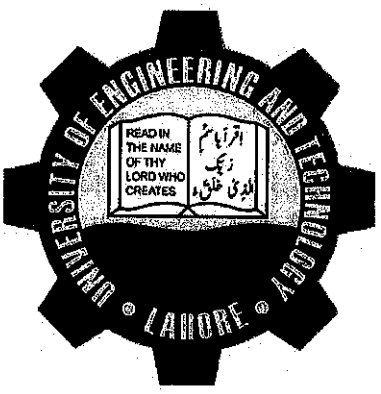
CLIMATE CHANGE IMPACTS ON CROP WATER REQUIREMENTS, CROP YIELD AND PRODUCTIVITY



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ABSTRACT

The global agricultural system is at risk of climate change. Uncertainties in temperature and rainfall regimes have a significant impact on crop growth, development and yield. Water and agriculture sectors are considered sensitive to climate change-induced impacts. Agriculture is the largest contributor in Pakistan's economy, accounting for 18.9% of gross domestic product (GDP). Due to the growing population, food and fiber requirements are increasing at an alarming rate and putting constant pressure on the water resources system. To meet the nutritional needs of the entire country and to increase agricultural water productivity, mitigation of negative impacts of climate change on agricultural crops, irrigation water requirements and crop water production should be addressed. Moreover, wheat is one of the most important crops in Pakistan, accounting approximately 40% of total cultivated area. However, its productivity is negatively affecting under changing climate and vulnerable to water stress. Therefore, present study investigates the response of wheat yield, crop water requirements and crop water productivity to climate change in Faisalabad district of Punjab.

The analysis was conducted using DSSAT crop simulation model with an ensemble of global climate model (HadCM3) under A2 and B2 scenarios with the help of statistical downscaling model (SDSM). Future climate projections indicated that maximum and minimum temperatures are expected to rise in the future for all periods, i.e., 2020s, 2050s and 2080s. Maximum temperature is expected to rise to 4.2 °C and 3.9 °C by 2080s under A2 and B2 scenarios. Similarly, minimum temperature is going to increase up to 1.8 °C and 2.0 °C by 2080s under A2 and B2 scenarios. Moreover, average annual rainfall is expected to rise under both scenarios for all three

future periods. Simulation of future wheat yield by using DSSAT crop simulation model found that a decrease is expected in the future wheat yield due to rise in temperature. Future wheat yield may reduce up to 8.96% and 7.92% cumulatively by 2080s under A2 and B2 scenarios, respectively. Although the amount of rainfall is expected to increase in the future; however, the temperature rise might be more severe. Therefore, crop water requirements will also be increased in the future due to high evapotranspiration. Average seasonal crop water requirements will increase by 38 mm and 30 mm under A2 and B2 scenarios, respectively by 2080s. Decreasing wheat yield combined with water deficit in the future would decrease the future crop water productivity (CWP) up to 17.76% and 14.95% under A2 and B2 scenarios, respectively. As, it is evident from the results that climate change is affecting the crop yield, crop water requirement and productivity, therefore, strategies should be developed to reduce the simulation uncertainties in climate change impact assessment. This study will also be helpful to formulate different adaptation strategies to address water stress and CWP issues under changing climate.