USDA Cooperative States Research Extension Education Service (CSREES)
Higher Education Challenge Grant program

Discovery-Based Undergraduate Opportunities: Facilitating Farmer-to-Farmer Teaching / Learning

Subcontract to the University of St. Thomas (UST), St. Paul, Minnesota

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June 11-23, 2008 Trip Report

Executive Summary

Dr. George followed up with the testing of the evaporative cooler at ENI and traveled to Borko, Sendégué and Mopti to participate in a holistic village discussion and to investigate the needs of the seed potato, pearl millet harvesting and water purification projects. The Cooperative Learning and Information Centers (CLICs) were designed by USAID-Mali for conveying information from one group in Mali to another, including farmers. These cyber cafes in villages and towns needed an inexpensive, sustainable way to cool the high heat-load space. Two groups of senior engineering students from the University of St. Thomas (UST) considered several passive and low-powered alternatives. They examined evaporative cooling with and without an underground duct to pre-cool incoming air as well as high reflective shading. The first senior design team (2005) built a prototype system, which was subsequently installed in a CLIC in Mali, and with the help of two Peace Corps volunteers test data was obtained for one year (2006). Using the actual temperature and humidity data as well as local user feedback, a second student team from UST redesigned it specifically for Malian conditions (2007). The new design incorporated an indigenous pad material and flipped the pad material location to be inside of a building to avoid an excessive build up of dust and sand. The new design was shipped to the Mali Institute of Engineering (a higher education institute that trains engineers). Within a few months, a Malian engineering student began testing and improving the prototype for his senior design project. He improved the design by mounting an exterior fan and found ways to increase the water evaporation rate (2008). The Dean of Engineering at this Institute requested that the prototype be installed in one of the classrooms at the institute and has asked the Mali Department of Energy to fund a larger technology trial of this sustainable, low impact cooling system to be in each of 10 classrooms. The same design will also be built by the Malian students to test in farming systems in Mali, such as preserving crop perishables, like certified disease-free seed potatoes. Eventually the design could be extended to the small business community and the training could be done by the Mali Agribusiness Network.

Trip Details

The following people traveled to Mali under the auspices of the grant, titled *Discovery-Based Undergraduate Opportunities: Facilitating Farmer-to-Farmer Teaching and Learning*

Faculty Member:
Camille George (UST engineering)

Students:
Anthony Caruso, President of the UST chapter of Engineers for a Sustainable World (ESW)
Robert Schulzetenberg, Vice President of fund raising (ESW)

1.0 Itinerary

Pre-trip itinerary is attached in ***Appendix A***.

Wednesday, 11 June 2008. Departure was re-routed because of bad weather. Originally we were scheduled to fly Minneapolis- New York- Paris- Bamako, but were re-routed to Minneapolis- Amsterdam- Paris- Bamako. In fact this trip took much less time than any previous trip and eliminated the long lay over at the Paris airport.

Thursday, 12 June 2008. We arrived in Bamako in the evening as scheduled. Two of our three checked bags did not arrive. Sidy Ba came to the airport to pick us up, but only airport personnel are allowed in the airport building. We did see him through the window. He was not able to assist us in filing the claims for the lost luggage, which took a long time because there was a bad storm at the airport and the power kept getting turned off. We did not arrive at the Hotel Sarama until past 11pm.

Friday, 13 June 2008. We met with Dean Drenk at the Hotel Sarama in the morning. Dean arranged for a money changer to change money. C. George changed $3000 to CFA at 412/$.

Greg McGrath a young engineering graduate from Iowa State introduced to me via e-mail by Kevin Sauter, a UST professor and former Mali extern mentor, came to the hotel. Greg had just spent a month at Medicine for Mali working on wooden water valves and with village level entrepreneurs to provide evening light for village events using car batteries and fluorescent bulbs. He was interested in starting an NGO that assists people with charging car batteries using solar panels. He was also interested in solar hot water.

Ecole National d'Ingenieurs (ENI)
Meeting minutes.
Present: Moussa Kante- Dean of Engineering, Arona Coulibaly- Director of the Thermodynamics lab, Daouda Coulibaly- Associate professor of the Thermodynamics lab, Sidy Ba, Camille George, Dean Drenk, Tony Caruso, Robert Schulzetenberg, Greg McGrath.

Everyone introduced themselves. The evaporative cooler, initially designed by UST faculty and externs as a low-powered alternative to cool high heat load space as found in the CLICs, has had a good reception. The full-size cooler built at UST was shipped last summer (2007) to Mali and arrived at ENI last November. A senior engineering student, Sidi Yaya Sangaré, was tasked to set up the cooler and make adjustments to get it running properly. He is currently conducting tests to measure its water consumption under the mentorship of the Drs. Coulibaly. The next step will be to install the prototype into a classroom. After that, the ENI professors would like to redesign the unit without the tall top (designed to hold beverages), and manufacture several units to install into classrooms. These classrooms will serve as showcases of the technology. Everyone was positive about the technology and its adaptation to Mali.

