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Measurement of the Impact of Water Reduction on Economic Sectors Production using Social Accounting Matrix (SAM)

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Abstract

Water is one of the most valuable resources available to mankind. Today, international communities are aware of the importance of water for sustainable economic growth in the present and future. In this study, the effect of reducing water resources on economic sectors and agricultural sub-sectors was investigated through a social accounting matrix model. The results are presented in the form of absolute and relative effects. The direct and indirect impacts of a 10 and 50 percent reduction in water resources have been a decrease in the production of 3.4 and 22 percent from the viewpoint of a demanding, 4.7 and 24 percent from the viewpoint of a supplier, for agricultural products. From the perspective of a demanding, a 10 percent reduction in water resources has led to 10.5 percent production reduction of other economic sectors. The relative effects of 10 percent water reduction from a supplier's point of view indicate that the greatest reduction was in water and other resources sectors. The relative reduction in water resources from the viewpoint of demanding has the greatest impact on water and veterinary sectors. From the perspective of the absolute effects on the demanding and the supplier, the vulnerability of urban households as a result of water resource reduction has been greater than that of rural households. Considering the relative impacts on a supplier, the impact of reduced income is greatr on urban low-income households than low-income rural households. Relative reduction of water resources from the perspective of demanding has a greater impact on capital factor than on labor factor.

Keywords: Social Accounting Matrix, Production, Water Resources

Classification JEL: C67, E23, O13

Introduction

Water is required as one of the important basic resources for country development. Renewable water per capita is one of the global indicators in the determination of the status of countries in terms of water. Inadequate spatial and temporal distribution and increased population and water consumption per capita have exacerbated this issue. The World Bank has predicted that water demand in developing countries would be double by 2025 (Berrittella *et al*., 2007).

Given the scarcity of water resources, the emergence of the water crisis in the future is not

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unexpected and this event can have many economic, social, and political consequences. Considering the recent droughts, the importance of water as a critical input becomes increasingly prominent. If we do not plan on the basis of sustainable development for water resources, the country will face insoluble problems in the future. If the impacts of crisis and water resource scarcity on agricultural sector development are not taken into account, the country's food security will definitely face serious problems (Yang *et al*., 2003). Given the essential role of water resources in economic development and the existence of various constraints, resource consumption should be controlled on the demand side. Water-related policies are one of the important issues in today's societies. For this reason, water scarcity is the agenda of policymakers and researchers in different countries around the world, especially in the Middle East and Africa.

Social Accounting Matrix (SAM) is a database by which the production potential in economic sectors can be measured and socioeconomic issues such as economic growth and interrelationship between different economic variables (production, income, consumption, and capital formation) can be simultaneously examined in the form of a single matrix. In many cases, SAM is used in socio-economic planning and policymaking, as well as to analyze the relationship between structural characteristics of an economy (Central Bank, 2008).

Understanding the importance of the issue, the present study examines the impact of water resource reduction on production of agricultural sub-sectors and other sectors, and by analyzing this issue will emphasize the use of SAM to improve this sector and examine positive strategies and effects. The present study aims to investigate the impact of water scarcity measurement on economic sectors and agricultural sub-sectors through the SAM model.

Review of literature

General equilibrium models in the form of input-output models and SAM can be used in conventional and special conditions. Accordingly, based on the approach, empirical studies can be divided into two groups according to their theoretical foundations.

A: Research literature based on two input-output and SAM approaches under special circumstances. In their study, Chang and Waters (2009), using a modified model of SAM evaluated the economic and social impacts and consequences of a 10% reduction in fishing on the entire economy. In this study, the production of the fishing sector is presented as a restricted sector. Zand *et al*. (2019a) used the social accounting matrix to study the socio-economic effects of investment development policy in the agricultural sector in Iran. The results included three scenarios: 15% increase in investment in agriculture, 10% and 15% in agriculture and horticulture, and 10% in other sub-sectors. They stated that with the implementation of these scenarios, the total income of the economy has increased. However, the first scenario had a greater impact on the total income of the economy (13.12%) than the other scenarios. Sotoodeh Nia *et al*. (2020) have studied the effect of green taxation on fossil energy consumption, greenhouse gas emissions and social welfare in Iran using social accounting matrix. The results showed that along with the increase in the green tax rate, if there is a positive shock to GDP, the trend of increasing consumption of oil, gas, natural gas and gasoline will decrease. Abbaszadeh and Ashrafi (2020) in a study using the social accounting matrix in 2011, evaluated the effect of developing the incoming tourism sector on the income of households and companies and its distribution. The results showed that companies, urban and then rural households experience the highest increase in income from tourism development, respectively, and the most important factor of production in this transfer of income to households and companies is labor and capital, respectively. Zand *et al*. (2019b) analyzed the effects of investment growth policy in agriculture based on the social accounting matrix method. The effects of this policy were analyzed in three scenarios. The results of net effects showed that the income of production activities increases in each of these scenarios. The findings also showed that the closed effects of the above scenarios on industries, services and trade were greater than the agricultural sector and its sub-sectors.

