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Assessment of Irrigation Schemes in Turkey: Cropping Intensity, Irrigation Intensity and Water Use

Cagatay Tanriverdi[a] and Hasan Degirmenci[a]

a University of Kahramanmaras Sütcü Imam, Agricultural Engineering, Kahramanmaras, Turkey

Introduction

Agriculture is the largest global user of water which is a valuable resource for agricultural production (Değirmenci, 2003) representing around 70 % of global water use (UN/WWAP, 2003). Turkey has total 78.6 million hectares surface area and 25.8 million hectares of these are agricultural land. However, 6.09 million hectares area are irrigated. Turkey has 643 mm/year annual rainfall and 501 billion m^3 evaporation. Water usage of Turkey are constituted by 72 % irrigation, 12 % of industry and 16 % of drinking water (Anonymous, 2014). A total of 94.6 % of irrigation projects in Turkey are non-transferred on the other hand 5.4 % are transferred (Cakmak *et al*. 2007). Therefore water management of irrigated agriculture is vital in meeting increasing demands for food for growing populations (Bouwer, 2000; Gal *et al*., 2003; Collaizi *et al*., 2010; Tanriverdi ve Değirmenci, 2011).

In this study, the variance between 2000-2013 years were evaluated in terms of water usage, irrigation intensity and cropping intensity indicators of irrigation areas which cover 2.847.382 ha of land in Turkey. In the assessment of cropping intensity, the distribution of crops in the irrigated areas were identified as a percentage value and variation between planting percentages are exhibited between years of 1995 and 2013. In Turkey, mostly planted crops in irrigation networks are corn, cotton, cereals, fodder crops and sugar beet respectively. Planting rates continuously differ from each other in the years. In specifying of field usage levels, irrigation rate indicator and difference between irrigation rates in past 14 years on transferred and non-transferred irrigation networks to a water-users organization are used.

Material and Methods

All the data were derived from State Hydraulics Works (DSI). These data are used for all calculations in this study.

Regression analysis was carried out to compare the trend in irrigation intensity between the transferred and the non-transferred systems during the period 2004-2010. The regression model fitted was as follows (Vermillion *et al*. 1999):

$Y\text{-}\beta_1+ \beta_2 D_i+ \beta_3 X_i+ \beta_4(D_i X_i)+\varepsilon\ldots.$

Y = Dependent variable (irrigation intensity), Di = 1 for turned-over systems, Di = 0 for non-turned-over systems, X = Time in years (2004–2010), β_1 = Intercept, β_2 = The difference in the dependent variable (irrigation intensity) between transferred and non-transferred systems, β_3= Slope coefficient giving the trend of the dependent variable (irrigation intensity) for the non-transferred systems during the period 2004–2010, β_4 = Slope coefficient indicating the differential effects of the transferred systems on the trend in the dependent variable (irrigation intensity) during the period 2004–2010, and ε =Error term.

Results and Discussion

Water Usage

Water use was slightly increased during the last decade depending on the development of new irrigation schemes (Figure1). Average steady flow for whole Turkey was estimated as 1.1 L/s/ha using steady flow values from irrigation systems placed at the different regions. All plants grown in the different regions were assumed to be irrigated 120 days per year.

