QUANTIFICATION OF GROUNDWATER RECHARGE USING NUMERICAL SIMULATIONS FOR THE SUSTAINABLE GROUNDWATER DEVELOPMENT

by

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ABSTRACT

Food and agriculture production is facing significant problems down the line due to expanding populations, stress on existing water resources and lack of efficient water management. For evaluating and addressing these concerns, it is essential to comprehend the issues surrounding water availability and usage. The direct or indirect groundwater contribution in meeting agriculture water requirements is about 70% while remaining 30% needs are fulfilled by surface water supplies (Qureshi, 2020). Also, Pakistan's irrigation system was initially designed at 67% cropping intensity but this number has now reached over 150% due to the ever-increasing demand of food and fiber as a consequence of increment in population growth with every passing year. So, the current situation has now become a serious challenge regarding groundwater sustainability. In this context, dynamic groundwater modeling has been done for LBDC command area in Punjab, Pakistan. A finite-difference 3D Visual MODFLOW model was used as a tool to analyze the current groundwater levels for a study period from 2010 to 2019. Penman-Monteith governing equation was used to calculate the crop water requirements and then net irrigation requirement for five major crops i.e. Wheat, Cotton, Rice, Maze and Sugarcane being sown in the LBDC command area. Results indicated that groundwater level is not declining at significant rate in the head reaches of canal command, i.e. Balloki and Okara while the depletion rate is high in the tail zones i.e. Sahiwal to Khanewal. The depletion rate for head zones is about 0.34m per annum and about 0.55m per annum in Sahiwal and Khanewal. Crop water requirement showed an increasing trend from head to tail due to low rainfall higher in temperature as the major factors. Finally, possible

management scenarios of reconsidering the existing cropping patterns, adaptation of modern agro-management practices and increasing/decreasing groundwater pumping in groundwater level declining zones are discussed in order to provide some sort of *relief* in terms of policy making and implementation for the betterment of farmers as well as sustainable groundwater development to badly hit areas in terms of deeper water table depths. Also, it is recommended to evaluate the surface and groundwater quality dynamics in the area which will help to develop an integrated approach along with the fluctuation in groundwater levels for an optimized cropping pattern.