Sahabi *et al*. (2016) examined the measurement of economic and social impacts of drought in the framework of a modified model of supply-oriented SAM. In their study, the effects of a 26.1 percent decrease in agricultural sector production resulted from the 2007 drought on the decrease in other sectors' production, the decrease of income of production agents, and the decrease of income of entities that have been studied. The results showed that the direct and indirect effects of a 26.1%

decrease in agricultural sector production from the viewpoint of demanding lead to 1.8% decrease in value-added of the country, while the corresponding figure from the viewpoint of supplier is 2.9% value-added. Banouei *et al*. (2013), in the form of a research project, measured the social and economic impacts and consequences of drought in the agricultural sector in the framework of the modified supply-driven SAM model. The results of their study showed that a 25% decrease in agricultural production from the viewpoint of demanding leads to a 3.2% reduction in value-added of the country. Faridzad and Mohajeri (2016), using the framework of a modified supply-driven model of SAM with a quantitative (production) approach, have addressed the important question of what economic and social implications will occur if there is a restriction on supply (or import) of any industry sub-sectors. Their results showed that the most restriction in the supply of intermediate imports occurs in coke manufacturing, petroleum products, and chemical sectors. In all industry sub-sectors that were faced with intermediate import restrictions, except for coke manufacturing sector, production of petroleum products, and chemical products, in other cases, urban households have experienced the highest income reductions compared to rural households and corporations, as expected. Other studies have also been done in this field by Hortono and Resosudarmo (2008), Faridzad *et al*. (2012).

B: Research literature based on two input-output and SAM approaches under conventional circumstances

Use of SAM models in conventional conditions in various economic, social, and energy areas has attracted a wide range of scholars among which the studies by Seyyed Mashhadi *et al*. (2011), Permeh *et al*. (2011), Sadeghi *et al*. (2015), Gakuru and Mathenga (2015), Afaqeh *et al*. (2015) can be highlited.

Due to taking into account most of the economic relations, SAM has been accepted as a comprehensive tool in analyzing the economic and social policy makings of countries. For this reason, in the above studies, the analyses have focused on this matrix aiming to examine the potential of production. There have been studies on the impact of water resource reduction on various sectors, including agriculture as well like studies by Nokkala (2000), and Banouei (2005).

SAM model in conventional conditions

The framework of the conventional model of SAM in conventional conditions is obtained by simultaneous relationships between productive balance and income balance of production agents and internal inputs of society which is as follows:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix} = \begin{bmatrix} (I-A_{11}) & -A_{12} & -A_{13} & 0 & -A_{15} \\ -A_{21} & (1-A_{22}) & -A_{23} & 0 & -A_{25} \\ -A_{31} & -A_{32} & (1-A_{33}) & 0 & -A_{35} \\ -A_{41} & -A_{42} & -A_{43} & 1 & 0 \\ 0 & 0 & 0 & -A_{54} & (1-A_{55}) \end{bmatrix}^{-1} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} \quad (1)$$

Equation (1) is generally used in effective and short-term economic and social analyses and policy makings under conventional conditions.

Modified SAM model in special conditions

Under certain conditions, production of some specific sectors or commodities is affected by factors such as climatic changes such as drought and flood and faces production constraints. In order to present a modified SAM model under special conditions, the process of modification is the following five general stages. Under this situation, it is needed to modify equation (1). In the first stage, the sector(s) and commodity(s) that are under special conditions are determined. In the second stage, based on endogenous and exogenous variables, the main SAM accounts are modified as follows.

$$(1-A_{11})y_1 - A_{12}y_2 - oy_4 - A_{15}y_5 - oX_3 = X_1 + OX_2 + OX_4 + OX_5 + A_{13}y_3 \quad (2)$$

$$-A_{21}y_1 + (1-A_{22})y_2 - A_{23}y_3 - oy_4 - A_{25}y_5 = OX_1 + X_2 + OX_4 + OX_5 + A_{23}y_3 \quad (3)$$

$$-A_{31}y_1 - A_{32}y_2 + (1-A_{33})y_3 - oy_4 - A_{35}y_5 = OX_1 + OX_2 + X_4 + OX_5 + B_{43} \quad (4)$$

$$-oy_1 - oy_2 - oy_3 - A_{54}y_4 + (1-A_{44})y_5 = +OX_1 + OX_2 + OX_4 + X_5 + OY_3 \quad (5)$$

$$-A_{41}y_4 - A_{42}y_4 - A_{43}y_3 - y_4 - oy_5 = +OX_1 + OX_2 + OX_4 + OX_5 - (1-A_{33})y_3 \quad (6)$$

The third stage reveals the partitioned matrix of the above equations which is a combination of conventional and special conditions. In the above equations, production in the third sector, formerly known as the endogenous variable under conventional conditions, is now in special conditions and due to constraints on supply and inflexibility against the changes in final demand in the third sector, is considered as the exogenous variable. Therefore, the equations (2) to (6), given the change in the status of exogenous and endogenous variables of the third sector, can be rewritten as follows:

$$\begin{bmatrix} (1-A_{11}) & -A_{12} & 0 & -A_{15} & 0 \\ -A_{21} & (1-A_{22}) & 0 & -A_{25} & 0 \\ -A_{41} & -A_{42} & 1 & 0 & 0 \\ 0 & 0 & -A_{54} & (1-A_{55}) & 0 \\ -A_{31} & -A_{32} & 0 & -A_{35} & -1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & A_{13} \\ 0 & 1 & 0 & 0 & A_{23} \\ 0 & 0 & 1 & 0 & A_{43} \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -(1-A_{32} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_4 \\ x_5 \\ y_3 \end{bmatrix} \quad (7)$$

In the fourth stage, the equation (7) is stated as follows.

