Abstract

Being one the most arid regions of the world with a relatively high spatial and temporal variation in the climatic parameters, Iran faces a looming water crisis especially in the agricultural sector in the recent years. Therefore, modifying the water consumption pattern for crops such as wheat, which has a considerable share in the peoples' food diet and is dominant in crop sown area, may alleviate the pressure on the country's limited blue water resources. Therefore, in this research, first the historical variations of crop sown area and total wheat production was analyzed during a 30-year period of 1980-2010. Then, wheat water footprint was calculated for 30 provinces of Iran and for the actual situation during the study period. Thereafter, the influence of applying different management scenarios on diminishing wheat water footprint was analyzed. Finally, wheat cultivation was spatially prioritized under each scenario and based on the blue water footprint index. The daily climatic data in 52 synoptic stations and agricultural data in 30 provinces of Iran was used to calculate wheat blue and green water footprint during the period of 1980-2010. Three types of management scenario was analyzed in this research: (a) first, deficit irrigation (DI) by supplying 10 (DI10), 20 (DI120), 30 (DI30), 40 (DI140), 50 (DI50), 60 (DI60), 70 (DI70), 80 (DI80), 90 (DI90) and 100 (DI100) percentage of crop water requirement; (b) second, applying different irrigation systems including drip, sprinkler, furrow, border and basin irrigation systems and (c) third, substituting the irrigated lands with rainfed lands. Total wheat sown area was 3.4 million ha (56% of rained) in 1980 which enhanced to 7.8 million ha (55 of rained) in 2010 through a growth rate of 130%. Such increase caused total wheat production in the country to increase from 58.5 in 1980 to 135 in 2010. Based on the current statistics, wheat water footprint enhanced from 15.4×10^9 m^3 in 1980 (2.5×10^9 m^3 of blue) to 29.4×10^9 m^3 in 2010 (11.4×10^9 m^3 of blue). The semi-arid and humid regions were, respectively, corresponded to the highest and the lowest contributions in total water footprint over the study period. Regarding total water footprint per ton of crop production, wheat production in the arid and semi-arid regions put higher pressure on the national limited blue water resources while producing wheat in the humid regions will diminish the water footprint per ton of crops up to 80%. Scenario analysis showed that although applying DI with higher intensity alleviate the total water footprint, applying DI with intensity higher than 50% (DI40, DI30, DI20 and DI10) would not be economic since they led to a considerable increase in blue water footprint per ton of crop production. Moreover, applying drip irrigation will enhance the net blue water footprint per ton of crop production compared to the other irrigation systems. Prioritizing wheat cultivation based on the water footprint index revealed that for the current condition and under all management scenarios, Mazandaran, Gorgan and Guilan provinces usually have the first to third ranks for wheat cultivation while Khorasan, Yazd, Kerman and Sistan and Balouchestan occupied the latest ranks.

Keywords: AquaCrop model, Deficit irrigation, Iran, Rain-fed and Irrigated cultivation, Unit water value.

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Analyzing the influences of irrigation management on wheat water footprint in Iran

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