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Assessing Impacts of Climate Variability and Change on Water Productivity and Nutrient Use Efficiency of Maize in the Semi-arid Central Rift Valley of Ethiopia

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Abstract : Changes in precipitation, temperature and atmospheric CO2 concentration are expected to alter agricultural productivity patterns worldwide. The interactive effects of soil moisture and nutrient availability are the two key edaphic factors that determine crop yield and are sensitive to climatic changes. The study assessed the potential impacts of climate change on maize yield and corresponding water productivity and nutrient use efficiency under climate change scenarios for the Central Rift Valley of Ethiopia by mid (2041-2070) and end century (2071-2100). Projected impacts were evaluated using climate scenarios generated from four General Circulation Models (GCMs) dynamically downscaled by the Swedish RCA4 Regional Climate Model (RCM) in combination with two Representative Concentration Pathways (RCP 4.5 and RCP8.5). Decision Support System for Agro-technology Transfer cropping system model (DSSAT-CSM) was used to simulate yield, water and nutrient use for the study periods. Results indicate that rainfed maize yield might decrease on average by 16.5 and 23% by the 2050s and 2080s, respectively, due to climate change. Water productivity is expected to decline on average by 2.2 and 12% in the CRV by mid and end centuries with respect to the baseline. Nutrient uptake and corresponding nutrient use efficiency (NUE) might also be negatively affected by climate change. Phosphorus uptake probably will decrease in the CRV on average by 14.5 to 18% by 2050s, while N uptake may not change significantly at Melkassa. Nitrogen and P use efficiency indicators showed decreases in the range between 8.5 to 10.5% and between 9.3 to 10.5%, respectively, by 2050s relative to the baseline average. The simulation results further indicated that a combination of increased water availability and optimum nutrient application might increase both water productivity and nutrient use efficiency in the changed climate, which can ensure modest production in the future. Potential options that can improve water availability and nutrient uptake should be identified for the study locations using a crop modeling approach.

Keywords : crop model, climate change scenario, nutrient uptake, nutrient use efficiency, water productivity
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