Δ

$$\begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ x_3 \end{bmatrix} = \begin{bmatrix} (1-A_{11} & -A & 0 & -A_{15} & 0 \\ -A_{21} & (1-A_{22}) & 0 & -A_{25} & 0 \\ -A_{41} & -A_{42} & 1 & 0 & 0 \\ 0 & 0 & -A_{54} & (1-A_{55}) & 0 \\ -A_{31} & -A_{32} & 0 & -A_{35} & -1 \end{bmatrix}^{-1} \times \begin{bmatrix} 1 & 0 & 0 & 0 & A_{13} \\ 0 & 1 & 0 & 0 & A_{23} \\ 0 & 0 & 1 & 0 & A_{43} \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -(1-A_{32} \end{bmatrix} \Delta \begin{bmatrix} x_1 \\ x_2 \\ x_4 \\ x_5 \\ y_3 \end{bmatrix} \quad (8)$$

The fifth stage is a comparison of the reduced form of equation (1) and equation (9). Equation (9) as an MN matrix is introduced below.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix} = M_a \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} \quad (9)$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ x_3 \end{bmatrix} = MN \begin{bmatrix} x_1 \\ x_2 \\ x_4 \\ x_5 \\ y_3 \end{bmatrix} \quad (10)$$

Equation (10) is used as the basis for the calculation of the economic and social impacts and consequences of water sector production reduction from the perspective of demanding on production reduction of other economic sectors, production reduction of the whole economy, income reduction of production agents, and production reduction of income of community entities.

$$M = \begin{bmatrix} (1-A_{11} & -A & 0 & -A_{15} & 0 \\ -A_{21} & (1-A_{22}) & 0 & -A_{25} & 0 \\ -A_{41} & -A_{42} & 1 & 0 & 0 \\ 0 & 0 & -A_{54} & (1-A_{55}) & 0 \\ -A_{31} & -A_{32} & 0 & -A_{35} & -1 \end{bmatrix}^{-1}$$

$$N = \begin{bmatrix} 1 & 0 & 0 & 0 & A_{13} \\ 0 & 1 & 0 & 0 & A_{23} \\ 0 & 0 & 1 & 0 & A_{43} \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -(1-A_{32} \end{bmatrix}$$

However, equation (10) compared to equation (9) has features that, in addition to being methodologically significant, can be used in the measurement of the effects and consequences of water resource constraints in special conditions:

Ghosh Supply – Driven Forward Multiplier of SAM (GSDSAM) in conventional and special conditions

In the real world, the sector considered as an intermediary supplier also appears in other economic sectors. This means that the effects and consequences of production reduction in this sector will lead to a reduction of intermediate demand of other economic sectors and reduction of income of production agents and a decrease in the income of community entities as well (Banouei, 2012).

Therefore, firstly the product-income relationship of the conventional and standard GSDSAM in conventional conditions is used (Kershner and Hubacek, 2009).

$$\acute{y}_n = \acute{y}_n G_n + W'_n \quad (11)$$

$$y_n - G'_n y_n = W_n \quad (12)$$

$$(I - G'_n) y_n = W_n \quad (13)$$

$$y_n = (I - G'_n)^{-1} W_n \quad (14)$$

$$\overline{M_a} = (I - G'_n)^{-1} \quad (15)$$

$$G'_n = [G'_{ij}] \;,\quad G'_{ij} = T'_{ij} [\hat{y}_i]^{-1} \quad (16)$$

$$(I - G'_n) = \begin{bmatrix} (1-G_{11}) & -G_{21} & -G_{31} & -G_{41} & 0 \\ -G_{21} & (1-G_{22}) & -G_{32} & -G_{42} & 0 \\ -G_{13} & -G_{23} & (1-G_{33}) & -G_{43} & 0 \\ 0 & 0 & 0 & 1 & -G_{54} \\ -G_{15} & -G_{25} & -G_{35} & 0 & (1-G_{55}) \end{bmatrix} \quad (17)$$

$$y_n = (y_i) = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix} \qquad W_n = (W_i) = \begin{bmatrix} W_1 \\ W_2 \\ W_3 \\ W_4 \\ W_5 \end{bmatrix} \quad (18)$$

In the above equations, G'_{ij} is the direct coefficients of three endogenous accounts called allocation direct coefficients matrix, distribution direct coefficients matrix, or output direct coefficients matrix, which is obtained by linear division of $G'_{ij} = T'_{ij}[\hat{y}_i]^{-1}$ from the supplier's perspective. This is while A_{ij} is calculated by column division of $A_{ij} = T'_{ij}[\hat{y}_i]^{-1}$ and from the demanding's perspective. Thus, A_{ij} matrix is an input matrix. The production agents (W) and its constituents for all sectors are exogenous and production (y) of all sectors is endogenous. The constituent variables in W_i vector are generally known as leakage items (imports, taxes, payment of production agents to the outside world) (Ghahramani, 2012).

In order to better understand the functions of the above equations under conventional conditions and then to modify them under special conditions, equation (19) must be written as independent equations for the three main SAM accounts.

$$(1-G_{11})y_1 - G_{21}y_2 - G_{31}y_3 - G_{41}y_4 - oy_5 = W_1 \quad (19)$$

$$-G_{12}y_1 + (1-G_{22})y_2 - G_{32}y_3 - G_{42}y_4 - oy_5 = W_2 \quad (20)$$

$$-G_{13}y_1 - G_{23}y_2 + (1-G_{33})y_3 - G_{43}y_4 - oy_5 = W_3 \quad (21)$$

$$-oy_1 - oy_2 - oy_3 + y_4 - G_{54}y_5 = W_4 \quad (22)$$

$$-G_{15}y_1 - G_{25}y_2 - G_{35}y_3 - 0 + (1-G_{55})y_5 = W_5 \quad (23)$$

Based on equations (19) to (23) for the endogenous and exogenous variables of the main SAM account assuming that the third sector is in special conditions, equations (19) to (23) need to be modified. The modification process is as follows.

