit of achieving CenUSA's vision of planting perennials on marginal land throughout the Corn Belt?

"Certainly the water-quality benefits would be substantial. That's sort of the lens through which I see things, so I am sure that others can talk about those other benefits, but from my angle, it's all about the water-quality aspect. If we were to have extensive perennial grasses, we would reduce soil erosion and nitrogen-phosphorus export of nutrients. This would improve local rivers and streams, as well as address the hypoxic concerns in the Gulf of Mexico.

Furthermore, it would probably have some substantial impact benefits for wildlife. Providing cleaner water for wildlife is one piece of that. It would provide habitat that corn and soybeans do not and would be beneficial for soils. I don't know that we have fully quantified what all of those wildlife and habitat benefits might be.

Another possibility is to see lowered nitrate levels in ground and surface water. This would possibly lead to reducing costs of removing nitrates in drinking water. That's another dimension through which water quality improvements can benefit people, by lowering those costs and reducing exposure to nitrogen in water."

What is the most noteworthy or most interesting facet of your research that you want the general public to understand?

"I think that on a broad level, there is an incredible connection between what we grow on our land, how we manage that land and the resulting air quality, water quality and wildlife habitat in the environment. Those large-scale land-use decisions we make have a really large effect on the environment of a region. I don't think the public understands that."

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

"Well, I already have in the sense that it really helped me understand how teams can accomplish what no individual can, and how to hopefully work a little more effectively at trying to lead and energize teams. Ken Moore and his crew were really good, and watching him do the work of leading a large and complex project like that helped me to understand what works."

In what new directions do want to take your own research moving forward?

"I continue to be super interested in water quality, so I will continue to work in that area. I want to learn and work more in a variety of ways in which water quality impacts people and ecosystem services. It's along the same lines of what CenUSA was doing, but going further into the areas of additional ecosystem services from water quality."

Cathy Kling CenUSA Work Product

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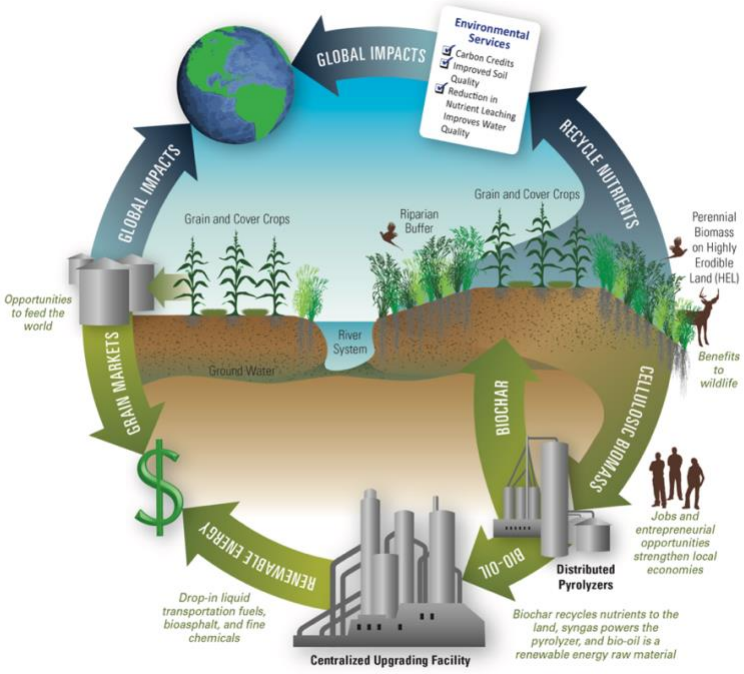

CenUSA Bioenergy Vision

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

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