Greg McGrath's presence initiated a conversation about the lack of communication between the many American academic groups (engineers without borders (EWB)) and engineers for a sustainable world (ESW)) and the engineers in Mali at ENI and IPR. We discussed that much of the appropriate technology needed in Mali had to be agricultural in nature because this was Mali's greatest need. We brainstormed ideas to get these two constituencies (American and Malian academic engineers) collaborating. We discussed having a website, a skype conference, or a traditional conference. Dr. Kante remarked that we would probably need two websites, one in Mali (in French) and one in the US. He also mentioned that ENI would need help in maintaining the website. The discussion continued and a consensus was reached that a traditional face-to-face conference would be the most beneficial because friendships begin when people begin to know each other. Also, a face-to-face would easily facilitate matching Malian and

American faculty with similar interests. Thus it was decided that we should organize a conference on appropriate technology in Mali.

Dr. Kante believed that the conference could be held in February-March time frame, but Dean Drenk made a compelling case for having the conference in early January. It was decided that we would all work towards such a conference in January 2009. We agreed on the following timetable:

> ***July 1st 2008*** – Conference Title and expectations. **Action:** C. George
> ***September 1st 2008***- Explore possibilities for funding, estimate the conference cost and obtain an idea of the possible number of participants.
> *A decision will be made September 1st if there is enough interest to continue the conference planning.*
> **Action:** C. George will personally call American groups with projects in Mali
> **Action:** M. Kante will discuss details with his faculty and contact the department of energy, transportation and geology for interest in financial support. ENI will also look into professional French/English translations. ENI faculty will also consider inviting like-minded French and European faculty.
> ***January 2, 2008***- Possible conference date. The conference will be longer than one day and less than 5 days. Pre- and post- conference trips to successful projects will be considered.

We discussed that we would like to invite NGO's working in Mali to facilitate the dissemination of the technologies presented and encourage Malian students to present their work. We discussed that all parties involved should think about inviting the many stakeholders that could benefit from such a conference.
The meeting adjourned and everyone except for Dean Kante proceeded to the thermodynamics laboratory to view the testing of evaporative cooler technology.

Sidi Yaya Sangaré was introduced as the engineering student that was working on the prototype cooler as his senior design project. He explained the modifications that he had completed.

- **a.** Fixed leak
- **b.** Removed fan and inserted a larger fan
- **c.** Placed new blower fan on the unit exterior and removed the axial fan in the interior
- **d.** Increased the drip rate by making larger holes in trough
- **e.** Added an exterior graduated cylinder to measure the water consumption

S. Sangaré explained that he adjusted the Fu thickness to guarantee that the air passage was adequate to facilitate room cooling. He adjusted the Fu orientation to a primarily horizontal orientation to facilitate an adequate residence time for the water droplets.

C. George asked a series of questions about maintenance. At this time the lifespan of the Fu was not known (ie. How often the Fu would need to be replaced?). The total water consumption has also not been determined. Mr. Sangaré will be working on these tests for the remainder of the summer.

The Drs. Coulibaly and C. George discussed the manufacture of the unit. A. Coulibaly believed it could be easily manufactured in Mali. The pump, fan and motor would most likely be imported. We discussed the possibility of alternative materials for the housing. A. Coulibaly believed that durability was very important and clay or ceramic materials would be too fragile and as well as absorb too much water.

After the current water consumption tests are complete (~1 month time), the unit will be put into a classroom for an extended test. ENI wants to engage technical students in building additional prototypes with minor modifications to cool a series of classrooms.
Action: A. Coulibaly will send data to C. George in about 1 month time.
Action: C. George will start a joint-journal publication this summer.

The professors also showed C. George an experimental set-up that included two evaporative coolers with and without a geothermal duct. They explained that the duct was laid two meters into the ground. They explained that the ground temperature was uniform at 2 meters and the ground experiences temperature cycling at depths of less than 1.6 meters. Their duct was 16 meters long and had thermocouples along its length as well as depth. These coolers had the Fu pad material on the exterior and the fan on the interior. They explained that having the pad material on the inside (interior) will probably work better in Mali because of dust build up in the Fu.

It was personally very satisfying to see the UST evaporative cooler senior design project being actively continued at ENI.

Institut Polytechnique Rural de Formation et de Recherche Appliquée. (IPR/IFRA)

Meeting minutes
Present: Fafré Samake, Gaiba Diarra, Mamadou Moussa Diarra, Greg McGrath, Tony Caruso, Robert Schultzetenberg, Sidy Ba, Camille George
Everyone introduced themselves. Fafré Samake , Dean of IPR, Gaiba Diarra, professor in zoology, Mamadou Moussa Diarra, chair of animal science. We introduced our idea about the 1st conference on sustainable and appropriate technology for Mali. We presented the tentative dates: July 1st title and summary statement, September 1st estimate of cost and possible attendees, and January 2nd the tentative dates for a conference in Bamako hosted by both ENI & IPR and possibly UST. Dr. Samake believed this to be a good idea. He mentioned that there was a science conference held every other August. C. George said that there is an agriculture professor at the University of Minnesota, Crookston, Harouna Maiga, of Malian descent that attends this conference. C.George stated that this conference would be different in that it would emphasize appropriate technology, especially the technology needed for agriculture. Everyone was in agreement that such a conference could be very productive and helpful.