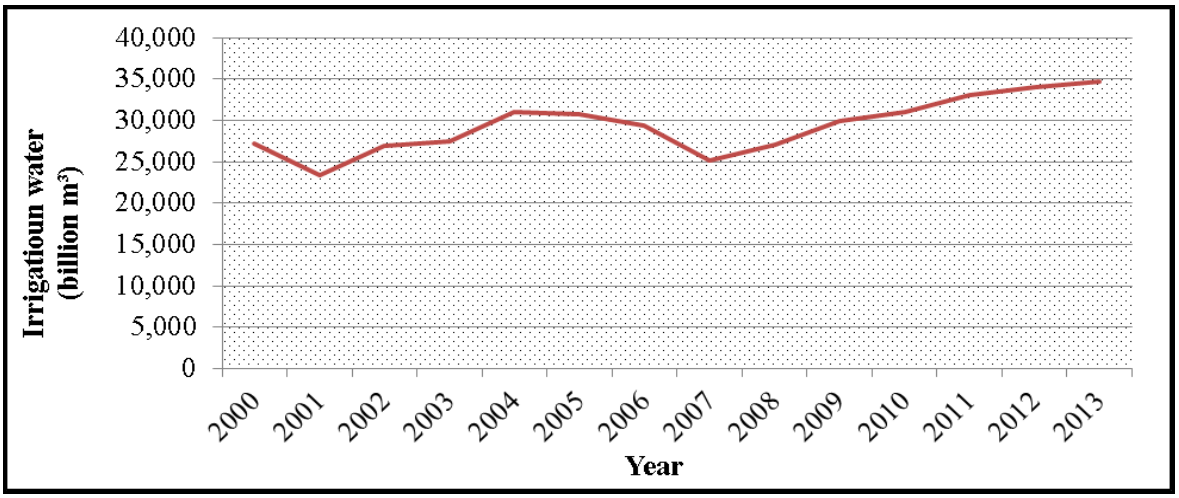

Figure 1. Irrigation water used in between 2000 and 2013 in Turkey

Irrigation Intensity

Irrigation intensity is defined as the ratio of the gross annual area irrigated to the irrigable area and is expressed in percentage terms. The annual irrigation intensity between 2004 and 2010 was evaluated for 223 irrigation schemes in Turkey: 205 transferred and 18 non-transferred systems. The mean annual irrigation intensities for the two groups of systems during 2004-2010 were given in Figures 2 and 3. It is evident that the mean irrigation intensity in the transferred systems was higher than in the non-transferred systems. Regression analysis was carried out to compare the trend in irrigation intensity between the transferred and the non-transferred systems during the period 2004-2010. The following parameter estimates (with t-statistic within parentheses) were obtained using the below equation.

$Y= 773.114 + 42.389 * Di – 0.367 Xi + 0.006 * DiXi$
$R^2 = 0.014$ $F = 11.074$ $P = Sig = 0.000$

The results indicate that there is statistically significant difference (at the 1 % level) in the trend in irrigation intensity during the period 2004–2010 between the transferred and the non-transferred systems. Graph 2 and graph 3 below shows the results.

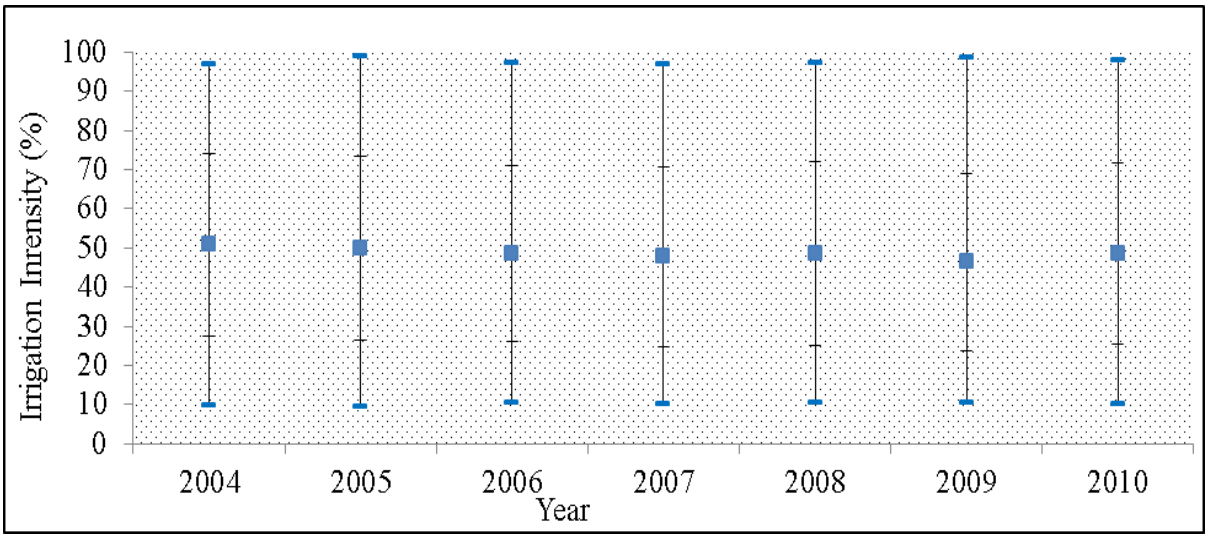

Figure 2. Irrigaiton densities with their minimum, maximum and standart deviations for transferred irrigation schemes in Turkey

