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Commentary

Management of Water in Agriculture

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DESCRIPTION

Agricultural production is heavily dependent on water and is increasingly exposed to water risks. It is also the largest consumer sector and a major water pollutant. Therefore, improved water management in agriculture is essential for the sustainable and productive agricultural food sector.

In agriculture, water plays an important role in food production and livestock. Due to the current trend of world population growth, agriculture must cope with this increase in land and water availability and reduced competition from other uses such as non-edible crops, urbanization, or industrial development.

Irrigated agriculture remains the world's largest consumer of water and tends to be driven by the fact that farmers in most countries do not pay the full cost of the water they use. Agricultural irrigation accounts for 70% of the world's water usage and more than 40% in many OECD countries. Intensive pumping of groundwater for irrigation can deplete aquifers and have a negative impact on the environment, with significant economic impact on the sector and beyond. In addition, agriculture remains a major cause of water pollution, agricultural fertilizer spills, pesticide use and livestock effluents all contribute to water and groundwater pollution.

Challenges related to water management in agriculture

The challenges that lie ahead are both extremely complex and locally diverse.

Water reuse and water pollution monitoring: Human and industrial activities can bring pollutants into the natural environment that lead to the deterioration of aquatic ecosystems due to the release of improperly treated wastewater.

Water pipeline monitoring: A water leak in the irrigation network can cause a decrease in the productivity of agricultural yields due to the lack of water for plants to grow. Real-time monitoring and control mechanisms help overcome these water distribution problems. The water pipeline monitoring system is one of the most successful solutions that requires technology to cover the problem of a water leak and provides an effective method of inspecting the pipeline infrastructure.

Water irrigation: This challenge is known by various names in the agricultural sector, including, irrigation, sprinkling or fumigation. Its main goal is to supply agricultural land based on methodological and mathematical forms, climatic conditions, surface topography, and soil conditions (acidity, particle size, etc.).

Livestock in management of water in agriculture deals with the breeding and maintenance of livestock, especially for the production of meat, milk and eggs. Understanding the role of animal feed in agriculture is a necessary prerequisite for the effective use of water in this area.

Measures to improve water productivity may include

- Provide more rainwater for crops when it is most needed (rainwater harvesting, soil and water protection, and use of deficit irrigation; additional irrigation, etc.)
- On-farm water management to minimize water loss through evaporation
- Use of improved plant varieties
- Use of improved cropping systems and agronomy, such as conservation tillage
- Develop financial frameworks to encourage the adoption of best practices and new technologies
- Use of poor quality water in unconventional applications (not for direct human consumption) such as forestry
- Assessment of rainfall patterns to determine the quantity and quality available for agricultural use and harvest planning.

To ensure food security and sustainable water management in agriculture, there is an urgent need to increase the crops per drop of water consumed in agriculture without adversely affecting the quantity and quality of downstream water. It is necessary to ensure water utilization efficiency.

Improving water resources management should be based on an integrated approach to soil-water-plant nutrition management. This should include more efficient irrigation systems such as irrigation planning optimization and drip irrigation. Soil fertility needs to be improved to ensure that plant growth is not restricted by nutrients or physical restrictions and that all water droplets are fully available for growth. Efficient plant water intake can be achieved through needs-based irrigation programs that take into account of different

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crop's water demand, growth stages, and general environmental conditions.

The efficiency of agricultural water use can be improved by minimizing the loss due to soil evaporation compared to the transpiration of plants in the field. The ability to quantify soil evaporation and plant transpiration provides information on specific plant species and growth stage irrigation levels that play important roles in water conservation and management.

Role of nuclear and isotopic techniques

Nuclear and isotope technologies play an important role in providing essential information for developing strategies for improving agricultural water management.

Isotopic signatures of oxygen-18 and hydrogen-2 in the water taken from field crops allow the separation of irrigation water into soil evaporation and crop transpiration, thereby providing information essential for improving the water use efficiency of crops.

Soil Moisture Neutron probes are ideal for measuring soil moisture in close proximity to plant roots and provide accurate data on water availability. This helps to create an optimal irrigation schedule and is the most suitable tool for measuring soil moisture in salt water conditions. It is also often used to calibrate conventional moisture sensors.

The isotopic property of nitrogen-15 is used to track the movement of tagged nitrogen fertilizers in soil, crops and water. This is essential to identify factors that can affect the efficiency and water quality of nitrogen fertilizers in agricultural landscapes. The combined isotopic properties of nitrogen-15 and oxygen-18 in nitrates allow the identification and separation of nitrate contaminants in agricultural catchment areas.

Cosmic ray neutron probes are used to assess landscape level water fluxes to establish sustainable land and water utilization management strategies.