After the meeting, C. George, T. Caruso, R. Schulzetenberg & G. McGrath had a pleasant dinner at Le Relax on the Route to Koulikoro.

Saturday, June 14, 2008

Meeting with Eva Weltzien, Principal Investigator ICRISAT.
Present: C. George & E. Weltzien

Meeting minutes
The meeting was set up by Bert Rivers from CTI. Eva Weltzien is in the last stages of planning a Gates foundation grant which she will manage through ICRISAT. Her grant is to increase consumption of pearl millet and sorghum. Her grant will focus on creating new varieties, increase consumption of these grains in urban areas and subsequently increase income on the village level. She has been working with grains (she is a plant breeder (pathologist) by training) for over 20 years. Her grant is interested in creating more market opportunities for millet and sorghum. In particular, create opportunities at the village level to process and sell grains and processed or pre-processed foods, improve the demand for high quality grains and improve the marketing of higher quality products.

Quality at the very least would be pearl millet and sorghum without sand or pebbles.

Her grant is aimed at several levels of production. First there is the farmer level and households of 40-80 people. In general farmers do not sell their grain but keep it in storage between 1-3 years. Farmers always save their grain because 1 of every 3rd year is usually bad. Farmers keep their grains as security against a drought. Men grow millet & sorghum but women are responsible for transporting and processing the grains. Many women however do grow sorghum and use it as a 4^{th} meal for children (this is in southern Mali). Husbands don't provide the grain for this extra meal. Both pearl millet and sorghum are crucial for survival. Millet grain is stored unthreshed, as entire panicles (on rachis (stalks)). A rich household is one that has many stalks in their granaries. Eva was very interested in the simple CTI technologies for pearl millet threshing. Threshing and processing pearl millet is a job done by women on a daily basis. Shortening the threshing and processing time would give women extra time to pursue other activities. Part of the Gates foundation emphasis is to provide benefits for women. Extra time could be used in producing something that could generate an income for women. She believed that the CTI technology would fit well with the grant emphasis. She believed that reactions from women about the technology could be done in the first year. She has many connections through Global 2000 and agriculture extension NGO's working over many countries in Sahelian Africa.

A second level of the grant is aimed at farmer unions and large commercial processing. Here larger machines would be used for threshing and processing, but she felt there may be a gap between the two levels. She believed there may be a role for UST in examining the various technologies as they relate to scale. Here UST-SoE could be in an exploratory role examining the technology continuum from subsistence farmer to commercial processor.

Another part of her grant deals with creating new varieties of grain, variety trials and training, and adoption of improved varieties. She will be working with various NGO's specializing in agricultural extension services to reach a large region. Finally she is interested in training farmers to produce seeds.

C. George explained the potato seed production project she was exploring with the Malian Network mentored by Montana State University, UST, UC- Davis & Chief Dull Knife. We

discussed that perhaps UST students could participate in gathering data about pearl millet production when they were working in Borko. She said Borko was a good location to try the millet processing technology because Borko had water and the residents of Borko were established farmers. It would be an ideal place to obtain user feedback. She explained that currently the glums from pearl millet can irritate people. Thus most millet processing is done away from the homes. She was interested in where the CTI technology would be used, would the women still process the millet away from their homes? Processing is currently done by 2-3 people working together. A change in behavior would have to be examined. Perhaps the processing could be done close to the homes and only the separation needed to be done at a physically isolated location. She believed that the CTI technology would be excellent to try on the small farmer scale and agreed to write CTI into the project.

She was also interested in creating more market opportunities for processed grains. Here she was interested in the role that CTI could play in creating millet or sorghum snacks for urban customers. Perhaps there could be a cooperative level where women would process the millet or sorghum to an acceptable pre-processed food to be sold to urban consumers. Again there is a continuum for food processing technology between the village and the city. At the conclusion of the meeting she was very enthusiastic about exploring a role for both CTI and UST engineering. She believed having women student engineers spend time with village women processing millet would be extremely beneficial in developing the technology because of the gender segregation in Malian society.

Action: E. Weltzien will email CTI to continue the discussion of adapting the pearl millet technology
Action: C. George will send her CV upon return to MN.

After the meeting, George, Caruso & Schultzetenberg went to Mali Chic to purchase gifts for Aissata's daughter's birthday party, and Sidy's wedding. Saturday afternoon was spent at Aissata's house celebrating Hawa's third birthday. It was a pleasant celebration complete with a birthday cake and the singing of Happy Birthday in French, Bambara & English. We left after dark.

