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Effect of Temperature on Crop Water Use Efficiency: Case Study in the Northeast of Iran

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1 Introduction

Water scarcity and availability are the main challenging issues to supply sufficient food for increasing population in most parts of the world particularly in arid and semiarid regions. Increasing food demand and water scarcity lead to a compulsory need of improving plant Water Use Efficiency (WUE). In this regard, UN-FAO organization revealed the slogan of 'more crop per drop' to more efficient use of water in agriculture (Beer et al., 2009). In the present study, we are seeking for WUE gap derived from agronomic practices.

Objectives

1- To Calculate WUE for major crops in Razavi Khorasan.
2- To investigate agronomic gap between actual and attainable crop WUE.
3- To analyze the sensitivity of WUE to temperature changes.

2 Material & Methods

- **Study area:** Razavi Khorasan Province with the area of 119000 km2 is one of the major agricultural regions in Iran (Fig. 1). Razavi Khorasan's climate is classified as arid and semiarid. The total annual precipitation is 220 mm and annual mean temperature is about 15 oC.

- **WUE:** Crop water use was acquired by estimating two components: reference evapotranspiration (ETo) and crop coefficient. The evapotranspiration was determined by multiplying the ETo (Penman-Monteith Equation) by the appropriate crop coefficient. Crop coefficients were determined for three stages of crop growth from days after sowing (FAO). The duration of each stage was estimated from thermal time scale based on cumulative growing degree days (GDD).

- **Fitting models:** A polynomial line was fitted to describe the best relation of two variables. Then, we drew the upper 95% confidence to limit upper boundary line Shatar and Mcbratney (2004).

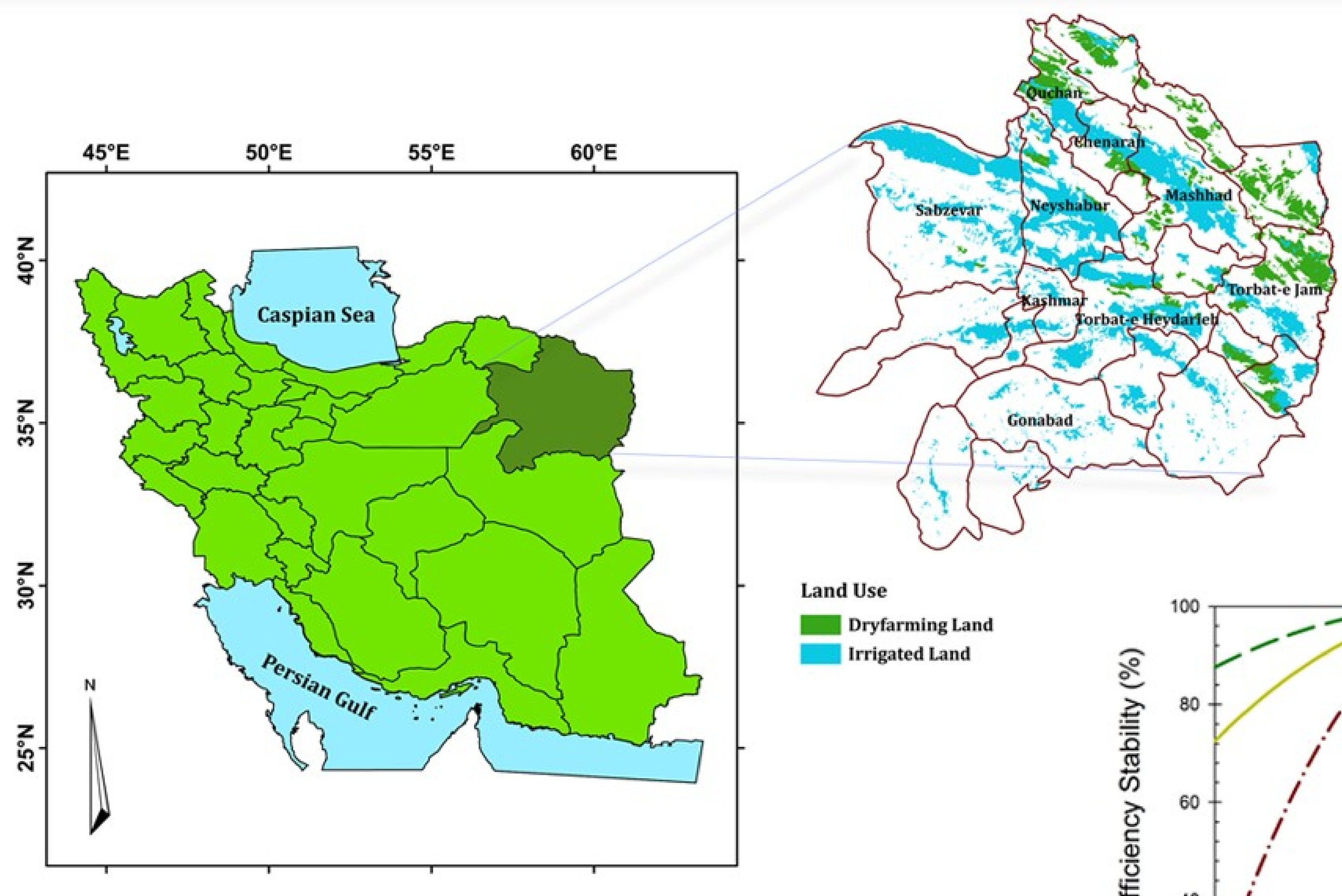

Figure 1. Study area (Razavi Khorasan) and the distribution of agricultural land over the county

