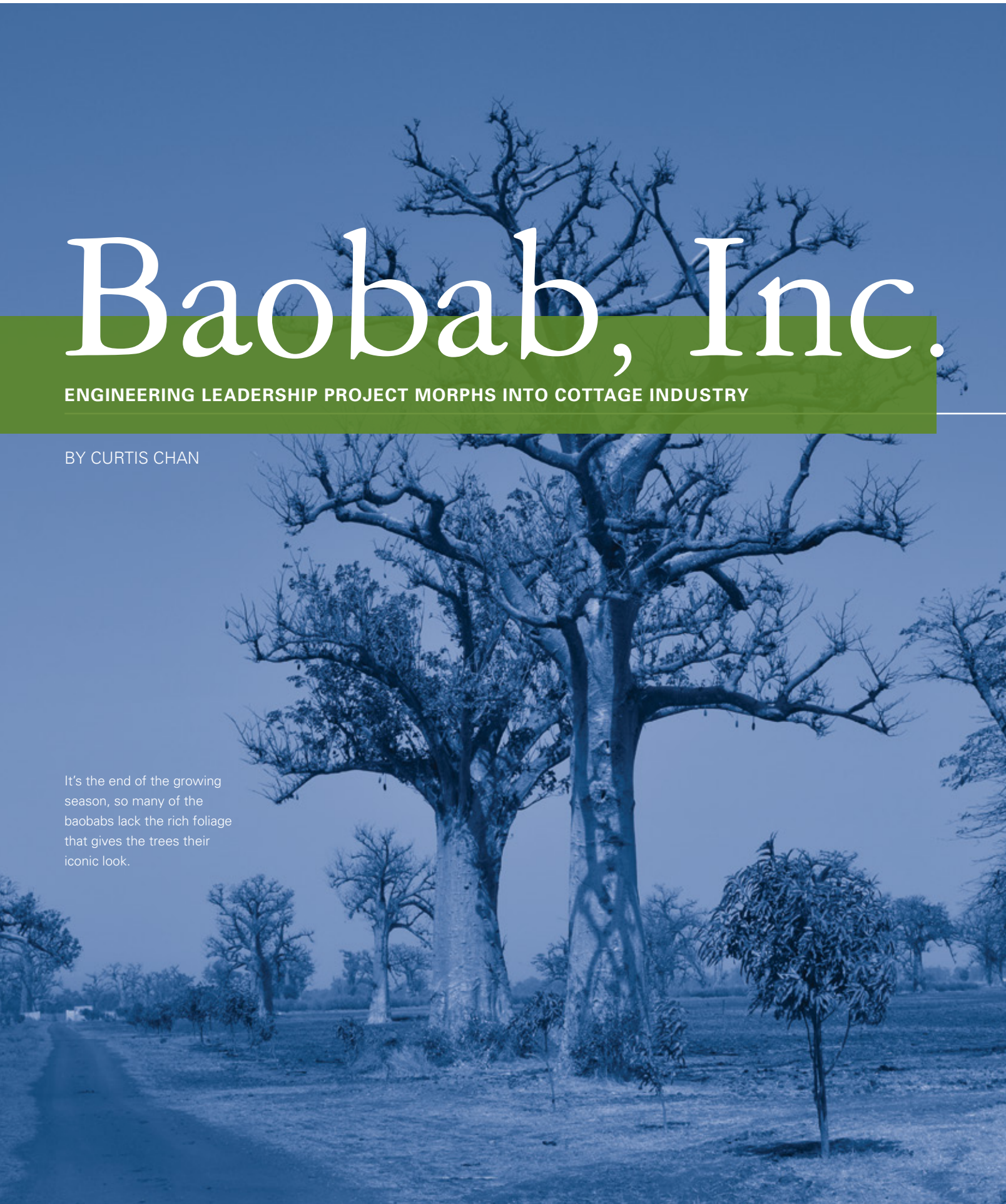
Baobab, Inc.

ENGINEERING LEADERSHIP PROJECT MORPHS INTO COTTAGE INDUSTRY

BY CURTIS CHAN



It's the end of the growing season, so many of the baobabs lack the rich foliage that gives the trees their iconic look.

The baobab fruit offers a source of nutrition and income to people in sub-Saharan Africa.

