



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

D.Raj Raman¹, Morrill Professor of Agricultural and Biosystems Engineering, spoke about his work and experience as a CenUSA co-project director focused on the CenUSA education objective with CenUSA Communications Intern Tyler Worsham in April 2019.² Raman outlined how through CenUSA, many educational endeavors, but especially the summer research programs, were used to teach university undergraduates and graduate students about the potential role of perennial grasses in Midwestern agriculture.

How did you initially get involved with CenUSA?



D. Raj Raman

“When the grant was being written around 2011, I remember very distinctly that I was the Associate Director for Education Programs in the Bioeconomy Institute working with Robert Brown [Distinguished Professor of Mechanical Engineering]. I had been in that role since 2007, so I had been doing that for about four years at that point. The Bioeconomy Institute was helping a team led by Ken Moore [Distinguished Professor of Agronomy] to go after this large NIFA-CAP grant, and they needed an education program. Since I was the education director, they asked if I could do this.

The funny part is that I was already pretty heavily involved as the University Education Director for the Center for Biorenewable Chemicals (CBRC), and I was chairing the Agricultural and Biosystems Engineering Curriculum Committee which had an upcoming accreditation visit of two programs, including the new BSE program whose development I led. I wasn’t sure that I had the bandwidth to do all of this. The reason I did it at the time was not only because I knew Ken (Moore) personally, but also because I felt that I had a responsibility as the Associate Director to do this if people asked it of me. I could not say no, and I’m glad

¹ Learn more about Raj Raman at <https://www.abe.iastate.edu/d-raj-raman>.

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.

that I didn't because it turned out to be a role that I enjoyed doing. I like to think that I was able to contribute in that setting."

What were some of the difficulties in managing all of those different roles all at once?

"It's a bandwidth issue for me. Through that time period, I continued to have a teaching role. The first reason why I'm in academia is because I love teaching and think that it's a central part of the mission. I never really dropped teaching in order to do administration. To do administration properly takes time, and the way that I managed that for many years, especially during the years I was with CenUSA and CBRC, was by hiring and retaining outstanding staff. There were some years of really heavy lifting, and we went through an accreditation of our engineering programs in the middle of that."

"At that time, I had a phenomenal staff member working with me who was funded by those grants and by Iowa State who then went by MaryAnn Moore. Her name is MaryAnn Grapp now, and she's over in Agronomy (Hall). She was fantastic, and she enabled me to not drop too many of the balls I was juggling. MaryAnn was my right hand for the summer research experience programs. There were two summers when we had 38 interns here. Twelve is plenty, but 38 is a real stretch, and that made for some very busy summers.

I am not ashamed to say that the summer of 2019 is the first summer in a decade when I won't have summer research students. I miss them all, but I'm glad I don't have them. I have done what I think that the directors of the CenUSA and CBiRC (The NSF Engineering Research Center for Biorenewable Chemicals) programs, Distinguished Professors Ken Moore and Brett Shanks, wanted. Both of them are outstanding faculty members by all metrics, and they have been very successful in the realms of teaching and research. Both of them think that the role of education is important, and they wanted those education programs to go well, so I have tried to live up to those expectations.

One highlight of our programming each summer was that we developed and delivered mentor training for the folks mentoring the 66 students in the CenUSA internship. I think we had 130 in CBiRC and another 35-or-so in a departmental program that I ran, so there were well over 200 students total. In addition to the mentor training – which we have shared through publication, presentation, and making a video available to other departments and universities – we did pre-and-post evaluations on what the mentees got out of it. I'm still in touch with many of them, and sometimes I unsolicited letters from them saying that I may not remember them, but they're getting an advanced degree and want to thank us. I think that the program we ran was very impactful."

What made you an ideal candidate for your position? Was it more than the position that you had at the university, or did it include other work experience that you had in the past?

"If you think about it from CenUSA's perspective, I was a good candidate because I already had a directorial role at CBiRC, a large, multi-year, federally-funded project at Iowa State. We kicked off CBiRC in 2008, so by



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the time CenUSA came around, I had been doing that for about three years. I already had experience doing the kind of thing that CenUSA wanted to be done.”

“I began my career at the University of Tennessee, where I spent just over 12 years before coming here (Iowa State University). I ran a USDA higher education challenge grant at Tennessee that had summer internships. Several of those students were in my lab, and I oversaw that. Because of CBIRC and my work at Tennessee, this (CenUSA) was not my first rodeo. The project’s goals of coming up with perennial ground covers that can be grown on marginal land to make biofuel fits the kind of things I’m interested in, so there was a lot of confluence.”

