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Increasing Water Efficiency and Wheat Yield by Altering Irrigation Supplies

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Perspective

In Pakistan, a lack of appropriate irrigation methods and policy reforms poses serious dangers to the country's water and food security. Irrigation will take place in the future when water is scarce, when inadequate irrigation water becomes the norm rather than the exception. As a result, precise water application and irrigation management are required. In Pakistan's dry and semi-arid regions, this study looked at wheat grain production and water use efficiency under constrained irrigation practises. DSSAT was used to simulate yield and evaluate alternate irrigation schedule based on various irrigation levels, ranging from full irrigation to 65 percent less irrigation. Different amounts of irrigation had significant influence on wheat grain output and overall water consumption, according to the data. After evaluating the various irrigation levels, it was discovered that in semi-arid areas, the large amount of actual irrigation reduced WUE and wheat grain production.

However, the arid site had the maximum wheat grain production 2394 kg ha1 and WUE 5.9 kg^3 on real irrigation, and wheat grain yield declined steadily as water was reduced. On semi-arid with 50% less water, the ideal irrigation level was achieved, with wheat grain yield and WUE of 1925 kg ha1 and 4.47 kg^3 respectively. On semi-arid, the best irrigation level was obtained with 40% less water, resulting in wheat grain yield and WUE of 1925 kg ha1 and 4.57 kg^3, respectively. The findings showed that decreasing irrigation levels could boost wheat growth, resulting in a higher WUE. In the end, good soil moisture management and efficient water use are critical to further increase the efficiency of agricultural water utilisation in the region.

The research region is located in the alluvial plains west of the Indus River and extends to the foothills and uplands of the Suleiman Mountains, where irrigation is required for sustainable crop production due to seasonal rainfall. Dera Ghazi Khan has a total size of 11294 km^2. The climate of Dera Ghazi khan district is arid and semi-arid, with four distinct seasons. Dera Ghazi Khan District's main source of irrigation is the Taunsa Barrage on the Indus River. Between 1981 and 2010, the average temperature and mean monthly sunlight hours were 24.2°C and 2987, respectively. For the period, the average annual precipitation was 268.8 mm and 221.5 mm, respectively.

The Pakistan Meteorological Department provided long-term baseline observation data for three study sites, which comprised minimum and maximum temperatures, daily precipitation. The Global Land Data Assimilation System, a public domain online source, was used to obtain solar radiation data for the research area (GLDAS). The daily precipitation (mm), solar radiation (MJ/m2), and maximum and lowest temperature (°C) for all sites in the study area are used to create the DSSAT model. The Pakistan Soil Survey provided information on soil profiles. Actual field practises, crop management data, and irrigation water were used as inputs to the DSSAT model that was used to deliver each treatment. Irrigation scenario comparison this process-based method comes to determine the ideal irrigation water use strategy once the DSSAT model has been successfully evaluated. The fourteen irrigation scenarios, which represent varying irrigation levels, were created by reducing the amount of irrigation water used and keeping irrigation timings constant for each irrigation scenario.

Comparison of irrigation options for the baseline period. Weather and experimental datasets are used in long-term simulations. The trend of wheat grain yield was assessed for each scenario, and it was determined whether the yield had achieved a stable maximum value before starting to drop. Actual watering schedules were employed in the study, and simulation scenarios were created to represent the consistent initial environmental conditions. The irrigation water use efficiency (IWUE) was measured in kg m3 for each treatment in three experimental sites. The most appropriate for a variety of experimental circumstances in the research area.

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