Modeling the virtual water trade in Iran agriculture sector

ABSTRACT

Due to agriculture direct impact on food security, water shortage in agricultural activities has turned into a global issue and thus calls for appropriate measures to guarantee sustainable water usage in the long term. In this respect, a concept that has recently attracted water management experts and policy makers' attention is water footprint and water virtual trade. Due to the significant role and useful function of water virtual trade, this paper aims to maximize virtual water value in agricultural production and trade in farming and gardening subsectors using the data for farming and gardening products of Iran in 1392. This study seeks to model virtual water trade in the abovementioned subsectors and to propose an optimal production and trade pattern for major agricultural products in order to maximize economic welfare, employment and water resource sustainability as well as calculating virtual water content of cultivated products in ecological-farming expanses, evaluating virtual water trade of major agricultural products for exports and imports in the base year and finally examining the economic, social and environmental impact of virtual water trade in agricultural sector. In this regard, the structure of this paper is based on four series of studies namely, i) the calculation of virtual water content, ii) water pricing, iii) economic studies and mathematical modeling and iv) examination of the economic, social and environmental impact of virtual water trade, where the results of the first 2 series of studies were applied to the economic modeling section and finally we made use of the results in the latter to examine the economic, social and environmental impact. We used GAMS, EXCEL and NETWAT to run the calculations. The findings indicate that the major parameters affecting virtual water content of farming and gardening products and virtual water content difference of a specific product in different geographical areas covered in this study depend to a large extent on the performance and product water footprint. In this regard, the maximum virtual water in farming products was associated with cotton while the minimum virtual water for production of a ton of farming products was associated with maize. Moreover, the maximum virtual water in gardening products was associated with saffron. For other gardening products except saffron, the maximum and minimum virtual water were associated with pistachio and citrus respectively.

In terms of virtual water export and import of farming products in the base year (1392), the maximum and minimum level of virtual imports were associated with oil seeds and beans respectively. In this respect, the maximum and minimum level of virtual exports of farming products were associated with kitchen garden and maize export respectively. In gardening subsector, the maximum level of water import was associated with tea while the maximum level of water export was associated with pistachio export whereas, the minimum level of water import and export were associated with olive import and barberry export respectively.

Regarding the value created by one cubic meter of water consumption in farming subsector, the highest value created was associated with potato while the lowest was associated with alfalfa. The highest value creation associated with one cubic meter of water consumption in gardening subsector belonged to citrus while the lowest came from olive.

As to the virtual labor of farming products, beans had the maximum amount of virtual labor while maize was marked with the minimum amount of virtual labor. In this regard, the maximum and minimum volume of imports in the base year (1392) were associated with oil seeds and maize respectively. Moreover, tomato and potato had the largest and smallest level

of exports. In regards to virtual labor of gardening products, barberry had the largest amount of virtual labor (except saffron) while grapes with 1.821 had the smallest level of virtual labor. The trade balance for virtual labor of gardening sector indicate that the greatest figure of trade balance for virtual labor belonged to pistachio and the smallest figure belonged to barberry.

The proposed pattern suggests that the cultivation area for farming and gardening products have fallen compared to the base year. Also, amount of water saved following the changes to cultivation pattern and area was 15 billion cubic meters. Apart from water saving in domestic production lines, 2 billion cubic meters of water are imported following the change in trade pattern. Due to the decrease size of cultivation area, employment had declined however, labor export has risen following an increase in gardening exports. Farmers profit have also declined which is negligible compared to the amount of water saving. Therefore it's suggested that serious attention be paid to value created from one cubic meter consumption of water, water content and virtual labor as well as water availability and sustainability while designing production and trade patterns for agricultural products.

University of Zabol
Graduate School
Faculty of Agriculture
Department of Agriculture Economics

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Supervisors

Dr. Ahmad Ali Kehkha

Dr. Mahmoud Sabuhi Saboni

Advisors

Dr. Mohamadreza Nazari

Dr. Mahmoud Ahmadpour Borazjani

By

Fahimeh Bahrami Mehneh

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