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ORIGINAL PAPER

Dryland farming wheat yield prediction using the Lasso regression model and meteorological variables in dry and semi-dry region

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Abstract
The risk of climate change and international market fluctuations complicate crop production. Wheat is considered one of the most strategic products in food security. Dryland farming of wheat is prevalent in many parts of the world, and it occupies a large part of the cultivated land. However, its performance is highly dependent on weather conditions and changes. Yield prediction models could be used for planning purposes when dealing with changes in yield. This study analyzed the effectiveness of the least absolute shrinkage and selection operator (LASSO) model in selecting variables for predicting dryland wheat yield in southwestern Iran. The model was used with 45 weather-based variables across annual, seasonal, and monthly time frames. The results showed that temperature, evaporation, and extreme temperatures followed by radiation and precipitation variables categories, are effective meteorological variables in estimating dryland farming wheat yield in the study area. Monthly timescale could estimate yield with minimum error compared to other timescales. However, considering all selected variables regardless of their timescale (total) results, the best estimation in most districts with the model's R^2 and normalized root mean square error (NRMSE) varied between 57.98–99.50 and 1.46–21.94, respectively. Therefore, the LASSO regression could be used reliably for each district considering the most effective meteorological parameters in that region for accurate decision-makers policies.

Keywords Climate change · Machine learning · Time scale · Diurnal temperature range · Evaporation

1 Introduction

The risk of climate change and international market fluctuations complicate crop production (Gitz et al. 2016). Although this risk is never eliminated, it can be minimized by recognizing the various parameters affecting crop growth and estimating the yields before harvest (Lobell et al. 2002). Drylands cover approximately 41 percent of global land areas, spanning diverse biomes and climatic zones worldwide. Due to the nature of dryland farming, abiotic stresses originating from variations in climatic factors have a significant role in the yield losses of crops. Therefore, it is crucial to analyze climatic variables and their temporal patterns to better comprehend their impact on crop production.Yield prediction models and risk analysis tools become more important to study for planning purposes when dealing with yield fluctuations. (Bahrami et al. 2020; Qian et al. 2009; Salehnia et al. 2020; Wang et al. 2020; Zarei et al. 2019).

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