

# Variation in agricultural water demand and its attributions in the arid Tarim River Basin

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**Abstract:** Agricultural water use shares more than 95% of the total water consumption in the extreme arid region of the Tarim River Basin. This region is strongly affected by climate change, which has intensified agricultural water consumption and exacerbated the already serious water crisis. Therefore, understanding the variation of agricultural water demand (*AWD*) and its attributions are therefore vital for irrigation management and water resources allocation to economy and natural ecosystems in this highly water deficit region.

In this study, we estimated the spatial-temporal variations of *AWD* based on weighted crop water requirement (*ETc*), which was estimated by using the Penman-Monteith equation and the crop coefficient approach. Then the contributions of meteorological factors and planting structure (i.e., proportions of crop acreages) to *AWD* variations were quantified based on traditional method and numerical experiment.

Results indicated that *AWD* decreased during 1960-1988 at a rate of 2.76 mm/yr (millimeter per year) and then started to increase at a high rate of 9.47 mm/yr during 1989–2015. For the first periods (1960-1988), wind speed (*uz*), maximum humidity (*RHmax*) and sunshine duration (*n*) were the most important factors leading to the decreased *AWD* while for the second period (1989–2015), the dominant factor affecting *AWD* was  $K_{cw}$  (representing the weighted *Kc* values representing the evolution of planting structure) was the most significant factor resulting in the rapid increase of *AWD*, followed by the minimum temperature (*Tmin*), *uz* and *RHmax*. The evolution of planting structure alone would lead to an increase rate of *AWD* being 7.1 mm/yr while the climatic factor would result in an increase rate of 1.9 mm/yr during 1989–2015.

Under the national initiation of boosting agricultural production, the changes in agriculture water demand need to be further examined. This study provides a basic idea on changes in agricultural water demand under historical changes of climatic factors and planting structure, which will shed light on changes in future water demand and water saving strategy.

**Keywords:** *Agricultural water demand, irrigation, driving factors, Tarim River Basin*