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Use of the Budyko Framework to Estimate the Virtual Water Content in Shijiazhuang Plain, North China

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Abstract : One of the most challenging steps in implementing virtual water content (VWC) analysis of crops is to get properly the total volume of consumptive water use (CWU) and, therefore, the choice of a reliable crop CWU estimation method. In practice, lots of previous researches obtaining CWU of crops follow a classical procedure for calculating crop evapotranspiration which is determined by multiplying reference evapotranspiration by appropriate coefficient, such as crop coefficient and water stress coefficients. However, this manner of calculation requires lots of field experimental data at point scale and more seriously, when current growing conditions differ from the standard conditions, may easily produce deviation between the calculated CWU and the actual CWU. Since evapotranspiration caused by crop planting always plays a vital role in surface water-energy balance in an agricultural region, this study decided to alternatively estimates crop evapotranspiration by Budyko framework. After brief introduce the development process of Budyko framework. We choose a modified Budyko framework under unsteady-state to better evaluated the actual CWU and apply it in an agricultural irrigation area in North China Plain which rely on underground water for irrigation. With the agricultural statistic data, this calculated CWU was further converted into VWC and its subdivision of crops at the annual scale. Results show that all the average values of VWC, VWC_blue and VWC_green show a downward trend with increased agricultural production and improved acreage. By comparison with the previous research, VWC calculated by Budyko framework agree well with part of the previous research and for some other research the value is greater. Our research also suggests that this methodology and findings may be reliable and convenient for investigation of virtual water throughout various agriculture regions of the world.

Keywords : virtual water content, Budyko framework, consumptive water use, crop evapotranspiration
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