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Yield Level, Variability and Yield Gap of Maize (Zea Mays L.) Under Variable Climate Condition of the Semi-arid Central Rift Valley of Ethiopia

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Abstract : Soil moisture and nutrient availability are the two key edaphic factors that affect crop yields and are directly or indirectly affected by climate variability and change. The study examined climate-induced yield level, yield variability and gap of maize during 1981-2010 main growing season in the Central Rift Valley (CRV) of Ethiopia. Pearson correlation test was employed to see the relationship between climate variables and yield. The coefficient of variation (CV) was used to analyze annual yield variability. Decision Support System for Agro-technology Transfer cropping system model (DSSAT-CSM) was used to simulate the growth and yield of maize for the study period. The result indicated that maize grain yield was strongly ($P<0.01$) and positively correlated with seasonal rainfall ($r=0.67$ at Melkassa and $r = 0.69$ at Ziway) in the CRV while day temperature affected grain yield negatively ($r= -0.44$) at Ziway ($P<0.05$) during the simulation period. Variations in total seasonal rainfall at Melkassa and Ziway explained 44.9 and 48.5% of the variation in yield, respectively, under optimum nutrition. Following variation in rainfall, high yield variability (CV=23.5%, Melkassa and CV=25.3%, Ziway) was observed for optimum nutrient simulation than the corresponding nutrient limited simulation (CV=16%, Melkassa and 24.1%, Ziway) in the study period. The observed farmers' yield was 72, 52 and 43% of the researcher-managed, water-limited and potential yield of the crop, respectively, indicating a wide maize yield gap in the region. The study revealed rainfed crop production in the CRV is prone to yield variabilities due to its high dependence on seasonal rainfall and nutrient level. Moreover, the high coefficient of variation in the yield gap for the 30-year period also foretells the need for dependable water supply at both locations. Given the wide yield gap especially during lower rainfall years across the simulation periods, it signifies the requirement for a more dependable application of irrigation water and a potential shift to irrigated agriculture; hence, adopting options that can improve water availability and nutrient use efficiency would be crucial for crop production in the area.

Keywords : climate variability, crop model, water availability, yield gap, yield variability
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