World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:02, 2024

Application of DSSAT-CSM Model for Estimating Rain-Water Productivity of Maize (Zea Mays L.) Under Changing Climate of Central Rift Valley, Ethiopia

Authors : Fitih Ademe, Kibebew Kibret, Sheleme Beyene, Mezgebu Getnet, Gashaw Meteke

Abstract : Pressing demands for agricultural products and its associated pressure on water availability in the semi-arid areas demanded information for strategic decision-making in the changing climate conditions of Ethiopia. Availing such information through traditional agronomic research methods is not sufficient unless supported through the application of decision-support tools. The CERES (Crop Environmental Resource Synthesis) model in DSSAT-CSM was evaluated for estimating yield and water productivity of maize under two soil types (Andosol and Luvisol) of the Central Rift Valley of Ethiopia. A six-year data (2010 – 2017) obtained from national fertilizer determination experiments were used for model evaluation. Pertinent statistical indices were employed to evaluate model performance. Following model evaluation, yield and rain-water productivity of maize was assessed for the baseline (1981-2010) and future climate (2050's and 2080's) scenario. The model performed well in predicting phenology, growth, and yield of maize for the different seasons and phosphorous rates. A good agreement between simulated and observed grain yield was indicated by low values of the RMSE (0.15 - 0.37 Mg/ha) and other indices for the two soil types. The evaluated model predicted a decline in the potential (23.8 to 26.7% at Melkassa and from 21.7 to 26.1% at Ziway under RCP4.5 and RCP8.5 climate change scenarios, respectively) and water-limited yield (15 to 18.3% at Melkassa and by 6.5 to 10.5% at Ziway) in the mid-century due to climate change. Consequently, a decline in water productivity was projected in the future periods that necessitate availing options to improve water productivity in the region. In conclusion, the DSSAT-CERES-maize model can be used to simulate maize (Melkassa-2) phenology, growth and grain yield, as well as simulate water productivity under different management scenarios that can help to identify options to improve water productivity in the changing climate of the semi-arid central Rift valley of Ethiopia.

Keywords : andosol, CERES-maize, luvisol, model evaluation, water productivity
Conference Title : ICSEA 2024 : International Conference on Sustainable Environment and Agriculture
Conference Location : Washington, United States
Conference Dates : February 26-27, 2024