In what ways did the project challenge and broaden your professional knowledge and skill set?

“The sheer size of the effort made me step up my game, for a lack of a better way to put it. You can sort of get away with things when you have an eight-student summer internship that is run with students in your department, but you can’t do that with 30-to-40 students or more from all around the country. You can’t do a proper job of building diversity in the students who participate by doing business as usual.

To do a good job, you have to do what I was fortunate enough to be able to do. I got to work closely with people like Thelma Harding and the graduate college at Iowa State to get a list of names of diverse students who are selected to direct outreach, to go to multiple events on our campus and community colleges, and to recruit from a broader swath of students who would normally not get these opportunities.

“A lot of that learning and growing was with the help of MaryAnn Moore whose abilities to keep track of things and tend to all of the details were

phenomenal. Without her, I don’t think I would have been able to make it happen. We were a great team. I had to learn to delegate and couldn’t get away with any tendencies to postpone or procrastinate because the project would have failed, and I don’t like failing.”

In other words, she helped you with the details which allowed you to look at the bigger picture?

“She was very much a part of it. We brainstormed together and she took care of both big and little details.”

To what new ideas and disciplines were you exposed as a part of your work?

“I had a unique seat with CenUSA because I saw the breadth of projects that were being done by these students, and in a weird way, I often thought that these students integrated across the projects almost better than anyone else in the whole program. They were doing weekly meetings where they got to talk about each other’s work. The faculty have to be deep in their area; they must have that priority. That’s not a critique of the faculty. If you told the faculty that they have to meet weekly to hear about what each other are doing, they’d be asking when they have time to do that.”

With the students, you can say that we’re doing this since we’re paying them. I was really impressed by the breadth of understanding that the students had in all of the areas across the project from the processing, to agronomy, genetics, et cetera. Those students did well really well across all of those areas.”

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

“Center for Biorenewable Chemicals was very similar, specifically in that it had faculty from all sorts of different disciplines.

Were there any other projects that you worked on, and how were they different?

“Like most faculty members, I’ve been involved in multiple \$300,000-to-\$500,000 grants, and they’re distinctly different in their scope, in the number of moving parts and the level of synergy that comes from it, whereas these bigger grants are obviously much greater. The big grants are very interesting to me, having been involved in two large ones in the last decade, in that they force us faculty to step out of our disciplinary silos and really try to understand the system that we’re working with a little more than we would otherwise. I’m interested in that as an agriculture and biosystems engineer since I’m a jack of all trades and a master of none anyway. That’s not true of all agriculture and biosystems engineers, but that is true of me. That’s just a little bit of my makeup. I was an electrical engineer as an undergrad student. I probably have an excessively diverse background.

These kinds of projects are very different because you’re required to work a little bit in that interdisciplinary space, so their potential to be high impact is increased by that. There are also significant transaction and reporting costs for those large projects. I am in the process of chasing another big project with Ken Moore, and we believe that one of the only ways to make the changes that we need to make for a greener agriculture is a large project like this with larger funding which could really spearhead this new idea that Ken has been developing right now. In order to take it to a higher level of technology readiness, we need a large grant.”

What was your specific involvement with the education efforts?

“There were two parts to the education effort. Patrick Murphy can tell you about how he did a tremendous amount of the modules that we created. There was this summer programming that was primarily for undergraduates. We did do one summer graduate program, and it did not go the way that I expected it to go. There were some good things that came out of it, but in general, the participants didn’t feel like it was a good use of their time. I hate running a program like that, and I felt terrible after that when I looked at the feedback.

We ran a two-week summer program here at Iowa State a few years earlier that was really well-received by students from around the world, and I tried to recreate that for CenUSA, but I think that I misunderstood how busy a time that summer was for students who were doing a lot of their own field work at the same time. I think the programming that I lined up did not reach those students in the way that I thought it would. That was a part of the project where I did not deliver what I hoped I would.”

Continuing from how you feel like you didn’t quite deliver in one area, were there any obstacles that you encountered in your work?

“That was the biggest problem I had. If you look beyond that to the summer internship programs that we



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ran for undergrads, that went extremely smoothly. There were teething problems that I had early on with CBiRC, and I learned from that. That's part of the mentor training that we did. We created a mentor-training video that is widely available online and that I share with people across the country. I think that we were able to fine-tune those summer programs really well."

What are some noteworthy successes that you think you and your team achieved?

"I think we learned about the qualities of good mentoring. I think that the contributions that the students made to their labs were things that I hoped would happen in a program like this. Most of the students did work that was eventually reported in meeting papers and published in refereed publications, a large fraction of whom decided to go on to pursue post-graduate education. A huge fraction of them reported that participation in the program broadly increased their understanding and interest in working in this area. I think the internship program was a resounding success."