$$(1-G_{11})y_1 - G_{21}y_2 - G_{41}y_4 - oy_5 - OW_3 = W_1 + OW_2 + OW_4 + OW_5 + G_{31}y_3 \quad (24)$$

$$-G_{12}y_1 + (1-G_{22})y_2 - G_{42}y_4 - oy_5 - ov_3 = OW_1 + W_2 + OW_4 + OW_5 + G_{32}y_3 \quad (25)$$

$$-OW_1 - Oy_2 - y_4 - G_{54}y_5 - OW_3 = OW_1 + OW_2 + W_4 + OW_5 + 0 \quad (26)$$

$$-G_{15}y_1 - G_{25}y_2 - oy_4 + (1-G_{55})y_5 - OW_3 = OW_1 + OW_2 + OW_4 + W_5 + G_{35}y_3 \quad (27)$$

$$-G_{13}y_1 - G_{23}y_2 - G_{43}y_3 - Oy_5 - W_3 = OW_1 + OW_2 + OW_4 + OW_5 - (1-G_{35}) \quad (28)$$

Therefore, the partitioned form of the above matrix, which is, in fact, a combination of conventional and special conditions, is stated below.

$$\begin{bmatrix} (1-G_{11}) & -G_{21} & -G_{41} & 0 & 0 \\ -G_{21} & (1-G_{22}) & -G_{42} & 0 & 0 \\ 0 & 0 & 1 & -G_{54} & 0 \\ -G_{15} & -G_{25} & 0 & (1-G_{55}) & 0 \\ -G_{13} & -G_{23} & -G_{43} & 0 & -1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ W_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & G_{13} \\ 0 & 1 & 0 & 0 & G_{32} \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & G_{35} \\ 0 & 0 & 0 & 0 & -(1-G_{33}) \end{bmatrix} \begin{bmatrix} W_1 \\ W_2 \\ W_4 \\ W_5 \\ y_3 \end{bmatrix} \quad (29)$$

Based on the general equation (14), the exogenous and endogenous variables of equation (29) in partial policy-making and planning are stated as below.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ W_3 \end{bmatrix} = \begin{bmatrix} (1-G_{11}) & -G_{21} & -G_{41} & 0 & 0 \\ -G_{21} & (1-G_{22}) & -G_{42} & 0 & 0 \\ 0 & 0 & 1 & -G_{54} & 0 \\ -G_{15} & -G_{25} & 0 & (1-G_{55}) & 0 \\ -G_{13} & -G_{23} & -G_{43} & 0 & -1 \end{bmatrix}^{-1} \times \begin{bmatrix} 1 & 0 & 0 & 0 & G_{13} \\ 0 & 1 & 0 & 0 & G_{32} \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & G_{35} \\ 0 & 0 & 0 & 0 & -(1-G_{33}) \end{bmatrix} \begin{bmatrix} W_1 \\ W_2 \\ W_4 \\ W_5 \\ y_3 \end{bmatrix} \quad 30)$$

The reduced form of equation (30) is written as below:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ W_3 \end{bmatrix} = \bar{M}^{-1}\bar{N} \begin{bmatrix} W_1 \\ W_2 \\ W_4 \\ W_5 \\ y_3 \end{bmatrix} \quad (31)$$

$$\bar{M}^{-1} = \begin{bmatrix} (1-G_{11}) & -G_{21} & -G_{41} & 0 & 0 \\ -G_{21} & (1-G_{22}) & -G_{42} & 0 & 0 \\ 0 & 0 & 1 & -G_{54} & 0 \\ -G_{15} & -G_{25} & 0 & (1-G_{55}) & 0 \\ -G_{13} & -G_{23} & -G_{43} & 0 & -1 \end{bmatrix}^{-1}$$

$$\bar{N} = \begin{bmatrix} 1 & 0 & 0 & 0 & G_{13} \\ 0 & 1 & 0 & 0 & G_{32} \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & G_{35} \\ 0 & 0 & 0 & 0 & -(1-G_{33}) \end{bmatrix}$$

From a policy-making perspective, equation (31), similar to equation (10), is a combinative equation for two reasons. First, it depicts conventional conditions and special conditions, and second, it contains hybrid exogenous and endogenous variables. That is, the exogenous and endogenous variables of sectors 1 and 2 (W_1, W_2, and y_1, y_2, respectively), income of production agents (W_4 and y_4), and income of community entities (W_5 and y_5) are considered as in conventional conditions. For example, sector 3 has a limited supply of production. Thus, the endogenous variable of the sector is considered as an exogenous variable (W_3) and the endogenous variable as an exogenous variable (Ghahramani, 2012).

The matrix $\bar{M}$ in equation (31), similar to the matrix M in equation (25), is a matrix of coefficients, except that $\bar{M}$ is calculated on the basis of the Ghosh supply model and from the viewpoint of a supplier, but M is obtained based on the demand-driven model of Leontief and from the viewpoint of demanding. In addition, both the equation of (10) and (31) are functionally supply-driven in nature. That is, the effects and consequences of production reduction due to different factors on production reduction of other sectors in both models is production-to-production. That is, by a reduction in the production of water sector, production reduction in other sectors is obtained and, unlike conventional conditions, supply constraint is considered (Chang and Waters, 2009).

$$\begin{bmatrix} y_1 \\ y_2 \\ y_4 \\ y_5 \\ W_3 \end{bmatrix} = \begin{bmatrix} \bar{G}_{11} & \bar{G}_{12} & \bar{G}_{13} & \bar{G}_{14} & \bar{G}_{15} \\ \bar{G}_{21} & \bar{G}_{22} & \bar{G}_{23} & \bar{G}_{24} & \bar{G}_{25} \\ \bar{G}_{41} & \bar{G}_{42} & \bar{G}_{43} & \bar{G}_{44} & \bar{G}_{45} \\ \bar{G}_{51} & \bar{G}_{52} & \bar{G}_{53} & \bar{G}_{54} & \bar{G}_{55} \\ -\bar{G}_{31} & -\bar{G}_{32} & -\bar{G}_{33} & -\bar{G}_{34} & -\bar{G}_{35} \end{bmatrix} \begin{bmatrix} W_1 \\ W_2 \\ W_4 \\ W_5 \\ y_3 \end{bmatrix} \quad (32)$$

Calculations and analysis of results

SAM has been used in the present study. The matrix has been developed in accordance with the available statistics and information and given the research goals. After the integration of some sectors, it includes 36 economic sectors in the production account. External world accounts (import and export), and accumulation (savings and investment) also each have their own row and column. Production agents' accounts include labor factor and capital factor, and entities' accounts include low-income, middle-income, and high-income urban and rural families and companies. Exogenous accounts also include other accounts obtained from the integration of three accounts of the government, the outside world, and the accumulation account.