Sunday, June 15, 2008

We spent most of the day at Aissata's home. We were hoping to help with the baby food package preparation, but we were more help just getting out of the way. Dean Drenk is organizing baby food packages to take to Sendégué. Aissata had obtained a recipe that included many ingredients. We had rice with spinach for lunch and left at 4 pm to attend Sidy Ba's religious wedding. Unfortunately we arrived late and missed the benedictions, but did enjoy a meal of chicken with onions. We did take pleasure in spending the day observing Malian life.

Monday, June 16, 2008

Aissata & Sidy Ba stayed in Bamako to attend the funeral of the director of IER-Sotuba. We traveled all day to Séveré. Aissata Thera arranged for a driver and a car. We stopped in Ségou for

lunch, San for cold drinks and Djenné to see the largest mud mosque in the world. We arrived after dark in Sévaré and stayed at the Mankan Te Hotel overnight.

Tuesday, June 17, 2008

Dean Drenk, Robert Schulzetenberg , Tony Caruso & C. George traveled to Bandiagara & Kani Kombole, in Dogon Country. We did not have a guide and subsequently did not stay long. No one in Kani Kombole spoke English and we decided to head back. Kani Kombole is at the bottom of the cliff separating the plateau and the 'cliff villages'. Upon our ascent back up the cliff we encountered a small van that had lost control and drove into a tree. The two occupants of the vehicle were alive but hurt. We rearranged our luggage to put on top of the vehicle and we helped the injured people into our vehicle. We drove them to the hospital in Bandiagara. We hope that they recovered from their injuries. We decided to have lunch in Bandiagara, and then continued to Mopti where we sat in a hotel lobby waiting for the driver to repair the car's air-conditioning system. He unfortunately was unable to fix the vehicle and had to order the broken part. We then traveled to Sévaré to wait for Sidy Ba & Aissata Thera. They arrived much later than expected. We decided to continue driving towards Borko. The weather became very windy and we decided to stay in Boré. Here one of Aissata's connections was kind enough to let us stay on the roof of his new home. The weather was incredibly windy and sand was everywhere. They brought us dinner and some water. The sand storm continued through most of the night. We woke to the call for prayer, covered in a fine layer of red dust.

Wednesday, June 18, 2008

Ashiou Kassambara, (tel number 536-2721) a native of Borko, accompanied us from Boré to Borko. We met with the village town council and explained the purpose of our visit.

Borko Town Council
Meeting Minutes
Present: Aljouma Kassambara, Maire of Borko, Souleymane Kassambara, 2nd Adjoint Maire, Maimouna Kassambara, 3rd Adjointe Maire, Issa Togo, Secrétaire general de la Commune, Irandé Kassambara, chef de village de Borko, Ashiou Kassambara, animateur agriculture, Camille George, Robert Schultzetenberg, Tony Caruso, UST engineering, Dean Drenk, Sidy Ba Aissata Thera.

Everyone introduced themselves. Aissata Thera had previously conducted a community goal setting holistic process in Borko where the community had requested assistance from the network in managing the native crocodiles and starting the production of seed potatoes. We discussed starting with a small pilot plot, work up to one ton and then increase seed potato production to 5 tons/yr within the next few years. The town council would be responsible for finding a location for an irrigated field, a location for storing seed potatoes, and a location that could house other university students from the US if they were to assist the villagers in Borko in building a seed potato storage facility or in conducting other projects.

The town council stated that there were 28 natural springs in their area that had flowing water year round. They agreed to show us two spring locations and arrange a meeting with the town farmers later that day. All agreed to work together.

Most of the members of the town council meeting walked over to the first water spring. We measured and photographed the first natural spring. We passed by one small crocodile. Borko prides itself on its crocodiles; all the community chairs have a crocodile logo and their village name painted on them.

Experimental Results of Flow Rate of the First Spring

In a channel that was 10 feet long, 11 inches wide and 12 inches deep, a small nut traveled 10 ft

10 ft	15.96 sec
	18.89 sec (held up by a disturbance)
	17.23 sec
	17.33 sec
	17.90 sec
	18.78 sec

The flow rate of the water was roughly 30 ft3/min. The measurements were done by timing the flow rate of a small floating seed using a hand watch.
The farmers of Borko would plant seed potatoes in September- November, grow them until February, and then need to store them until the planting season. The temperature on June 18, 2008 was 38.4 deg C and 23% RH to 40.3 deg C 20% RH. C. George had brought a small portable temperature and relative humidity meter to take the measurements.

Meeting with farmers in Borko

Aissata Thera explained the goal of the visit, to speak about seed potato production, which was previously expressed as a holistic goal by the villagers, to introduce the possibility of a new pearl millet processing, and to discuss a nutritious baby food project. She spoke in Bambara which was then translated to Dogon and then to English.