Photo credits: Curtis Chan

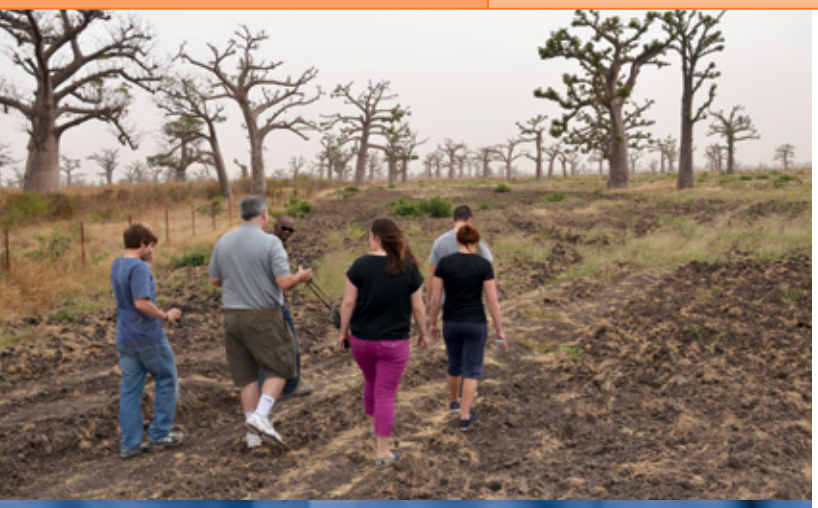
For students in the engineering leadership development minor, it's the project that keeps on giving. Over the past three years, Penn Staters have been designing and building machines to process baobab—a football-sized fruit harvested in Africa that serves as both a food and an income source.

The project has already taken engineering leadership students to Africa three times—twice to Benin and once to Morocco—to deliver baobab machines.

Earlier this year, the students returned once again, this time bringing machines to Senegal and Benin.

An accidental cottage industry

For the program, baobab has developed into something of an accidental cottage industry. The effort, which began as a routine class assignment to design an apparatus that would take some of the difficulty out of processing the fruit, went viral once a PDF report was posted online.



"One of the keys to making baobab more accessible is to widely distribute the technology, and we have had requests from a number of countries."

After students built two machines for a tiny cooperative in Natitingou, Benin, more emails from Africa began arriving, inquiring about the Penn State machine.

One of those emails was from Papa Fall, a managing partner with Sunu Harvest, a Senegalese company focused on developing "super foods," such as moringa and baobab—natural products with high nutritional value. He began discussing the possibility of bringing a machine to Senegal with former director of the leadership program **Rick Schuhmann** and current director **Mike Erdman**.

"We saw the University was working on a baobab machine," Fall says. "From there, we really connected."

Fall, who earned his undergraduate degree from North Carolina State University and resides part-time in Asheville, NC, with his wife and managing partner, Stephanie Tomatis, says he envisioned the device providing not only food for people, but also jobs to help process the fruit.

"Baobab is a 'super fruit.' We are trying to add value to baobab. We want to make an impact on rural communities and help African producers add value to their product. We want to make the product more accessible and even enter the global market," he states.

The couple's firm works with Selina Naturally, a U.S. health food distributor, which also supported Sunu Harvest as a startup, to distribute their products.

Erdman, who is the College's Walter L. Robb Director of Engineering Leadership Development, says, "One of the keys to making baobab more accessible is to widely distribute the technology, and we have had requests from a number of countries."

For the Penn State team, it was another opportunity to field-test the device. So during the holiday break between the fall and spring semesters, Erdman and four engineering leadership students headed to Africa.

A bumpy ride

For the Penn Staters, the sun and warmth of Senegal's capital of Dakar offered a nice respite from the Pennsylvania winter. Though some of the students had visited Africa before, the trip to the west African nation was a first for all.

Industrial engineering senior Alyssa Joslin demonstrates a seed press to Senegalese farmers.

(Clockwise from top right) Engineering Leadership director Mike Erdman, mechanical engineering senior Abbie Swoboda, industrial engineering senior Alyssa Joslin, mechanical engineering senior Mike Colvin, and mechanical engineering graduate student Erick Froede troubleshoot the baobab processor.

The plan for the team was to test the revised machine—now in its fourth iteration—at a farming cooperative outside the capital.

The road to Sunu Harvest's partner farm is cratered with potholes, tossing Fall and the Penn Staters around as they slowly ambled their way to the farm.

Towering baobab trees—taller and far older than some of the oldest elms on the Penn State campus—pepper the landscape, which also supports crops of okra, green beans, and watermelons. It's the end of the growing season, so many of the baobabs lack the rich foliage that gives the trees their iconic look. A baobab tree is not dissimilar to the signature Tree of Life attraction at the center of Walt Disney World's Animal Kingdom.

In a simple steel quonset building used by the farmers for equipment and crop storage, as well as the occasional meeting, the students got to work unpacking and assembling the baobab machines.

Baobab is normally processed by hand—a labor-intensive effort that starts by gathering the fruit hanging from the tree, cracking open the shell, gouging out the innards, pounding the pulp, and finally sifting debris from the powder. The resulting powder is used for food and drink and exported to markets in Europe and United States.

"Making baobab powder is really hard on women," Fall says. Traditionally, women use an oar-sized wooden pestle to smash the pulp in a giant mortar. The continual up-and-down motion with the pestle often causes repetitive stress injuries to the women.

The engineers' machine, which looks a bit like a tabletop pinball machine, is designed to alleviate much of the heavy labor, increase volume, and reduce production time.