Results and Discussion

It is necessary to mention two key points before the presentation of results and their analysis: In practice, three general criteria are used to measure the economic and social impacts and consequences of production reduction under special circumstances: in this study, production reduction will be as percentage and in different scenarios and the obtained results will be actual figures. The obtained results are organized in terms of absolute effects and relative effects. Figures of absolute effects are more important for overall economic policies and their contribution to GDP and ultimately for economic growth, while relative effects are applied for sectional policies and inter-sector interactions. In light of the above, the effects and consequences of a reduction in the percentage of water resources are calculated as a part of supply constraint on the production of other economic sectors (sectors without supply constraint), and the results are presented in the following tables.

Absolute effects of water resource reduction on production of agricultural sub-sectors

According to the results in Table 1, the reduction of water resources causes the most damage to agriculture and horticulture and the least damage to the forestry sector in terms of demand-driven and supply-oriented patterns. However the impact of water reduction is different in the context of a mixed demand-driven and supply-driven model. The vulnerability of the agriculture and horticulture sector due to the depletion of water resources reflects the fact that the production of this sector is highly dependent on the amount of water.

Relative effects of water resource reduction on agricultural sector productions

The results in Table 2 are related to the relative percentage of production reduction in agricultural sectors that are not subject to special conditions. This ratio has been obtained by dividing agricultural sector production reduction by the actual output value of those sectors multiplied by 100.

Table 1- Effects of 10, 30, and 50% reductions in water resources on production in the agricultural sector in demand-driven and supply-driven models (figures: million Rials)

Economic sectors	Demand-driven			Supply-driven		
	10	30	50	10	30	50
Agriculture and gardening	56501	169503	282506	1108697	3326092	5543486
Livestock, poultry, silkworm and bee breeding, and hunting	33602	100806	168010	421879	1265637	2109395
Fishing	22587	67762	112936	22785	68354	113924
Forestry	20581	61743	102904	6320	18961	31601
Total	133271	399814	666356	1559681	4679044	7798406

Source: research results

The results related to relative effects of production reduction show that: firstly, the highest relative reduction has been in forestry sub-sector as equal to -0.2382 for 10% reduction, -0.7146 for 30% reduction, and -1.1911 for 50% reduction; secondly, the rank and position of agricultural sub-sectors that have been associated with the highest relative production reduction is different from the agricultural sub-sectors that have experienced the highest absolute production reduction. Also, the ratio of production reduction of agricultural sub-sectors in the whole economy resulted in limited supply (reduced water resources) to the total value added of the country has been calculated. The highest relative reduction of production has been related to the sub-sector of agriculture and gardening as equal to -0.2008 for 10% reduction, -0.6025 for 30% reduction, and -1.0042 for 50% reduction. The effects of production reduction in agricultural sectors are not the same in terms of relative impacts. The forestry sector from the perspective of demanding and the agriculture and gardening sector from the perspective of supplier show the most relative decreases. The order of relative reduction in different agriculture sectors is also different from the viewpoint of demanding and supplier. The nature of the four sub-sectors of agriculture in terms of the absolute effects of production reduction is also different from the nature of the four sub-sectors in terms of relative effects of production reduction. Also, based on the results of Banouei (2012), the nature of the five economic sectors in the absolute effects of reduced production is different from its relative effects.

Table 2- Relative effects of reduced production of agricultural sub-sectors on their actual production resulted from reduced water resources on demand-driven and supply-driven model bases (figures are in percentage)

Economic sectors	Demand-driven			Supply-driven		
	10	30	50	10	30	50
Forestry	-0.2382	-0.7146	1.1911	-0.0732	-0.2195	-0.3658
Fishing	-0.0796	-.2388	-0.3979	-0.0803	-02409	-0.4014
Agriculture and gardening	-0.1020	-0.0307	-0.512	-0.2008	-0.6025	-1.0042
Livestock, poultry, silkworm and bee breeding, and hunting	-0.0095	-0.-285	-0.0476	-0.1194	-0.3583	-0.5972

Source: research results

Absolute effects of water resource reduction on production of other economic sectors (demand-driven model)

The effects and consequences of water resource reduction as the sector included in special conditions on production reduction of other economic sectors in the framework of the demand-driven model in terms of absolute effects are presented in Table 3. It shows that the decrease in water resources by 10% has led to 3767033 Rials of production reduction in other economic sectors. The decrease of water resources by 20% to 50%, respectively, has led to 7534067, 11301100, 15068133 and 18835166 Rials of loss in production of different economic sectors. In the first 15 sectors of production that have had the highest production reduction, the largest impact of reduction has been on the water, education, other services, and transportation sectors, with real estate services, public affairs, urban affairs, and business services being the next ones. The reason for water sector loss is completely clear according to the accounting and social matrix table, and it is because of the direct dependence of this sector from the viewpoint of demanding. However, the most important reason for production reduction in education, other services, and transportation sectors due to decrease in water resources is not direct dependence of water upon these sectors because the direct intermediate needs of the water sector (from the viewpoint of demanding) in the above sectors are lower than the direct intermediate needs of water sector (from the viewpoint of supplier). The lowest amount of production reduction with water supply limitation was in hotel and restaurant sectors with 32369 Rials, other mines sector with 33645 Rials and chemical, rubber, and plastic products production with 33873 Rials. Also, the vulnerability of the public affairs sector, urban affairs sector, and business services, banks, insurance, and other financial intermediaries due to a decline in the supply of water resources indicates that the mentioned sector is indirectly dependent so much on the sectors most connected to water supply sector.

Table 3- Absolute effects of 10 to 50 percent reduction in water resources on the production of other economic sectors in the demand-driven model (figures: million Rials)

Economic sectors	10	20	30	40	50
Water	2573732	5147464	7721196	10294927	12868659
Education	196885	393771	590656	787541	984426
Other services	101396	202792	304188	405584	506980
Transportation	82634	165267	247901	330535	413169
Real estate services	80347	160694	241041	321389	401736
Public, urban, and business service affairs	60711	121422	182133	242844	303555
Bank, insurance, and other financial intermediaries	50621	101242	151863	202484	253105
Defense and military affairs	48680	97361	146041	194722	243402
Health and medication	44937	89875	134812	179750	224687
Construction	39917	79834	119750	159667	199584
Manufacturing, processing, and tanning of textiles, clothing, and leather	36737	73474	110211	146947	183684
Post, telecommunications, and warehousing	36293	72585	108878	145170	181463
Manufacturing of food, beverage, and tobacco products	34358	68715	103073	137431	171788
Manufacturing of chemicals, rubber, and plastic products	33873	67746	101619	135492	169365
Other mines	33645	67290	100935	134580	168225
Hotel and restaurant	32369	64738	97107	129476	161845
Sum of all other sectors	3767033	7534067	11301100	15068133	18835166

Source: research results

Absolute effects of water resource reduction on production of other economic sectors (supply-driven model)

The results in Table 4 show the absolute effects of water resource reduction from the perspective of production suppliers on other economic sectors in the framework of the supply-driven model. The results of the absolute effects are presented in this table. In the first 15 production sectors that have been associated with the largest reduction in production, the obtained figures show that the water sector experiences the highest production reduction compared to other economic sectors due to a decline in water resources. The reason for this, as mentioned earlier, is the direct dependence of this sector from the perspective of the supplier. However, wholesale, retail, vehicle and goods repair, construction, food, beverage, and tobacco production, chemicals, rubber, and plastic production, transportation, and real estate services sectors are among the top six sectors that experience loss due to reduction of water resources, indicating the direct and indirect dependence of the aforementioned sectors on water-limited sector. For example, the direct and indirect impacts of a 10% reduction in water resources lead to production reduction equal to 938954 Rials in wholesale, retail and repair of vehicles and goods sector, 573521 Rials in the construction sector, and 573521 Rials in food, beverage, and tobacco products sector. Transportation and real estate services sectors are among the first five sectors experiencing loss due to water resource reduction from the perspective of demanding and supplier. The lowest rate of production reduction with water supply constraints equal to 187522 Rials is related to the health and medication sector, and 188949 Rials in the manufacturing of motor vehicles, trailers, semi-trailers, and other transportation equipment sector.

Relative effects of 10 to 50 percent water resource reduction on production of economic sectors from the perspective of a supplier

The second part of the results, which can be seen in Table 5, is the relative decline in the production of economic sectors due to water supply constraints. Conceptually, relative effects are the quantities that show the decline in production of other economic sectors (after water supply constraint) on their corresponding actual production caused by a decrease in the water supply. The results related to relative effects of 10% decrease in water show that the highest relative production reduction is related to water, other mines, public, urban, and business service affairs, education, and manufacturing of food, beverages, and tobacco sectors with 9.1483, 0.1196, 0.1003, 0.0897, and 0.0890 percent, respectively. The economic sectors that experienced the highest relative production reduction were different from the economic sectors that experienced the highest absolute production reduction. Although they are common in some manufacturing sectors, their position and rank are different. For example, in the wholesale, retail, and repair of vehicles and goods sector, percentage of relative production reduction is much lower than the absolute production reduction such that with a water supply restriction of 10% to 50%, the mentioned sector is in the second place of absolute production reduction while among the 15 production sectors with the highest relative production reduction, is in the seventh position.

Faridzad and Mohajeri (2016), among the industrial sub-sectors, the most limited supply of intermediate imports has been in the field of coke, petroleum products and chemical products, which has caused the greatest decrease in production in the whole economy.

Table 4- Absolute effects of 10 to 50 percent reduction in water resources on the production of other economic sectors in the supply-driven model (figures: million Rials)

Economic sectors	10	20	30	40	50
Water	2573732	5147464	7721196	10294927	12868659
Wholesale, retail, repair of vehicles and goods	938954	1877908	2816861	3755815	4694769
Construction	573521	1147042	1720563	2294084	2867605
Manufacturing of food, beverage, and tobacco products	558710	1117420	1676130	2234840	2793550
Manufacturing of chemicals, rubber, and plastic products	426336	852672	1279008	1705344	2131681
Transportation	353698	707395	1061093	1414790	1768488
Real estate services	302079	604157	906236	1208314	1510393
Manufacturing of basic metals and fabricated metal products	292977	585954	878931	1171909	1464886
Crude oil and natural gas	292062	584124	876187	1168249	1460311
Manufacturing of coke, refined petroleum products, and nuclear fuels	274469	548938	823408	1097877	1372346
Education	240112	480224	720337	960449	1200561
Electricity and gas	224713	449427	674140	898854	1123567
Defense and military affairs	194279	388557	582836	777115	971393
Manufacturing of motor vehicles, trailers, semi-trailers, and other transportation equipment	188949	377897	566846	755794	944743
Health and medication	187522	375044	562566	750088	937610
Sum of all other sectors	8896617	17793234	26689852	35586469	44483086