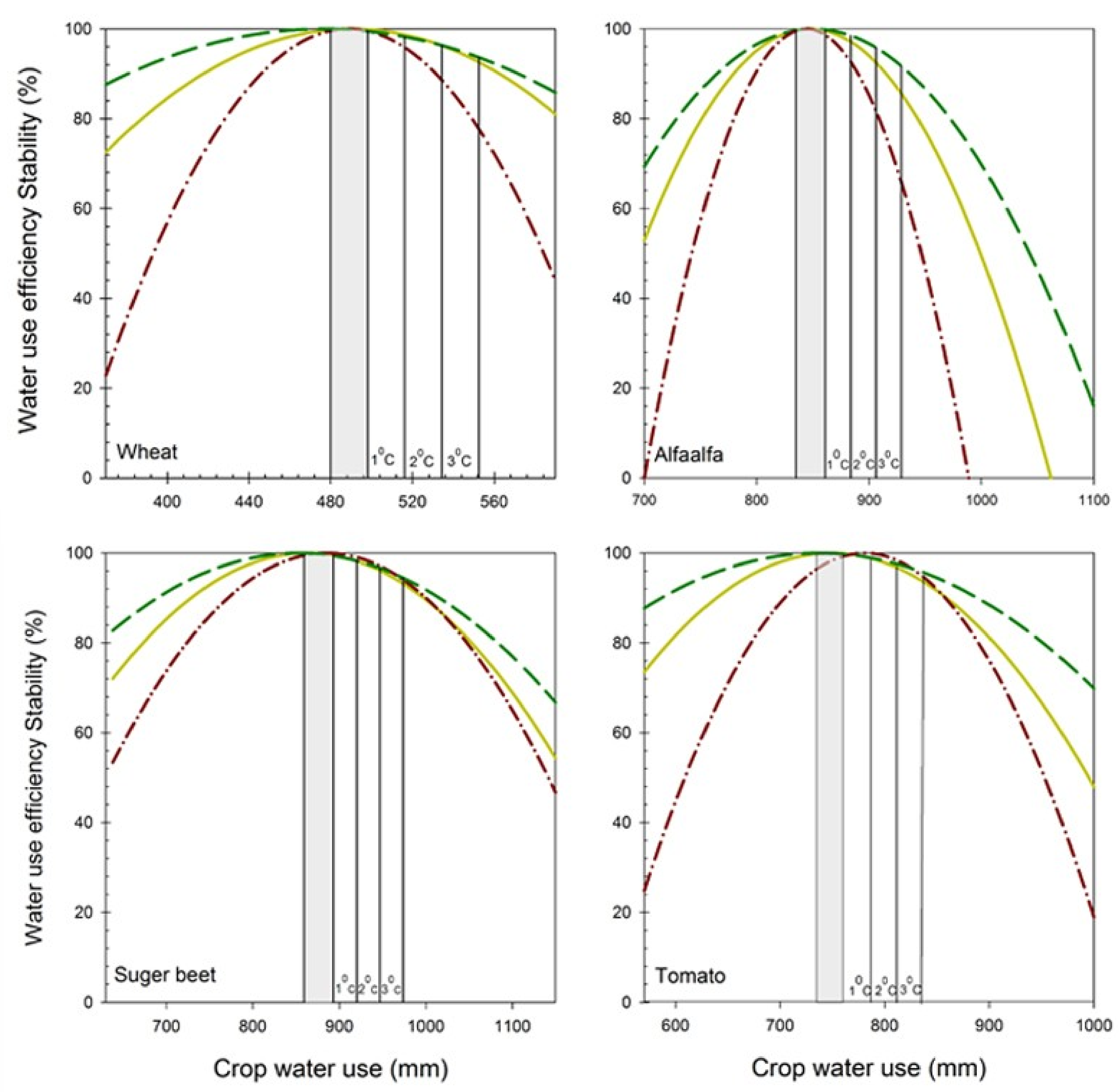

Figure 3. Water use efficiency stability against crop water use changes. Vertical lines show 1, 2 and 3 oC increase in air temperature.

3 Findings

- For each crop, increasing CWU increased WUE to the peak, and then led to decreasing WUE (Fig. 2).