Raw pulp is dumped into a hopper at the top and crushed by a stainless steel roller. The resulting powder is then sifted through a metal mesh to separate the debris—mostly seeds and other baobab parts—to create a pure product.

Though all the parts were present, the students encountered a snag assembling the machine.

"The biggest problem we had was things weren't lining up," says **Alyssa Joslin**, an industrial engineering senior.

She said the chain connecting the motor to the machine's heart—the heavy steel roller designed to crush the baobab pulp—wasn't properly aligned.

Mike Colvin, a mechanical engineering senior, states, "We think maybe some of the parts were bent in transportation."

Mechanical engineering graduate student **Erick Froede** says other small problems cropped up, including chains slipping off sprockets and seeds getting stuck.

Though frustrated at the minor setbacks, the team got the machine working before the end of the trip.

Abbie Swoboda, a mechanical engineering senior, says there's a big difference between building something in the lab and doing it in the field.

"Until you actually build the machine, you really don't know what's going to happen. It was definitely harder to assemble the machine in Senegal. You can't rebuild the machine while you're there."

"Until you actually build the machine, you really don't know what's going to happen. It was definitely harder to assemble the machine in Senegal," she says. "You can't rebuild the machine while you're there."

Swoboda adds, laughing, "I was almost surprised it worked!"

Fall says he has high hopes for the Penn State machine. "We're going to take this machine to the rural community farm and test it and give the students feedback. We think this machine is going to help us get clean, consistent product in large volume."

He adds, "It was a great experience. I was impressed with the whole team and with the machine. I'm really happy with the size. It's small and efficient and can be mobile. It's a really simple machine, and it can be serviced here. We're looking forward to testing it for performance."

Return to Natitingou

For the leadership students, the success in Senegal only marked the halfway point in the trip.

As Colvin and Swoboda returned to the United States, the remaining three—Erdman, Froede, and Joslin—headed to Benin for a return visit to the cooperative that started all of the baobab trips to Africa.

The visit marked the third trip in less than two years by Penn State engineers to the cooperative in the country's north.

"It was about renewing old relationships," Froede says. "We're going to support them. You don't promise these people something and leave them high and dry."

Although there were minor bugs to work out of the Natitingou machine, assembly of the second machine went more smoothly than the first.

"We did a couple of field modifications," Froede says. "But we got it up and running, and it worked like a charm."

He said it takes the machine about six minutes to produce a kilogram of refined baobab powder.

"I was very nervous," Joslin says. The industrial engineer was on the initial trip to Benin in May 2011 and recalled the disappointment at the cooperative when some

of the parts were lost by the airline and the team couldn't assemble the first machine. Though a second machine was brought to the village in December later that year, Joslin said the second device went largely unused.

"To travel back and give them one that worked was more than I could have hoped for. It was great seeing their reactions to the new machine," she says. "It was extremely rewarding to see them smile."

Version five and beyond

Buoyed by the recent success in Africa, the team is well under way planning improvements and modifications for the next generation machine.

Colvin says the team was already considering reducing some materials to save not only cost, but also construction time. The engineers plan to eliminate two legs and some steel plates, as well as trim down the heavy, stainless steel heart responsible for grinding the baobab pulp.

"It's a lot of wasted material," Colvin says of the current heart. "That's a lot of scrap stainless steel you don't need."

He said the team also plans to address the alignment issue after some parts bent while being transported on some bumpy roads.

"We're going to try to flip the motor to put it on the same plate as the heart," Colvin says of the planned upgrade.

Swoboda says the engineers are considering adding more support for the stainless steel heart, adjusting the machine's design to facilitate cleaning its innards, and making it more compact. The team is also looking at making it possible to swap out the motor that drives the baobab machine.

Simplicity will also be key. Joslin says, "Having 57 bolts is not OK. The people at the co-op can't easily disassemble it to fix it."

For Erdman, the inquiries he's received from a number of countries in Africa may spawn a new model of learning and outreach for engineering students.

"Going to Africa is very expensive," he says.

Froede agreed, saying, "We'd construct the machine and bring it over. Students paid their way, and we'd shoulder the costs."

Instead, Erdman envisions a partnership model, with companies or groups in Africa who are interested in the baobab machine partnering with the leadership program to share in the cost to build the machine and send students to Africa.

Erdman says, "We can give you a machine, if you help support a student."

Froede says the idea was intriguing. "It's an interesting shift. And we would have these partners to give us feedback."

Erdman says he's already talking to people from Ghana, South Sudan, and Madagascar about the baobab machine, as well as handling inquiries about other student projects from Ethiopia, Djibouti, Nepal, Haiti, and Peru.

He hopes to be able to expand the effort and offer more students the opportunity to work on projects that have a positive impact on people in other countries.

Froede says his overseas trips with the engineering leadership program have taught him a great deal about how the world works.

"Benin was the first place where I got to see how the majority of the world lives," he observed. "It was amazing to see these issues up close and personal." ■

The Penn State engineers share a traditional Senegalese meal at Papa Fall's Dakar home.

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