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CONSERVING WATER: COST AND PRODUCTIVITY ANALYSIS OF RESPONSIVE DRIP AND CONVENTIONAL IRRIGATION

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Abstract

In this study, the aim is to examine the United Nations-Sustainable Development Goals (UN-SDGs) and the impending climate change challenges in Pakistan. The focus is on comparing different irrigation techniques in terms of their water savings, cost efficiency, and crop yields, in relation to the conventional flooding method (CFM). Specifically, the research considers the responsive drip irrigation system (RDI), subsurface drip irrigation (SDI), and raised-bed irrigation method (RSB). The data for this study relates to a 1-hectare tomato farm located in the Potohar plateau of Pakistan. Joint interview sessions were conducted to gather integrated data, along with information from previous studies.

To analyze the cost-effectiveness of the irrigation techniques, the study utilizes system dynamics (SD) and employs "VENSIM PLE" software. A single SD model was created to meet the requirements for cost-effectiveness analysis (CEA), simulating the implicated techniques over a period of 25 years. Additionally, an optimization scenario was developed using geometric mean maximization, aiming to maximize monetary benefits while maintaining environmental benefits in equilibrium.

The findings of this study indicate that the cost-effectiveness ratio (CER) for water-saving capacity is highest for RDI, which can save 0.135 million m^3 of water over 25 years. Furthermore, RDI achieves a 78% higher crop yield compared to the CFM. On the other hand, SDI demonstrates the highest CER for crop yield, offering 41.5% more benefits to farmers when compared to the CFM.

Key words: cost analysis, drip, irrigation, productivity, system dynamics, water conservation

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