Background

Sustained economic growth, quality of life and the social stability of an increasingly urban globe will depend largely on food security and a reliable supply of fresh water. Chronic, or even sporadic, water shortages could derail impressive economic growth of the last few decades in countries that depend on agriculture as a core contributor to their GDP.

Agriculture uses approximately 70% of the planet’s freshwater supply, of which 40% is used for rice cultivation (FAO 2016). Currently, rice constitutes a staple food for half of the world’s population; more than three billion people rely on the grain for their main source of livelihood. Enhancing rice production – and increasing water use efficiency – will be essential to ensure food security for this population.

The Challenge

The sustainable use of freshwater in agriculture is a growing concern worldwide. Currently, more than 2.7 billion people must cope with less water than they need for at least one month every year. Researchers and development practitioners have recommended many technologies that have the potential to save water in rice production; however, adoption has been low. Most interventions consider water as a single facet commodity. Many of these “water saving” technologies focus on product development rather than on building systematic and strategic changes in both behavior and institutions.

The core challenges we sought to address include

- Inefficient water use and management for irrigation
- Uncoordinated, ineffective water governance
- Lack of sustainable, scalable programs providing holistic solutions from field to policy
- Lack of real-time data to drive decision making for irrigation

How does it work?

AutoMon™ (automated monitoring) is a decision support tool for sustainable water management created by scientists at the International Rice Research Institute (IRRI). AutoMon™ is an Internet of Things (IoT) solution, which refers to a network of objects – things – that communicate with water level sensors using wireless connectivity. As an IoT solution, it provides

- Efficient water management
- Continuous, real-time monitoring and reporting
- Verification of water management practices
- Multi-stakeholder interface
- Reduction of transaction times and cost of effective coordination amongst stakeholders

AutoMon™ is based on a scientifically proven method for irrigation called alternate wetting and drying (AWD) that improves water use efficiency and management. However, it is a challenging for farmers to measure water levels manually, meaning that often it is not employed at all. Moreover, farmers lack a decision-making role for irrigation scheduling (except for pump irrigation). Using AutoMon™, AWD irrigation is made more efficient:

1. Water level sensors are placed in AWD tubes to measure ground water levels
2. Real-time data on field water levels is automatically sent to a central database
3. Farmers, irrigation/farmers associations and irrigation/agricultural departments receive information based on their roles and requirements for precise water management
4. Policy- and decision-makers receive quantitative evidence on water demand and use at the field to landscape levels
Lessons Learned and Recommendations

Over the past few years, IRRI has been testing cheap, robust and reliable sensors to create a sustainable, scalable solution to irrigation challenges. Some of the key lessons learned include:

- **Connectivity:** A key limitation to large-scale deployment of any IoT sensor network is connectivity range. Gateways that wirelessly communicate to individual sensor nodes are expensive and require a static connection to the internet, placing constraints on their geographic location. The AutoMon™ team explored GSM, Wi-Fi, and long-range transmission using radio frequency, primarily using GSM for ground water irrigation system and radio frequency for surface water irrigation system.

- **User interface:** The transmitted data is processed to share relevant information tailored to specific stakeholders. This component is still under development as this information is categorized; currently, open apps, Google cloud and local government servers are used to store and process information.

- **Specific farm context:** The number of sensors required within a farm depends mainly on topography. IRRI uses remote sensing to provide guidance on the deployment of sensors at strategic locations to minimize the overall cost.

- **Cost and environment:** During the prototype and testing phases, IRRI experimented with the different principles of sensing water level (capacitance, ultrasonic, resistance and infrared), and connectivity technology. Further, the accuracy and sensitivity of these principles/technologies under different conditions, including different water levels, submergence, salinity, turbidity, humidity and temperature were all tested to gauge accuracy and robustness. Similarly, connectivity technologies with different land gradients, crop canopy, height and types of antenna were tested. Though tools that can withstand these conditions/environments are available in market but may still be cost prohibitive for large scale deployments.

Next Steps

IRRI continues to pursue partnerships to advance the AutoMon™ work. To date, we have worked with the Philippines Department of Agriculture-Bureau of Agricultural Research, Philippines Rice Research Institute, National Irrigation Administration and TechAguru to prototype and test the solution. We are actively seeking partners for the roll out of this decision support tool for irrigation across Asia and Africa.

As AutoMon™ is deployed in the Philippines, IRRI will further test its capacity as a water governance and precision farming tool for at all levels for more effective water management.

Complementing the data collected by AutoMon™ sensors, unmanned aerial vehicles (UAVs or drones) can provide additional insights about fields, crops and environment-specific factors that can provide holistic recommendations and guidance for water management.

Reference: