2015-2016 TWRI Mills Scholarship Program Application

John Blake
Email: john.k.blake@tamu.edu

Degree being pursued: Masters of Science in Environmental Engineering

Faculty Advisor:
Dr. Rabi H. Mohtar, TEES Research Professor
Department of Biological and Agricultural Engineering, and Zachry Department of Civil Engineering
224 Scoates Hall Mail Stop 2117, College Station, TX 77843-2117
Email: mohtar@tamu.edu, Telephone: 979.458.9886

Green Water Mapping and Management for Future Water Savings

Texas is facing a challenge that will change the state permanently. The current water supplies do not meet the growing demands projected for the next 40 years. The Texas Water Development Board's (TWDB) 2012 Texas Water Plan projects an unmet water demand of 8.3 million acre-feet by 2060. That is approximately 40% of the total projected demand. Currently, 70% of the State's water is allocated for agricultural purposes. Over the next 40 years, that number is expected to drop to approximately 40% due to irrigation technology improvements, water allocation shifting from agriculture to cities, and depletion of groundwater resources. Although water supplies for food production will decrease, demand for food will only escalate. In order to meet this growing demand, the productivity of the limited water must increase.

This is where green water accounting can have an enormous impact. Green water, which is generally perceived as the soil water available for plants to use, accounts for 5% of global fresh water according to "Bridging the Water and Food Gap: The Role of the Water-Energy-Food Nexus" by Mohtar et al (*in press*). Although this percentage may seem insignificant, two facts greatly increase its value: (1) 60% of food production worldwide is produced by green water, and (2) only 30% of renewable green water is utilized globally. These approximations are calculated from a global perspective, which fails to capture the true impact of green water within Texas' borders. A study of Texas soils must be done to better understand this abundant resource. The lack of knowledge starts with the definition of green water. The purpose of this project would be to define and quantify green water, which until now, is only qualitatively described. These two outcomes will lead to optimization of water productivity for crop production. The lack of awareness and accounting for green water calls for an immediate paradigm shift in the current practices and management of soil water. The outcome of this research project would be a recommendation for a new dynamic water management plan for crop irrigation, through the quantification and understanding of green water and how it relates to water productivity.

The following steps will be taken to achieve the goal of saving water through green water accounting:

- For an initial case study, San Antonio and its surrounding counties will be considered. The area has long been known for its thriving and diverse agriculture and with its growing population and the recent oil and gas development in close proximity, competition for the already limited water supplies has only increased. According to the TWDB's 2012 Water Plan, approximately one third of water supplies in Region L (the San Antonio area) will be allocated to each of the three competing sectors; agriculture, municipal, and industrial by 2020. With all the expansion,

government officials and water systems operators are constantly searching for better conservation practices and new water sources. The San Antonio area encompasses a good representation of the challenges that face Texas and thus, the results of this pilot study can be easily scaled up to the State as a whole.

- Current soil maps will be used to identify the different types of soils in the region. This must be done because each soil type is unique in its ability to supply water to plants and in its potential for water storage.
- After identification, samples from each type of soil will be taken and analyzed using the TypoSoil™ apparatus. This novel device quantifies the hydro-structural properties of a soil which will help to determine the soil's green water capacity and potential crop productivity.
- The results from the TypoSoil™ will then be spatially mapped to help define where and how much water should be allocated to different regions for irrigation purposes. This will be done by matching crop properties with soil characteristics to develop a system with the highest water productivity.

Proposed Use of Funds:

I currently have the position of Lab Manager in the Pedostructure Characterization Lab, I am paid for that work through a graduate research assistant position that covers my tuition and can be considered as matching funds. Consequently, should I receive the TWRI Mills scholarship, its funds would be used, in their entirety, to support the research problem: enabling the purchase of supplies for soil analysis in the TypoSoil™ device, covering the costs of transportation to the field to collect the soil samples needed for the project, and allowing participation in professional meetings to disseminate the outcomes of the research.

Intended Career Path:

After completion of my academic work (which forecasts a PhD in the future), I intend to remain in my home state of Texas and help to solve the growing problems arising from water shortages. Primarily, I plan to look for ways to expand water supplies by exploring new water sources. Furthermore, I hope to use the knowledge and experience I gain from my research and studies at Texas A&M to help developing countries and communities around the world solve their water issues.