

Providing Water to Those in Need

University of Delaware group engineers a water system for village in Cameroon.

By Rebecca VanderMeulen

Just five years ago, the 3000 people who live in and near the village of Bakang in the West African nation of Cameroon drank and cooked with water from hand-dug wells and nearby streams.

These supplies emptied during dry months. When water was available for women and children to fetch, it was contaminated with parasites and pathogenic bacteria. Diseases including cholera, typhoid fever, and dysentery were common.

The dire situation began to change in 2006 after Olivia Mukam, whose father is mayor of this locality, headed to Johns Hopkins University. She approached the Engineers Without Borders club on campus about providing clean water for Bakang. That chapter was busy with other projects, though, so Mukam was sent to a new chapter at the University of Delaware, about an hour's drive northwest of the Johns Hopkins campus.

Delaware faculty advisor Steven Dentel, Ph.D., PE, DEE, and the stu-

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dents in Engineers Without Borders didn't anticipate the challenges they would face while bringing potable water to Bakang, a hilly area where most people live on less than a dollar a day, raising crops such as maize and plantains to feed their families. The village has hilly topography and lacks electricity.

"If we had known the time, effort, and cost involved, we would have said, 'This is impossible. Let's find something more feasible,'" says Dentel, a professor of environmental engineering.

Assessing the Community

Dentel and five students flew to Cameroon in May 2007 for the first of a series of twice-yearly trips scheduled during breaks in the University of Delaware academic calendar. The idea was not to start building a new water system right away, but to assess

Engineering Without Borders team members from the University of Delaware and Bakang residents work together to build a ferro-cement water storage reservoir.

Bakang's needs and the resources that were available to provide potable water.

Samantha Sagett, who graduated from Delaware in 2009 with an undergraduate degree in environmental engineering, recalls feeling the residents' hopes during that first trip.

"It was a matter of identifying what the problems were," Sagett says. "Once we got there, it was like we were making a promise to do something."

Partnering with residents was imperative. Emmanuel Mukam, mayor of the French-speaking Bamandjou region that includes Bakang, provided local expertise along with his background as a civil engineer who runs a construction firm called Cacoco-BTP. The village also has a well-respected chief, who is chosen by a council, who holds decision-making power.

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Rebecca VanderMeulen is a freelance writer living in southeastern Pennsylvania.

Engineering Without Borders team members from the University of Delaware evaluate hand-dug wells for water quality and quantity.



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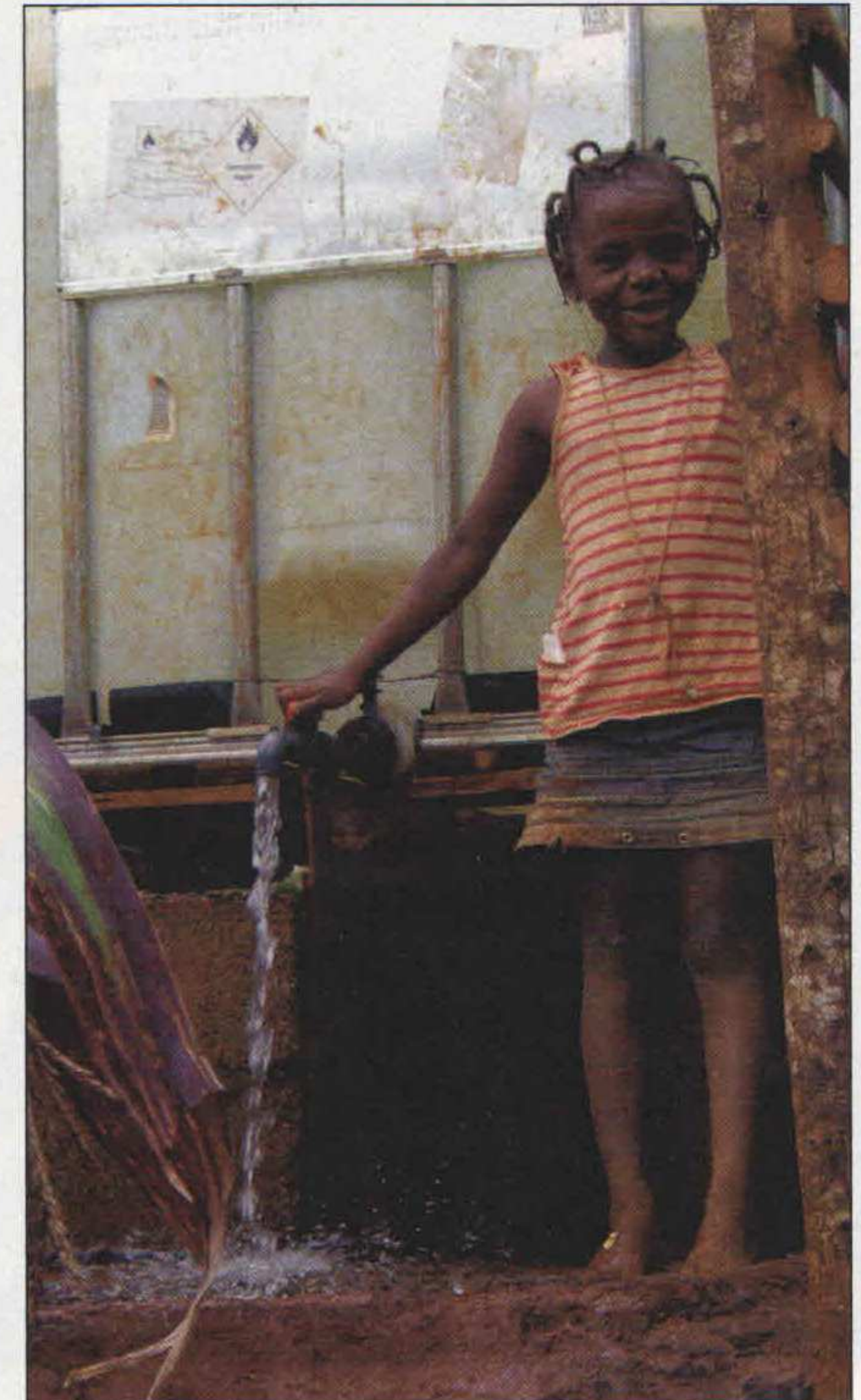
Additionally, the village and the Delaware team organized a committee of residents specifically for consultation on the water system. The committee intentionally included equal numbers of men and women because of the genders'