So young people were receptive and interested in your educational programs?

"Yes. There was huge, positive feedback specifically on those summer internships. There was huge interest and a lot of positive feedback. On the one hand, we did a good job training mentors and soliciting students to participate. On the other hand, the PIs (principal investigators) on the project did a fantastic job of preparing, being there and working with their students. We had a great group of investigators who did right by the students." Could you give some examples of the exact feedback you've received from students?

"A common theme was that 'it was a life-changing experience. I really learned how to do good research, and I realized that I have a passion to

work in this area.' We have that kind of feedback on a regular basis."

How did researchers determine what education programs and tools were and were not most effective?

"I'm not really sure that we did that. Virtually all of the faculty PIs on this project had experience working with undergraduate students, so my job was attracting students to apply. What we had what I thought was a very good process of matching students to projects. This area is so broad that you cannot just take any student who applied to the program and stick them into any lab and have success.

We had a great process where MaryAnn and I would do an initial sorting of students and provide each principal investigator with three-to-six students who met the baseline criteria and who were actually interested in their labs. We would then have them rank those students, and we would go through the process of making sure that these students weren't all from one school or one part of the country. We had a very well-developed process, and we've written about that. This enabled us to meet the program goals of a group of students with a wide range of backgrounds, getting into labs that were a good fit for them."

What is the most important or most interesting facet of your work that you want the generally interested members of the public to understand about your work?

"I want the general public to understand that we take education seriously, whether it's in the classroom or in the lab. We don't just sit around expecting good things to happen, we know that planning and preparation cause good things to happen.

We took our job and the money that the public gave us very seriously. We had a responsibility to

those students and to the public whose money we were spending to place well, to get good research done and to give those students experiences that really helped them grow. We did that.”

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

“I now have an understanding of large, multidisciplinary and transdisciplinary projects, as well as how to structure educational opportunities for students in a way that lets them benefit from the transdisciplinary nature (of the project). We did specific things: weekly meetings, building the posters early on, presentations by faculty, and so on. We did things to make sure that students didn’t just disappear into ‘lab number seven.’

“We also tried to ensure that students were not just going into situations where their work was nothing more than grunt work. I had a handful of times where that maybe happened, but out of the 66, it probably wasn’t any more than three times. The vast majority of our students got to do intellectually meaningful work. That was really important for those experiences to have value.”

In what new directions do you hope to take your own work? You mentioned something that you and Ken Moore are trying to start.

“Ken and I were working on a project that he really initiated, but into which I’ve inserted myself. It’s a project focused on the introduction of a perennial ground cover into conventional row-cropping in the Midwest, that is, corn and soybeans. I think that this vision that Ken has for perennial groundcover is game-changing.”

“We have been thinking and worrying about soil erosion and water quality in the upper Midwest arguably since the Dust Bowl, but certainly for the last 30 or 40 years. There are a lot of neat solutions, and to their credit, a lot of people are starting to implement them, but we do not have the range and rate of implementation that we need to make a huge dent in soil erosion and in nitrogen and phosphorus emission. I believe that this project will do that, and I do not say this lightly. I tend to be a pessimist and a skeptic. The reason it could do it is because if we look at some of the preliminary data and make some not-crazily-optimistic assumptions about what could be achieved, we think that we could get people to do this (implement proposed solutions) because they might make a little more money doing it.

If the environmentally beneficial practice is also economically beneficial, you’ll get what we’re seeing in the energy sector right now, adoption rates for wind and solar that are greater than anybody could have imagined. Is this happening because they want to stop carbon emissions? No, it’s because it’s cheaper now. There are a lot of people working this, and there are a lot of different solutions that could work, but I believe that this PGC, perennial groundcover vision, is particularly powerful because I think people might be able to make money doing it. If that happens, and you hit the kind of uptick rates that could follow, we might finally make a dent in this problem in a way that we never have in decades.”

D. Raj Raman CenUSA Bioenergy Work Product

- ✓ **Moore, K.J.**, S. Birrell, R.C. Brown, M.D. Casler, J.E. Euken, H.M. Hanna, D.J. Hayes, J.D. Hill, K.L. Jacobs, C.L. Kling, D. Laird, R.B. Mitchell, P.T. Murphy, D.R. Raman, **C.V. Schwab**, K.J. Shinnars, K.P. Vogel, J.J. Volenec. 2014. Midwest Vision for Sustainable Fuel Production. *Biofuels* 5(6): 687-702. doi: 10.1080/17597269.2015.1015312.

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