Student engineering teams' innovations for developing nations showcased

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Could algae that feast on wastewater produce clean bio-fuels and a healthful supply of fish food? Can impoverished African community gardeners learn to use and maintain a simple, centuries-old, non-electric water pump to grow more vegetables?

Two Johns Hopkins student teams are working hard to move these "green" ideas off the drawing board and into the real world. Both teams will showcase their progress at the 2013 National Sustainable Design Expo, which will be held Thursday and Friday on the National Mall in Washington, D.C. The event, which is open to the public, is sponsored by the U.S. Environmental Protection Agency, which provided $15,000 initial grants to each of the Johns Hopkins teams and to more than 40 other students groups that will also participate.

During the expo, student teams will compete for follow-up grants of up to $90,000 to bring their concepts closer to real-world applications. The awards are part of an EPA program called P3: People, Prosperity and Planet Student Design Competition for Sustainability.

One of the Johns Hopkins student projects focuses on growing large masses of algae to address three sustainability issues: pollution control, the limited supply of fossil fuels, and production of healthy food. The team, dubbed AlgaFuture, is composed of undergraduates and graduate students from the departments of Geography and Environmental Engineering and Chemical and Biomolecular Engineering. Their goal is to deploy algae at wastewater treatment facilities to feed on hard-to-

remove pollutants such as nitrogen and phosphorus, which are found in human and animal waste and in agricultural runoff containing fertilizer. If algae can flourish while dining on these pollutants, the plant-like organisms could then be used to produce renewable bio-fuels or food for fish farms.

But the process is not as simple as it sounds. "Wastewater can contain pathogens and dangerous metals like mercury, chromium, and arsenic," said Pavlo Bohutskyi, an environmental engineering doctoral student and leader of this team. "If algae grow in these materials and then are eaten by fish, is it safe for us to eat these fish?"

The pathogens in wastewater, such as viruses, fungi, and bacteria, could also destroy the algae themselves and thwart the plans to produce biofuels and fish food. With an initial EPA grant, the student team tested 20 species of algae. "We found two strains that can grow well alongside pathogens and one that is already present in wastewater samples," Bohutskyi said.

If the team receives one of the additional EPA grants, he said, the students plan to do further studies to see whether fish food or biofuel production is the most economically viable use for algae grown in wastewater. Their faculty advisers are Edward Bouwer, professor and chair of the Department of Geography and Environmental Engineering, and Michael Betenbaugh, professor in the Department of Chemical and Biomolecular Engineering. Both departments are within the university's Whiting School of Engineering.

The other Johns Hopkins team aims to improve the irrigation of vegetable gardens that provide nutrition and income for families in remote rural communities in South Africa. In these areas, women and children often spend hours each day hauling heavy containers of water from the local stream to drink and to water crop-growing sites up to a

half-mile away.

Since 2006, students with the Johns Hopkins chapter of Engineers Without Borders-USA (EWB-USA) have journeyed to Africa to help install low-cost ram pumps, devices that date back to the 1700s and do not require electricity or fuel. Instead, they use the kinetic energy of flowing stream water to power the lifting of a fraction of this water to a higher elevation. The process eliminates current practices of hand-carrying water and provides much needed irrigation water for the cultivation of winter vegetables. In an additional effort aimed at sustaining the benefits from the EWB-USA effort, a team of undergraduate and graduate environmental engineering students obtained an initial EPA grant to develop a new understanding of pump performance and repair and to help plan sustainable "service centers." The goal is to enable the community gardeners to maintain and repair their pumps. The focus is on a particularly inexpensive type of ram pump designed by a South African named David Alcock.

"We're working on detailed descriptions of the pump parts and how the pump can be assembled and how it can operate most efficiently," said Emily Prosser, an undergraduate environmental engineering student who is helping to lead the team.

Dano Wilusz, a graduate student member, has been assisting with the plans for the project's next phase. He added, "We've also been working with the Johns Hopkins Carey Business School and South African partners to plan different types of government-supported service centers that could provide advice, spare parts, and other help to the community in running these irrigation systems. It's important because the water allows the farmers to grow more vegetables during dry seasons for their own use and for sale to others."

Provided by Johns Hopkins University