Potato

The farmers were interested in seed potatoes and agreed that the chief and mayor's staff would pick the seed potato storage and seed potato plot location. They were interested in seed potatoes both for food and for cash. Currently they were growing garlic and onions as their cash crops. If seed potatoes would be profitable, they were willing to stop growing other vegetables. One farmer voiced the concern that potatoes were difficult to store, especially in hot climates. The farmers were very enthusiastic if we were to find a storage solution. They were ready to work hard and do their part in growing seed potatoes.

One elder remembered that farmers in Borko used to grow potatoes and wheat during the time of French colonization. They grew potatoes from October to February. We asked how they stored

potatoes in the old days. The farmer replied that they did not store them. The white people brought in the potatoes for planting and took out the potatoes after harvest.

Aissata said that it would be important that the Borko farmers organize themselves into a cooperative. To be successful they would need to be recognized as a seed potato organization that would supply other Malian farmers.

Pearl Millet

C. George showed the pearl millet device. It worked very well. The heat of the day had melted the glue that held the wooded handles, but the device worked well without the wooden pieces. They were interested in the possibility of new varieties of pearl millet, especially millet with a shorter growing cycle. Camille asked if irritation from the pearl millet glumes was a problem. The farmers stated that it was not a problem and they washed their hands with soap after handling the stalks. It should be noted that all but one participant in the meeting was a man. Camille asked if inhalation of the glumes was a problem. The village health person said that some people did come in with respiratory irritation after working with pearl millet. C. George said that perhaps wearing cotton gloves and covering the nose and mouth would decrease the possibility of reaction. It should be noted that C. George's hand became very irritated after handling just 3 millet stalks. The irritation did not go away for about 12 hours, despite washing her hands with soap. It felt very much like the irritation one gets after handling insulation.

Baby Food

D. Drenk explained his baby food packets. The village people told him that they already receive large quantities of dried ground baby food. Aissata took one of the village packets to record its ingredients. It is uncertain if the village had previously mentioned health or nutrition as a concern in the village.

Other issues
We asked if there were any other issues that the farmers wanted to discuss. They said that they would like to have a pond for the crocodiles. Earlier that day we spoke to a man who was in charge of the road construction from Boré to Borko. He said that there were plans to remove a large patch of weeds and create a pond for the crocodiles. He suggested that there could be a crocodile park and the people of Borko could charge tourists to see the pond. The pond could then be stocked with fish and frogs to feed the crocodiles.

A second issue they raised was the desire to have a middle school in Borko. Their current school provides education from 1-6th grade. If a child wanted to continue he/she must move to a bigger town or city. As a result, few children continued their education and most just stopped after the 6th grade.

They did not bring up any other issues. We asked if Malaria was a problem. They said that about 60% of the kids get Malaria.

We slept in front of the city hall, which was adequate. For future grant trips the village has three air-conditioned buildings that were built for the road construction team. These buildings could house future teams of students; however, the conversation with the town council was not specific or conclusive on this topic. We paid 15,000 cfa for lunch and dinner for 6 people, and then 3000 cfa for a breakfast of rice pancakes with sugar and Lipton tea.

Phase 1:
Action: A. Thera will see if the seed potatoes can be planted twice in one year. She will see if 2 months is enough time for the dormant phase.
Action: S. Ba will find the temperature and humidity information for the Borko region.
Action: C. George will send her the possible temperatures that could be achieved with evaporative cooling based on the temperature and humidity information recorded in Mali.
Action: A. Thera will experiment with a small batch of seed potatoes to see if they can be stored at the evaporative temperatures.
Action: ESW will investigate if there are any alternative options. This will include speaking to seed potato specialists in Minnesota, and reviewing the cooling literature.

Phase 2:
Only after these preliminary investigations would UST-ESW, IPR and the network proceed with a seed potato plot. Such a seed potato plot would need to transport clean water. The water in the springs looked clean, but at all the springs we observed we saw women washing clothes and children running around. For seed potatoes it would be necessary to have an irrigation system installed. A team would need to make a cost analysis of using PVC pipe versus a naturally found material. The region is full of rocks, but hauling and cutting the rocks would be hard work and time consuming. Currently, some of the irrigation ducts are lined with cut rocks.

Phase 3:
A storage facility would be built in a location that was close to the selected spring, but also shaded from the sun.

Thursday, June 19, 2008

After breakfast we went to the second spring location for a possible seed potato project location. It was about 5 kilometers from Borko in the middle of their current fields. Here we found a spring that separated into two branches. Again, there were numerous women washing clothes. There was evidence of indigo dye leaching into the water from some of the fabric. It is not clear if this would affect seed potato production.