- When CWU increases excessively, WUE decreases likely as a result of raising evaporation/evapotranspiration ratio (Sadras and Angus 2006). Therefore, CWU changes as a consequence of climate conditions.

- Increasing CWU from the optimum point caused polynomial decrease of WUE in all three models, but in different rates. As in the third model reduction rate was higher indicating more sensitivity to CWU changes (Fig. 3).

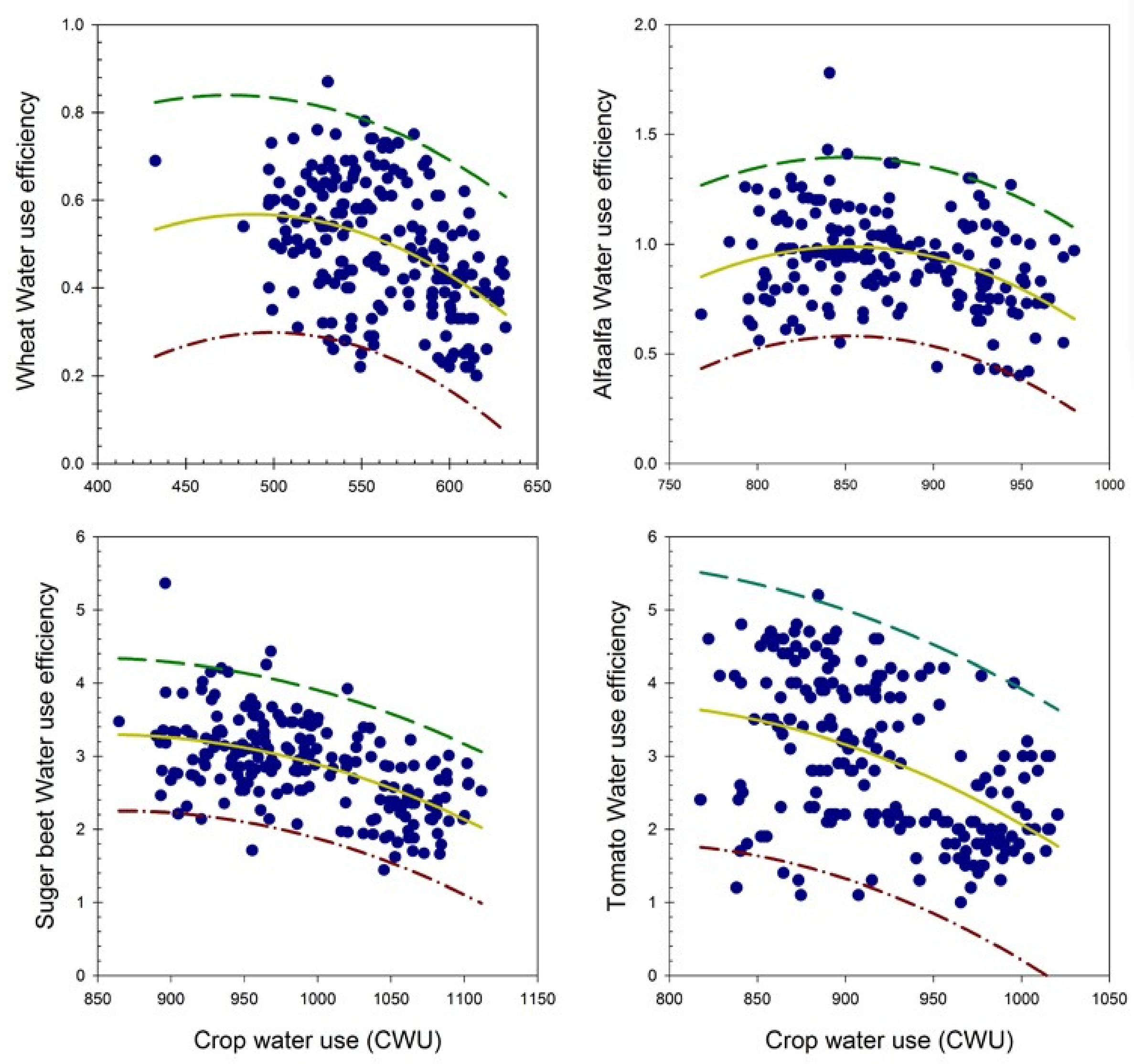

Figure 2. scatterplot of water use efficiency against water use. Yellow line is the fitted model and dotted lines are upper and lower boundary lines.

References

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4 Conclusion

Upper boundary lines depict attainable WUE. This procedure simply shows agronomic factors responsible for WUE gap. Potential crop water use is influenced by temperature, precipitation, relative humidity, and water vapor deficit during growth period. For a given site and specific variety, field management such as sowing date, plant nutrition, irrigation, pest management and plant arrangement are determining factors to widen or narrow the gap. Gap analysis to adapt climate change effects should be considered in future.

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