different roles in their households.

"Women are the ones who do the washing and the cooking," Dentel explains. "They are the ones who make sure the children get the water."

Making so much effort to include locals had another important purpose. To give the people of Bakang a sense of

A storage tank next to a well drilled by a team from the University of Delaware provides water for nearby residents as well as for the higher-elevation ferro-cement reservoir.



ownership over their new water system. If the residents didn't feel as if the system belonged to them, it would certainly fall into disrepair.

Dentel and the students didn't intend to complete any work on local water supplies during their first trip. However, while completing preliminary studies, they found a hand-dug well with a malfunctioning hand pump. The well was repaired with about \$120 and supplies from a city about an hour's travel from Bakang. Sagett, now an environmental engineer with Golder Associates in Mount Laurel, New Jersey, remembers feeling gratified when she saw clear water flowing.

Besides opening up a source of clean water, that repair did another thing—it erased local skepticism.

"People realized that we were capable of doing this," Dentel says.

Designing the System

After that first trip, the team designed a system based around a central storage tank near the village school, which is on top of the community's highest hill. The frame of the 5283-gallon tank was constructed with a combination of rebar and chicken wire and the tank itself was made of ferro-cement. The idea was to pump water from strategic locations around the village into the reservoir, where gravity would then deliver the water downhill to tap stands where residents could access it for their homes.

The well that the team repaired in the spring of 2007 was built into the new system because it provided clean water with no traces of bacteria. Two hydrologists—one from America and one from Cameroon—determined the best locations to drill two more wells. They would be drilled between 160 and 200 feet deep and produce as much as 400 gallons per hour. Pumps would feed the water into 2-inch polyethylene pipes that flowed into the storage tank.

One-inch or 1½-inch pipes would then carry water from the reservoir to six tap stands located throughout the community. Bakang residents on the committee set up for the project voted on where they would be built. Gravity and calculated losses of pressure limited where the tap stands could be installed. They also needed to be built in places

that were accessible to the highest number of people.

"If you're more than 1000 meters from a water source, that means you're not going to use it habitually," Dentel explains. "You're going to get it from the nearest creek."

Since Bakang has no electricity, the entire system would be powered with solar panels. Even though the wells would only work at full capacity around noon, the sun would provide a free source of energy and the panels would last for decades. To compensate for this, a total of eight plastic storage tanks, each with a capacity of 260 gallons, would be added next to the wells.

The team estimated the new water system would be able to provide each resident with 2.6 gallons per day. That is considered a meager supply for most in the United States, but in Bakang it would allow for a greater quality of life.

"They burst into applause when we told them this is how much water we thought we could provide them," Dentel recalls.

Work on the system began in June 2008 with the installation of one solar-powered borehole well. It has continued ever since during two-week trips from Delaware to Bakang twice a year.

However, the students and their advisor have not completed the work on their own. Emmanuel Mukam used his contacts within the construction industry to secure contractors to drill the wells and local workers were hired to dig ditches to install the pipes.