Experimental Results of Flow Rate of the Second Spring (first branch)

In a channel that was 10 feet long, 1.5 feet wide and 2.5- 4 inches deep, a small nut traveled 10 ft

10 ft	16.43 sec
	14.09 sec
	15.09 sec
	16.73 sec
	16.53 sec

	18.58 sec
	16.49
	16.36
	15.38
	15.04

It should be noted that people moved the rocks and disrupted the flow a few times during the trials.
Temperature 91.4 deg F, 49% RH, 90.0 deg F, 50% RH, 33.3 deg C 48% RH.

Calculated flow rate: based on 10 ft/16 sec was about 14 ft3/min.

Experimental Results of Flow Rate of the Second Spring (second branch)

The second branch was based on a 5 ft duct that was 1.5 ft wide and between .5 and 2.5 inches deep.

5 ft	4.16 sec
	4.91 sec
	5.1
	4.17
	4.10

Calculated flow rate: based on 5 ft/4.5 sec was about 12.5 ft3/min.

We said goodbye to our contacts in Borko and travelled to Sendégué. Dean Drenk decided not to go with us to Sendégué and drove by himself to Mopti. We stopped in Konna for cool drinks and arrived in Sendégué for a late lunch. Everyone napped after lunch.

Meeting with women in Sendégué

In the late afternoon many women gathered in the chief's courtyard for an extended conversation. Sidy Ba explained that we wanted to ask the women about a device that would make pearl millet processing easier and we wanted to ask if they wanted to discuss any other issues. Easier pearl millet processing was not mentioned by the women as one of their goals but they said they would be interested in a demonstration of the technology.

Pearl Millet

Sidy Ba demonstrated the pearl millet device. The women were genuinely interested and the demonstration yielded many approving gestures. We told them a second device would remove the florets and finalize the threshing (decorticate or remove the outer layer of the millet). One woman asked why the design had two steps. She suggested that the second device receive a broken up stalk. That would eliminate handing the stalk and transferring the millet. Another woman agreed that a one step device would be preferential to a two step machine. In general they would be interested in being part of a larger trial. Another woman also commented that she

threshes and decorticates millet to make a living. Her livelihood would be eliminated by an easier pearl millet thresher and decorticator.

Other issues

We asked if they had any other issues to discuss. They said weeding the garden and getting water were both difficult chores. Sendégué has several closed hand water pumps. The women said that they were difficult to use and were often broken. Sometimes it would be weeks before the pumps were fixed. We asked who fixed the pumps. They replied there was a person in town who fixed the pumps but he was not efficient. Later that day we went to see one of the hand pumps. In general the water from the pumps was clean. Tony Caruso commented that Sendégué needed to invest in a pump repair person that knew how to fix all the pump styles and could build or get replacement parts. His cell phone, tools and repair truck would all be part of his business model. Sidy, Camille, Tony & Robert discussed the question of who should be responsible for water project repairs or improvements. The UST group suggested that the Sendégué town council and other neighboring communities should have a repair system fund. It would be up to the town councils to decide how they would manage an infrastructure fund. In the US, funds are collected through local taxes.

A. Caruso thought it should be noted that the desired outcome of such a system would be a designated community leader (in each village) who would meet the "repairperson" during visits, gain an extensive knowledge of the various pumps and problems that arise (worn out or broken parts) and eventually become competent enough so that the central water pump "repairperson" would not need to be called for every repair thus greatly reducing the amount of downtime for water access.

Meeting about gardening in Sendégué

Potatoes and Vegetable Gardening

Aissata, Sidy and a few men and women of Sendégué gathered for a meeting on growing potatoes. The villagers said they had a small fenced community garden. They had no objections to growing potatoes and said they would be interested in having some help from IER in improving their agricultural skills. We walked over to see the community gardens. The garden was very sandy. The people mentioned termites & squirrels as potential problems for growing potatoes. They currently grow cassava, mint-tea, sugar beet, eggplant, tomatoes and lettuce. They told Aissata that they would be interested in additional training to expand their vegetable assortment. Aissata said that the people also needed composting training to improve their soil.

Action: Aissata will look into getting composting and vegetable gardening training to Sendégué.

We retired at Sidy's family home with a delicious dinner of spaghetti, toh, and fish. Camille commented that the house would be a great location to showcase a sustainable Sahelian house. The *Sustainable Sendégué House* would have a grey water sanitation system and a kitchen emphasizing solar powered cooking.

Friday, June 20, 2008

In the morning, we visted Seydou Traore the county level agent at Sendégué's city hall. We discussed our mission and he replied that most Malian's were subsistence farmers and sustainable technology would have to be focused on its agriculture. We visited Sendégué's health center and then traveled to Mopti where we met with Dean Drenk later that morning. We stopped at the Secretariat General de la Mairie of the Commune of Mopti. We spoke with Bougouti Konate about our sand filtration project. He informed us that we needed to contact the Commune of Sokura. Sidy spoke with a local agent who agreed to accompany us to the village of Danguere Maliki later that afternoon.

We had a nice lunch at the Restaurant Bozo in Mopti.

