

# Evaluation of the Impacts of Climate Change on Irrigation Requirements of Maize by CROPWAT Model

Ali Kaan Yetik<sup>\*1</sup>, Burak Şen<sup>1</sup>

<sup>1</sup> Department of Biosystems Engineering, Faculty of Agricultural Sciences and Technologies, Nigde Ömer Halisdemir University, Nigde, Turkey

## Introduction

- Climate change threatens water availability, necessitating sustainable water management.
- Human being has adapted to the climate throughout history.
- Maize is a vital crop, adaptable to various climates and known for efficient water use.
- CROPWAT is widely recognized and accepted, making it an essential tool for modern agricultural practices.
- The Çukurova plain in Turkey is well-suited for maize cultivation and is also recognized as a region impacted by climate change.
- This study examines climate change's impact on maize water requirements in Mediterranean conditions, utilizing the CROPWAT Model with the FAO-modified Penman Monteith method.

## Methods

- The area selected for the present study is Adana Province, situated in the southern part of Turkey (see in Figure 1).
- CROPWAT 8.0 model was used to calculate reference evapotranspiration and to simulate the irrigation water requirements and crop evapotranspiration, under different managements and climatic conditions.
- The maize (*Zea mays* L.) was selected as plant material.
- The daily reference evapotranspiration values, seasonal irrigation water requirements and crop evapotranspiration of two different periods (1961-1990 and 2070-2099) were compared.



Figure 1. Study site

## Discussion

The increases in monthly average temperatures are in line with the temperature increase expectations reported by IPCC (2014).

Ye et al. (2015) stated that the IWR of rice cultivation will increase by 6-24% by 2100 compared with 1951-1980 under tropical climate conditions. Jones et al. (2015) reported that the increased evapotranspiration (and decreased rainfall in some cases) in 2070-2100 climate scenario in Southern Africa, caused increases in IWR of sugar cane by about 11%.

Shahvari et al. (2019) conducted a study with 3 different climate scenarios for the Varamin plain in Iran and under all three scenarios, future-period evapotranspiration will increase, posing a threat to the region's water supplies.

## References

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## Take-Home Points or Main Finding

- Maize cultivation faces significant challenges from climate change, with a predicted temperature increase of 17.07% between 1961-1990 and 2070-2099.
- Climate change will lead to a 7.37% increase in irrigation water requirements for maize cultivation in the Çukurova region.

## Results

1 The monthly average temperatures determined by 30 years of climate data obtained as a result of RegCM3 model are given in Figure 2. The highest mean temperature value seen in the study region between 1961-1990 was measured as 27.4 °C which was predicted to increase to 30.2 °C with the effects of climate change. It is predicted that the lowest average temperature value in January will increase by 3.8 °C, from 11.4 °C to 15.2 °C

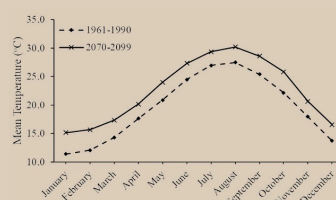


Figure 2. The monthly average temperatures of the 30-yr periods (1991-1990 and 2070-2099)

3 The determined crop evapotranspiration (ETc) values by the model using the ETo and crop coefficient (Kc) of maize for each year between the periods 1960-1990 and 2070-2099 are given in Figure 4. The ETc values reached 537.1 mm in the period of 2070-2099 and while the average ETc of the period was determined as 513.4 mm, the average of the 1961-1990 was determined as 480.1 mm.

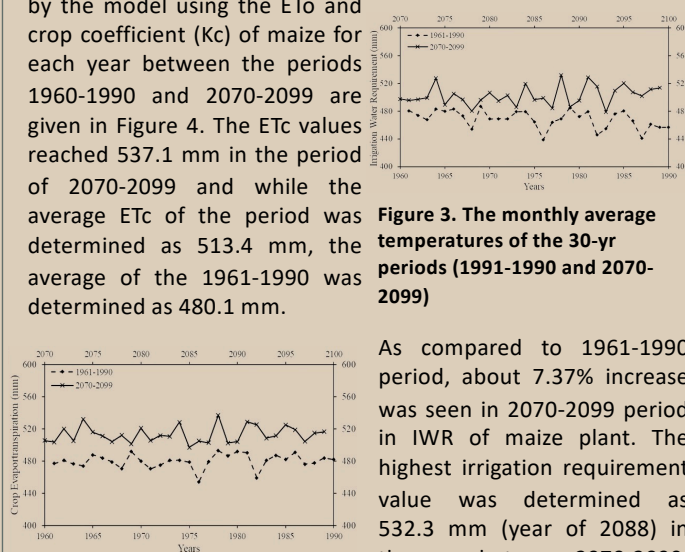


Figure 4. The crop evapotranspiration of maize plant for the years between 1961-1990 and 2070-2099

2 The seasonal irrigation water requirement variations of maize plant obtained by running the CROPWAT model separately for each year between 1961-1990 and 2070-2099 are shown in Figure 3. Considering the 30-yr periods, it was determined that the average IWR of the growing season for the 2070-2099 is 502.6 mm, while the average for 1961-1990 is 468.7 mm.

Figure 3. The monthly average temperatures of the 30-yr periods (1991-1990 and 2070-2099)

As compared to 1961-1990 period, about 7.37% increase was seen in 2070-2099 period in IWR of maize plant. The highest irrigation requirement value was determined as 532.3 mm (year of 2088) in the years between 2070-2099, and the lowest value in the period of 1961-1990 as 438.8 mm (year of 1976).