Source: research results

Table 5- Absolute effects of 10 to 50 percent reduction in water resources on the production of 15 economic sectors with the highest production reduction from the supplier's perspective

Economic sectors	10	20	30	40	50
Water	-9.1483	-18.2966	-27.4449	-36.5931	-45.7414
Other mines	-0.1196	-0.2392	-0.3588	-0.4784	-0.5980
Public, urban, and business service affairs	-0.1003	-0.2006	-0.3009	-0.4011	-0.5014
Education	-0.0897	-0.1794	-0.2691	-0.3588	-0.4485
Manufacturing of food, beverage, and tobacco products	-0.890	-0.1780	-0.2670	-0.3560	-0.4450
Defense and military affairs	-0.868	-0.1737	-0.2605	-0.3473	-0.4342
Wholesale, retail, repair of vehicles and goods	-0.0858	-0.1715	-0.2573	-0.3431	-0.4288
Other services	-0.0808	-0.1617	-0.2425	-0.3234	-0.4042
Veterinary	-0.801	-0.1602	-0.2402	-03203	-0.4004
Health and medication	-0.0798	-0.1596	-0.2394	-0.3192	-0.3990
Compulsory social security	-0.743	-0.1486	-0.2229	-0.2972	-0.3715
Manufacturing of other non-metal mineral products	-0.740	-0.1480	-0.2220	-0.2961	-0.3701
Banks, insurance, and other financial intermediaries	-0.732	-0.1463	-0.2195	-0.2926	-0.3658
Construction	-0.698	-0.1397	-0.2095	-0.2794	-0.3492
Publication, printing, and copying of recorded media	-0.697	-0.1394	-0.2091	-0.2787	-0.3484

Source: research results

Relative effects of 10 to 50 percent water resource reduction on production of economic sectors from the perspective of demanding

The effects and consequences of the relative reduction of water resources as the sector included in special conditions on the reduction of the production of other economic sectors (sections not included in special conditions) in the framework of the demand-driven model are presented in Table 6. According to the figures shown in Table 6, it can be seen that relative decline in water resources from the perspective of demanding has the highest effects on water, veterinary, publication, printing, and copying of recorded media, compulsory social security, and education sectors, with other services, and other mines sectors being the next ones. The economic sectors that were associated with the highest relative production reduction from the perspective of suppliers were different from the economic sectors that experienced the highest relative production reduction from the perspective of demanding. For example, the veterinary sector experiences the highest loss after the water sector in terms of relative effects from the perspective of demanding, but in terms of absolute effects is not even among the first 15 affected sectors. The reason for this is that among the 71 economic sectors of SAM table, the veterinary sector has the smallest share of value-added in the country. So, the veterinary sector experiences a significant decline in proportion to its production, but this decline is not significant in terms of absolute effects. The water sector is the first sector to be affected both in terms of absolute and relative effects and this shows that this sector has a huge impact on the economic growth of the country. In this regard, Salami and Permeh (2001) concluded that the agricultural sector can play a very effective role in the economic growth of the country due to its close relationship with other economic sectors and due to the significant use of other economic sectors.

Table 6- Relative effects of water resource reduction on production of economic sectors from the perspective of demanding

Economic sectors	10	20	30	40	50
Water	-9.148	-18.297	-27.445	-36.593	-54.741
Veterinary	-0.744	-1.487	-2.231	-2.974	-3.718
Publication, printing, and copying of recorded media	-0.203	-0.406	-0.608	-0.811	-1.014
Compulsory social security	-0.163	-0.325	-0.488	-0.651	-0.813
Education	-0.074	-0.147	-0.221	-0.294	-0.368
Other services	0.060	-0.121	-0.181	-0.192	-0.302
Other mines	-0.048	-0.096	-0.144	-0.139	-0.240
Public, urban, and business service affairs	-0.035	-0.096	-0.104	-0.103	-0.173
Manufacturing of wood, paper, and their products	-0.026	-0.051	-0.077	-0.101	-0.128
Manufacturing, processing, and tanning of textiles, clothing, and leather	-0.025	-0.51	-0.076	-0.098	-0.127
Hotel and restaurant	-0.025	-0.049	-0.074	-0.087	-0.123
Defense and military affairs	-0.022	-0.044	-0.065	-0.084	-0.109
Banks, insurance, and other financial intermediaries	-0.021	-0.04	-0.052	-0.076	-0.105
Health and medication	-0.019	-0.038	-0.047	-0.074	-0.096
Post, telecommunications, and warehousing	-0.019	-0.037	-0.037	-0.069	-0.093

Source: research results

Absolute effects of 10, 30, and 50 percent water resource reduction on production agents and entities

The effects of income reduction of production agents and income reduction of community entities from the viewpoint of demanding and supplier in terms of the absolute effects resulted from water resource reduction are presented in Table 7. The direct and indirect effects and consequences of 10, 30, and 50 percent of water resource reduction from the perspective of demanding leads to a reduction in value-added equal to 65968, 197905, and 329842 million Rials in the whole economy, respectively. The corresponding figures from the perspective of the supplier are also 3716096, 11148288, and 18580479 Rials, respectively. According to the results presented in Table 7, among the two constituent categories of production agent accounts, the labor factor (compensation for services and mixed-income, gross) has decreased absolutely more than the capital factor (operational surplus, gross).

Table 7 also presents the results of water resource reduction on the income of domestic community entities (except the government). The results obtained from the distribution of income of entities show that in terms of absolute demanding and supplier effects, the vulnerability of urban households resulted from water resource reduction has been more than rural households. This impact on the income of low-income households is higher than that of high-income households. Sahabi *et al*. (2016) also showed that the absolute figures for the decrease in the income of urban salaried labor are higher than the decrease in the income of rural salaried labor, which confirms the results of the above study.

