Mapping underground water sources for drip irrigation could transform African village life

December 6 2011, By Sarah Jane Keller

Solar panels power a solar drip irrigation system for a collective women's garden in Kalale, Benin. The system provides a cost-effective, clean way to irrigate crops, especially in the long, dry season.

(PhysOrg.com) -- Rural farmers in sub-Saharan Africa live under risky conditions. Many grow low-value cereal crops that depend on a short rainy season, a practice that traps them in poverty and hunger.

But reliable access to water could change the farmers' perilous situation. Stanford scientists are calling for investments in small-scale irrigation projects and hydrologic mapping to help buffer the growers from the erratic weather and poor crop yields that are expected to worsen with climate change in the region.

The potential for increased irrigation is there, said Jennifer Burney, a fellow at Stanford's Center on Food Security and Environment.

Burney's team partnered with the Solar Electric Light Fund (SELF) to measure economic and nutritional impacts of solar-powered drip-irrigated gardens on villages in West Africa's Sudano-Sahel region. Burney will present the group's work on small-scale irrigation Wednesday, Dec. 7, at the fall meeting of the American Geophysical Union in San Francisco.

"Irrigation is really appealing in that it lets you do a lot of things to break this cycle of low productivity that leads to low income and malnutrition," said Burney.

Modern irrigation often means multi-billion-dollar projects like damming rivers and building canals. But Burney says that these projects have not reached sub-Saharan Africa because countries lack the capital and ability to carry out big infrastructure projects.

A different approach, gaining popularity in sub-Saharan Africa, involves cooperation. Individuals or groups, called smallholders, organize to farm small plots and ensure their access to irrigation. These projects allow farmers to grow during the dry season and produce profitable, high-nutrition crops like fruits and vegetables in addition to the cereal crops they already grow.

Still, only 4 percent of cropland in sub-Saharan Africa is irrigated.

Smallholder irrigation

Burney and her colleagues' work in two northern Benin villages is an example of successful investment in smallholder irrigation. They worked with women's cooperative agricultural groups to install three solar-

powered drip irrigation systems. Drip irrigation conserves water by delivering it directly to the base of plants. The technique also reduces fertilizer runoff.

The team surveyed 30 households in each village and found that solar drip irrigation increased standards of living and increased vegetable consumption to the U.S. Department of Agriculture's recommended daily allowance. By selling the vegetables, households were able to purchase staples and meat during the dry season.

Drip irrigation conserves water by delivering it directly to the base of the plant. Credit: Both photos courtesy of Jennifer Burney / Stanford University

Successful smallholder irrigation projects have high investment returns, said Burney. Her team has seen real success from irrigation projects – like those in Benin – that provide enough returns for women to send kids to school or buy small business equipment like a sewing machine or market stall.

"That's when I think it really becomes a ladder out of poverty," Burney said.

Lessons for success

For solar technology projects to be successful, Burney said, just dropping in and giving people irrigation kits doesn't work. Communities need access to a water source and need to see the benefits of a project.

"You need the technology and management and the water access, all together," said Burney. "Our solar project incorporates all of that."

According to Burney, smallholders need not limit themselves to solar irrigation systems. "Solar is great if you have an unreliable fuel," she said. "But if you're someplace that's connected to the grid, an electrical pump would more economical."

"There are a lot of different solutions that involve many different kinds of water harvesting," Burney said. "Groundwater, rainwater, surface water, and there are a lot of places in the Sahel, like Niger, for example, where there are artesian wells." The Sahel is a transitional belt of grasslands between the Sahara Desert and the savannas further south.

Given the diversity of water resources in West Africa, Burney suggests that nongovernmental organizations and governments prioritize detailed hydrologic mapping in the region. Otherwise, the cost of geophysical surveys and finding water sources, especially unseen groundwater, could become an insurmountable barrier for farm communities.

"It needs to be really detailed, comprehensive, usable information that's out there for everybody to be able to take advantage of," she said.

Burney says that both of the benefits that farmers get from irrigation systems –growing outside of the rainy season and producing more diverse, profitable crops – are important for adapting to climate change.

"You can produce more value on less land in most cases and not be as beholden to the whims of the rainy season," she said. Having more disposable income also will reduce vulnerability to hunger and malnutrition. "Economic development can be a form of adaptation," she said.

Rosamond Naylor, director of Stanford's Center on Food Security and the Environment, and Sandra Postel of the Global Water Policy Project were collaborators on the project.

Provided by Stanford University