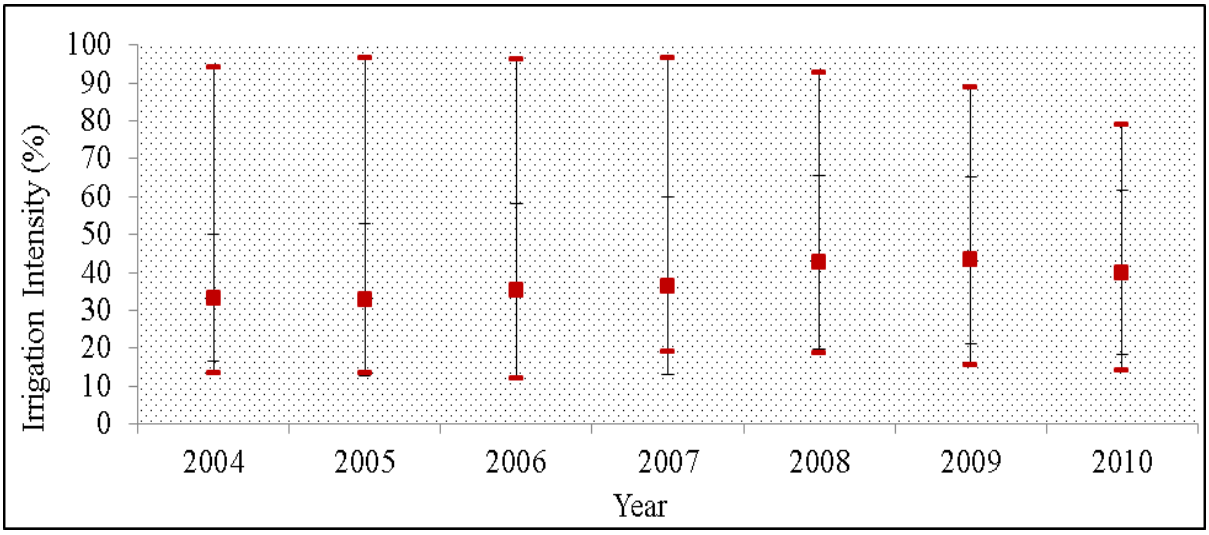

Figure 3. Irrigaiton densities with their minimum, maximum and standart deviations for nontransferred irrigation schemes in Turkey

The most important 3 reasons of low level of irrigation intensity are due to firstly enough precipitation / rainfall, secondly social and economic reason and lastly fallowing land.

Cropping Intensity

The significant changes in crop patterns were determined in between 1995 and 2013 (Anonymous, 2015). But cropping intensity changed every year (Figure 4). The reason of this was due to product prices and irrigation water shortages.

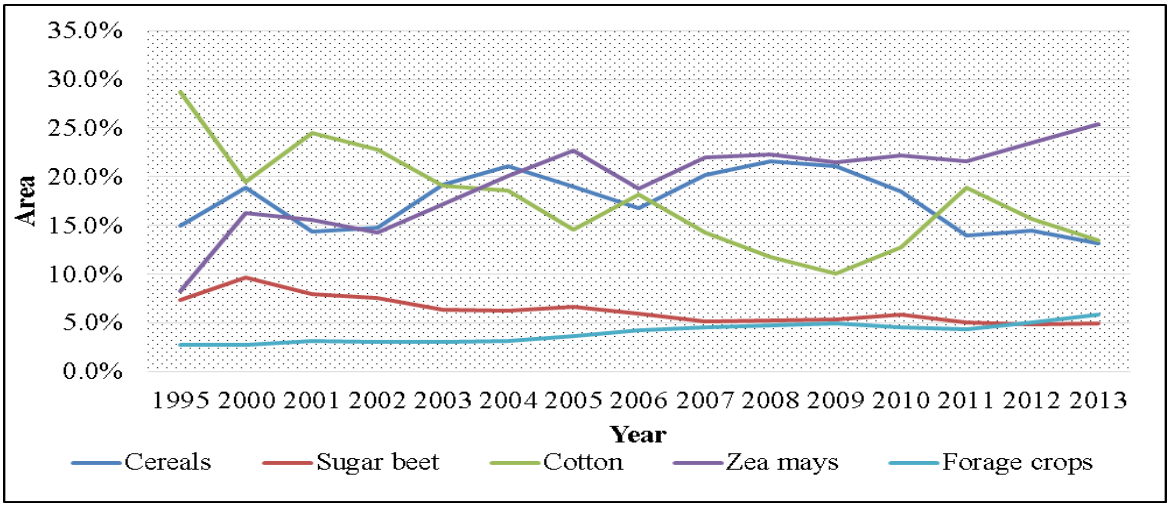

Figure 4. Crop distribution in transferred and non-transferred irrigation area in Turkey

Conclusions and Outlook

As result of this study, conclusions are made that important changes in cereal crop pattern, water and field usage have occurred the effects of global climate changes are barely seen and precautions must be taken to ensure the effective usage of water in agriculture.
Physical and administrative measures should be taken to save water in irrigation projects. In transferred irrigation schemes irrigation intensity should be raised. In all irrigation schemes land consolidation and farm drainage network services should be established.

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