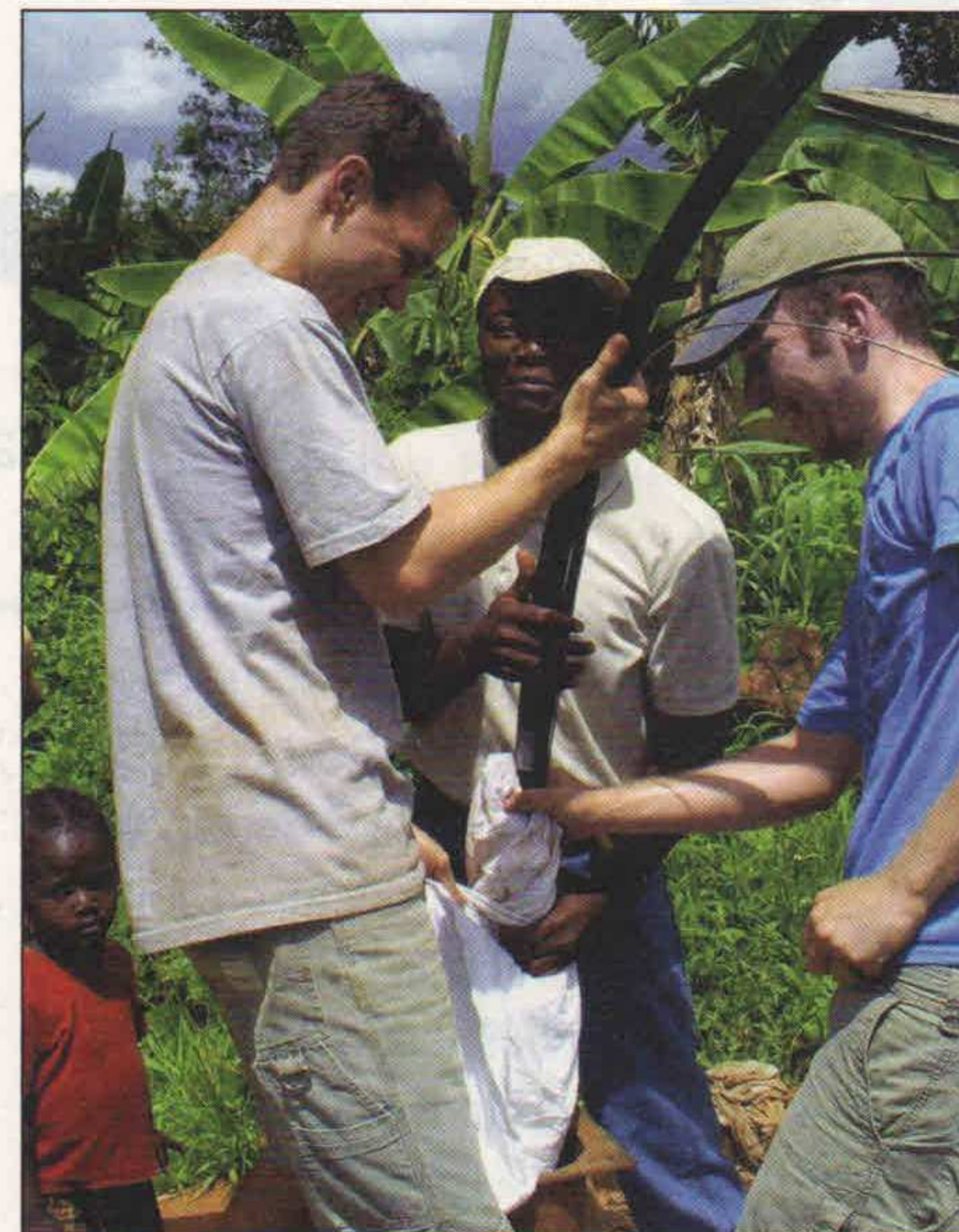
The residents' committee opted to pay them with a one-time tax of roughly \$1.50 per man and 50¢ per woman—a huge sum for many locals. Families with more means were charged higher taxes. A Peace Corps volunteer in a nearby community served as a liaison between the two continents.

Other funding for the project was secured through grants and fundraising at the University of Delaware. Those who traveled to Cameroon paid their own airfare of about \$1700 per person.

Finishing the Job

The Bakang storage reservoir has been built since 2008. The wells have been drilled and five tap stands installed. Dentel expects the team to make

University of Delaware students and a Bakang resident install a pump into a well. The base for a hand pump was included for temporary replacement by a backup hand pump in the event of failure.



one more trip to Bakang for the purpose of construction. Another tap stand is needed and one well does not yet feed water into the storage tank, so a pump will be added. Additional solar panels will be installed to run these parts of the system as well.

Even when the entire infrastructure is complete, it won't be accessible to Bakang's more remote homes. For that purpose, the team constructed household-sized sand filters that are essentially concrete boxes filled with sand. Water trickles through the sand, and pipes pump toward a spigot. Locals learned how to build the filter boxes themselves and were initially paid about \$5 to use them so other residents could be convinced that they worked.

After the water system is finished, Delaware team members plan to make follow-up visits to Bakang to see how well everything works.

"This is not just installing wells," Dentel says.

Emmanuel Mukam is impressed with what has been built so far. In fact, if the system is successful he says it might become a model for providing potable water for other rural communities in Cameroon. *WWJ*