Table 7- Absolute effects of 10, 30, and 50 percent water resource reduction on the income of production agents and income of entities from the perspective of demanding and supplier (million Rials)

Production agents and entities	demanding			Supplier		
	10	30	50	10	30	50
Labor factor	60007	180022	300037	2990304	8970912	14951521
Capital factor	5961	17883	29805	725792	2177375	3628959
Sum of production agents	65968	197905	329842	3716096	11148288	18580479
Urban low-income	99172	297515	495859	537918	1613754	2689590
Urban middle-income	127436	382308	637180	1186099	3558296	5930493
Urban high-income	85935	257805	429674	1601088	4803264	8005439
Rural low-income	89134	267403	445672	135289	405868	676447
Rural middle-income	129248	387745	646242	312268	936803	1561339
Rural high-income	87375	262126	436876	404086	1212257	2020428
Companies	34	101	169	3106	9318	15530
Sum of entities	618335	1855004	3091673	4179853	12539560	20899266

Source: research results

Relative effects of 10, 30, and 50 percent water resource reduction on production agents and entities from the perspective of demanding and supplier

According to the results in Table 8, it can be seen that a relative reduction of water resources from the perspective of demanding has a greater impact on capital factor than the labor factor. However, the opposite is true from the perspective of the supplier. In other words, the labor factor has experienced more income loss than capital factor and relatively has had the largest reduction. But in terms of relative impacts, the highest impact of income reduction from the perspective of supplier is on urban low-income households, and the highest impact of income reduction from the perspective of demanding is on rural low-income households. Regarding the effects of distribution of income of entities, given the Table 8, from the perspective of supplier, urban low-income, rural middle-income, urban middle-income, rural low-income, rural high-income, urban high-income households, and companies, respectively, are mostly affected; and from the perspective of demanding, urban low-income, rural middle-income, urban middle-income, rural low-income, rural high-income, urban high-income households, and companies, respectively, have the highest income reduction.

In a study conducted by Sahabi *et al*. (2016), it was found that reducing the production of the agricultural sector causes the most damage to mixed income, which is due to the high volume of mixed income compared to others and this group constitutes the largest number of people in society.

Table 8- Relative effects of 10, 30, and 50 percent water resource reduction on the income of production agents and income of entities from the perspective of supplier and demanding

Production agents and entities	Supplier			demanding		
	10	30	50	10	30	50
Capital factor	-0.0212	-0.0636	-0.1059	-0.0002	-0.0005	-0.0009
Labor factor	-0.1065	-0.3195	-0.5325	-0.0021	-0.0064	-0.0107
Urban low-income	-0.1176	-0.3529	-0.5881	-0.2169	-0.652	-0.1084
Rural middle-income	-0.1150	-0.3451	-0.5751	-0.0476	-0.1428	-0.2380
Urban middle-income	-0.1128	-0.3385	-0.5642	-0.121	-0.0364	-0.0606
Rural low-income	-0.1065	-0.3195	-0.5325	-0.0702	-0.2105	-0.3508
Rural high-income	-0.1001	-0.3004	-0.5007	-0.02165	-0.0650	-0.1083
Urban high-income	-0.0993	-0.2980	-0.4967	-0.0053	-0.0160	-0.0267
companies	-0.00012	-0.00036	-0.0006	-0.0000013	-0.0000039	-0.0000065

Source: research results

Recommendations

The results of this study can be of great importance for the economic and social dimensions of the country. Water resource reduction indicates that production sectors, due to their direct and indirect intermediary links with the water sector, will face production reduction. For this reason, it is necessary to invest in a variety of areas, including improved water use practices, improved crop cultivation methods, proper use of running waters in industry and agriculture, and controlling of surface waters to further exploit water resources.

Optimization of water use in agriculture is more important because a relative share of water consumption in agriculture is higher than in other economic sectors. Attention to issues such as development of long-term strategies for greater water efficiency, educating and informing about the problems resulted by water resource reduction, use of modern methods of irrigation such as drip and tubular irrigation instead of flood irrigation in farms and gardens and use of tree species resistant to water shortage, major changes in irrigation system and crop production technology, financial incentives and investment in reducing water consumption, and creating a culture for consumption pattern of households through the media can provide a procedure of reduction and optimization of water consumption.

In the present study, it was found that production reduction due to water resource constraints leads to a change in the income distribution of production agents and income distribution of entities and increases poverty across different economic sectors. However, this constraint has not taken into account the increase in other economic indicators and households' living cost index. So, it is recommended that policymakers and researchers take it into account in future studies.

References

1. Afaqeh, M., Y. Andayesh, and M. Chenari. 2014. Tax Prioritization of Economic Sectors to Improve the Income Distribution in Iran's Economy Using Social Accounting Matrix. Quarterly Journal of Quantitative Economics, 11(1): 1-18.
2. Banouei, A.A. 2012. The impacts of Agricultural Sector Production Reduction on production of Other Sectors in the form of mixed pattern with an emphasis on conventional and special conditions. Agricultural Economics and Development, 20: 155-186.
3. Banouei, A.A. 2005. Investigation of relationship between income distribution and output growth in Iran using social accounting matrix. Journal of Iranian Economic Research, 23: 95-117.
4. Banouei, A.A. 2012. The effects of reducing the production of the agricultural sector on the production of other sectors in the form of mixed patterns with emphasis on conventional and special conditions. Agricultural Economics and Development, 20 (79): 155-186.
5. Banouei, A.A. F. Momeni, H. Amadeh, Z. Zakeri, and M. