Smart Water Management on Quality Crop Production

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ABSTRACT

Climate change influences agriculture and agriculture-based livelihoods both directly and indirectly. Agriculture is the biggest consumer of freshwater in the world, amounting to up to 70% of the total use, which makes the case for smart water management in order to guarantee water and food security to the world's population. In recent decades, research on precision irrigation driven by climate change has developed a multitude of strategies, methods and technologies to reduce water consumption in irrigation projects and to adapt to the increasing occurrence of water scarcity, agricultural droughts and competition between agricultural and industrial sectors for the use of water. In this context, the adoption of water-saving and application practices implies a multidisciplinary approach to accurately quantify the water needs of crops under different water availability and management practices. The intelligent irrigation technique is a valuable tool for monitoring and quantifying irrigation water added for plants as well as for irrigation scheduling. Thus, this review article presented a review of technologies and new trends in the context of precision irrigation, future perspectives and critically analyze notions and means to maintain high levels of land and water productivity, which minimize irrational water consumption at the

field level.

INTRODUCTION

As the most important resource for life, water has been a central issue on the international agenda for several decades. Agriculture is highly susceptible to the impacts of climate change, posing significant challenges to global food security. In order to cope with future estimates of water shortages, some measures aimed at streamlining and optimizing the efficiency of water consumption in the agricultural sector are critical in view of the large volumes of water required for the production of crops. Water management is becoming more vital with the increasing withdrawal of water and competition over water resources, and the advance of climate change. Smart water management (SWM) technology can play a role in managing these complex water- related issues. Proper scheduling of irrigation is critical for efficient water management in crop production, particularly under conditions of water scarcity (Madni *et al*., 2019). These technologies provide a means to collect, analyze and visualize real-time data that are essential for informed decision-making in the face of soil variability in terms of temperature, moisture, pH, EC etc. Sensor and model based irrigation technologies represent a valuable and evolving toolset for addressing water scarcity in agriculture and helping to secure food production with increasing world's population.

Smart Water Management (SWM) Technologies

Smart Water Management is a kind of innovation, in which the manual interventions are replaced by an automated system to perform all the operations. These are a diverse set of tools and techniques used to collect, analyze, manage and visualize data related to the soil surface and its features. Here are some key components of SWM technologies:

a) **Sensors:** These are the device used in the system for producing electrical signals related to the parameter to be measured and provide the basic data to drive the automatic control system (Munoth *et al*., 2016). There are different types of sensors are used in SWM in agriculture such as soil moisture sensor, soil pH sensor, soil temperature sensor, Thermocouple sensor, leakage sensor etc.

b) **Micro-controllers:** It is considered as the heart of automation system and its function is to coordinate the operation of entire system. Micro-controllers helps in operating hydraulic valves, automatic metering valves, solenoid valves etc.

c) **Relay circuit:** A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch.

d) **Transformers:** It is a device that transfers electric energy from one alternating-current circuit to one or more other circuits, either increasing (stepping up) or reducing (stepping down) the voltage.

e) **Comparator:** It is electronics, a comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger.

f) **IoT:** IoT appears as natural choice for applications of smart water management. IoT owes to the co-occurrence of different factors such as less- power wireless technologies,

inexpensive instruments, high-performance devices in the commodity platform, algorithms, availability of cloud data centers and management frameworks. Various IoT used in smart irrigation are wifi, LoRa WAN, global system for mobile communication, Message Queuing Telemetry Transport (MQTT).

g) **LCD:** Liquid Crystal Display is a type of flat panel display which uses liquid crystals in its primary form of operation.

Application of SWM Technologies in Agriculture

1. **Precision farming:** It help the farmers for proper optimization of resources, such as water, fertilizers, and pesticides, based on spatial and temporal variability in their fields. These technologies enable precise monitoring and management of crops, leading to increased yields and reduced resource waste.

2. **Forecasting and Prediction:** Modelling technologies can collect and analyze climate data, helping farmers anticipate weather patterns, temperature fluctuations, and precipitation levels. Timely weather information enables farmers to make informed decisions about planting and harvesting, reducing the risk of crop loss due to extreme weather events and it helps in irrigation scheduling e.g. CROPWAT model etc.

3. **Water Resource Management:** Farmers can use these technologies to manage irrigation systems efficiently and adapt to changing water availability and drought conditions. Micro irrigation system possesses all qualities to introduce automation in this irrigation system

4. **Real-time data Monitoring:** Sensors and UAV (Unmanned Aerial Vehicle) are used to monitor the real time soil parameters. It also further helps in detection and rapid response can help prevent the spread of invasive species and reduce crop damage, especially in the face of changing pest patterns driven by climate change (Khan *et al*., 2022).

CONCLUSION

Water scarcity has become a big threat to the sustainable development of agriculture, food security and the livelihoods of farmer. Smart water management technologies are essential for enhancing the climate resilience of agriculture by providing data-driven insights, improving resource management, and supporting adaptive strategies in the face of changing climate conditions. These tools empower farmers and researchers to make more sustainable and informed choices, ultimately contributing to food security and environmental sustainability.

REFERENCES

Khan, A., Gupta, S., & Gupta, S. K. (2022). Emerging UAV technology for disaster detection, mitigation, response, and preparedness. *Journal of Field Robotics*, 39(6), 905–955. https://doi.org/10.1002/rob.22075

Madni, A. M., Madni, C. C., & Lucero, S. D. (2019). Leveraging digital twin technology in model-based systems engineering. *Systems*, 7(1), 7.

Munoth, P., Goyal, R., & Tiwari, K. (2016). Sensor based irrigation system: A review. NCACE. USA. https://www.researchgate.net/profile/Priyamitra-Munoth/ publication/ 303842913_ Sensor_ based_Irrigation_System_ A_ Review/links/5757e4ca08ae05c1ec1972b7/Sensor-based-Irrigation-System-A-Review.pdf