Meeting with people in Danguere Maliki about the Sand Filtration Project

Present: Almamy Salamanta, chief, Hassey Teme (from Mopti), Sidy Ba, Aissata Thera, Camille George, Dean Drenk, Tony Caruso, Robert Schulzetenberg.

We all traveled across the Niger River on a pirogue to meet with the elders of Danguere Maliki. Sidy explained he wanted to ask the village council a few questions about their water supply.

How many people live here? Between 100 and 600. The population fluctuates and is not constant.
Where do they get their drinking water? They use the river water or go to the next village. Danguere Maliki does not have a well in their village.

Have they already been contacted by an NGO to supply clean water? No, they had no project prospectives, but they would like clean water.

Who is in charge of getting water? The women.
Even if it means going to the next village? Yes.
If they had a pump or a well, who would be in charge of taking care of it (maintaining the hardware)? The men, but the woman would take water from it every day.

We asked if they could suggest a site location. We explained that we wanted to filter river water through a slow sand filtration system. Sidy explained that a continuous system would work the best. We looked at one site, but the water was too far. We saw a second site that could potentially work.

Action: Ashley Williams could survey the site to obtain the geographic particulars.

Since the river level changes all year it will be necessary to have the inlet always submerged, but the water transport will need some protection system.

Action: Camille George and Tony Caruso will explore the possibility of the water filtration project be an ESW national SEED project. They will submit the paperwork this winter.

We returned to Mopti, said goodbye to Sidy Ba and Dean Drenk and travelled to San. Along the road we were caught in a very heavy rain storm. We had a pleasant evening staying with Aissata's family and friends in San.

Saturday, June 21, 2008
After an early breakfast, Aissata stopped by to say hello to several of her elderly relatives and we traveled from San to Bamako. We stopped to get some mangoes and other fruits along the way. In Bamako we went straight to the Broadway Café in the Hippodrome. Both Tony and Robert enjoyed their American style lunch. We checked in at the Villa Soudan, which had a lovely view on the Niger River. We drove Aissata back to her home, stopped at her neighborhood tailor to order a Malian outfit, and finally said goodbye.

Sunday, June 22, 2008

Camille, Tony & Robert took a cab to the Catholic cathedral in the center of Bamako. We found the chapel that had a service in English. The two hour mass included multiple baptisms, an interesting drum ensemble and a completely full church with overflow seating. After church we visited the National Museum and had Wijila for lunch. We spent the rest of the day shopping in the artisan market for souvenirs. In the evening we walked in the Badalabougou neighborhood and dined at the Amadine Restaurant. The Malian soccer team won a match against Sudan that evening and everyone was out on the street celebrating.

Monday, June 23, 2008

Meeting with Belco Tamboura.

Meeting with Belco Tamboura, Camille George, Robert Schulzetenberg, and Tony Caruso. Robert & Tony summarized our trip to Belco. Then Belco and Camille had a private meeting as requested by Florence Dunkel.

Camille asked Belco what was happening with the network. He stated that the network consisted of six people and their mission had not changed since returning to Mali. Camille asked if they were following the work plan that the network had written in 2006 or following the Microsoft project work plan they had written last year. Belco said no, they had not used the project documents. Camille gave Belco the paper copies she had with her. Camille asked if they had a permanent location. Belco replied that they did not. Camille asked what had happened to the office furniture from USAid. Belco said it was in storage at ENI. Camille told Belco that each network member will need to report on their work since the kick-off last September for the 2007-2008 year end report. Belco said that Keriba was in Sikasso and did not have the funds to pay for travel to his research site and then wait for a reimbursement. Camille stated that Florence needed clarification on the $51,150 devoted to the network's budget. Aissata had used her $5000.00, and about $1,000 had been used for printer cartridges and the Shea butter analysis. Belco needed to clarify that this $1,000.00 was to have been taken from his sub grant. Camille also told Belco that four of the eleven sub-grants still needed budgeting. Camille asked about the preparations for Katy Hansen's trip in July. Belco said he had not planned out any details but would start

making some phone calls that week. Camille stated that Florence Dunkel was very concerned about the details of Katy's trip and wanted to hear from him with an agenda as soon as possible. Camille asked if the network had been incorporated. Belco stated that the incorporation was not complete. Camille asked if the network had decided on their internet connections. Belco said they had not reached a consensus but his proposal was correct. Camille stated that Florence had asked for a final proposal for their internet connection.

Camille explained to Belco what she had observed in Borko and Mopti and her ideas on the potato seed project and the water filtration project. Belco asked Camille about the Shea Butter project. She said that she believed that Ernie had posted his class's document on the project website. Belco stated that he had not checked his e-mail in one month. Camille asked if there were any plans to build another Shea mixer based on John Walker's re-design and Mike Hennessey's observations. Camille showed Belco the mixer redesign sketch. Belco said no, the network was only focused on finding external markets for the Shea butter being made at the already established Shea cooperatives.

Meeting at Institut d'Economie Rurale (IER)-Sotuba
Meeting with Belco Tamboura, Aissata Thera, Abdoulaye Camara, Kadiatou Gamby, Camille George, Tony Caruso, Robert Schulzetenberg.

We spoke at length about the potato project in Borko and the Shea butter project. Belco Tamboura asked how could Shea nuts more be fried more effectively. Camille stated that there were two competing mechanisms for drying- elevating the local temperature to drive the water out of the produce, and moving the saturated air away from the produce. The optimal temperature and air flow rate was usually determined by experiment. She also said that many of the low cost processes were discussed in the literature by Iranian authors because much of their export produce was dried (apricots and pistachio nuts). The temperature and flow rate for Shea has not been published in the literature.

Action: Aissata will prepare to have a batch of seed potatoes for this autumn.
Action: Camille George will send materials for a simple passive evaporative cooler with the UST group this January.
Action: Aissata will conduct a survival trial with the seed potatoes starting from February 2009.
Action: Aissata will see if the dormant period can be shortened.

If a critical amount of potatoes does not survive the dormant period with passive evaporative cooling, then alternative cooling strategies would be examined by C. George and the ESW club for academic year 2009-2010.

After the meeting, Belco, Aissata, Robert, Tony & Camille had a lovely lunch at San Toro's. Camille received her Malian outfit, and Belco helped with some last minute bargaining at the artisans market. The three from UST departed back to US and traveled back to Minnesota without any delays.

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Appendix A

-Draft-

University of St. Thomas

Trip Objectives June 2008

Preliminary Program & Schedule

Travelers:
Camille George, Faculty Advisor

Students:
Robert Schulzetenberg
Anthony Caruso

Dates: June 11-24, 2008

Purpose:

1. Meet with ENI to review evaporative cooler prototype.
    a. Meet with Dr. Arona Coulibaly, Dr. Daouda Coulibaly and Sidy Ba
2. Examine needs of potato project with Network.
    a. Collaboration with Aissata Thera, Sidy Ba & Dean Drenk
3. Travel to Sendegue for village holistic interview.
    a. Collaboration with Aissata Thera, Sidy Ba & Dean Drenk
4. Explore possible projects for UST-ESW engineering group 2008-2009.
5. Explore possibility of hosting a national ESW summer SEED site for summer 2009.

Evaporative Cooler Objectives :

1. Evaluate technical capability, field performance, and socio-economic acceptability of the UST evaporative cooler.
    - Is FU working as a pad material?
    - Is the consumption of water in the unit acceptable?
    - What is the acceptable maintenance procedure for the FU?
2. Discuss availability of materials and appraise technical capability of local firms to manufacture the evaporative system.
3. Explore design changes to the evaporative system that would utilize more indigenous materials.
    - Can a clay shell replace a sheet metal shell?
4. Connect with Dr. Arona Coulibaly and Dr. Daouda Coulibaly, the two thermodynamics professors at the School of Engineering Laboratoire de Thermique Appliquee and discuss a joint publication.

Appendix B

Robert Schulzetenberg

Mali Report

"You'll never forget Mali", was said to me before leaving from a two week "fact finding mission" in Mali. My friend was absolutely right. I'll never forget the street scenes and the endless driving into the wasteland. Our talks with the villagers and friends about the Malian culture are something I share to everyone at home now.

The most surprising part of the experience was driving through the country and seeing the remote villages. It seemed like a country that was inhabitable, but every several miles we had to slow down for a village by the road. The people seemed to have so little resources and were so far from any conveniences. I tried to imagine living in those places, and it made me miss home a lot.

The best part of the experience in Mali was seeing how the people in Borko managed to prosper in their remote location. The road up to Borko was almost a day of driving from Mopti and the road was not always sound. In addition, the heat in Mali is so unforgiving it seems impossible to get anything done. However, the Borko people were excellent farmers and had good crops and everyone worked hard to make a living. I enjoyed seeing how they made a living. Their techniques were very different than in the U.S. and that is what made it so interesting.

I will incorporate the experience I had in Mali into Engineers for a Sustainable World a few different ways. We will try to see if the seed potato project is possible and hopefully it will become a project that ESW members can work on in Minnesota and Mali. I will tell my fellow members what the conditions are in Mali and what it takes to have a successful project. The sand filtration project also has potential for ESW members to help with.

I saw the Network using Holistic processes when we had to consider who's role it was to do the seed potatoes or the pearl millet shredder. We had to look at the big picture and realize that it would be useless to talk to the men about pearl millet because they do not grind it or useless to talk to the women about seed potatoes because they are not in the fields. The Network exercised Farmer First processes when I was told that the main occupation in Mali was agriculture and that we were concentrating our efforts to help the farmers succeed.

I saw a lot of new sights and experienced many new things; not all were enjoyable or comfortable, but I definitely learned a lot. When someone asks me how I liked Mali, I don't always know where to start. All I can say is, "It was an experience; a very good one."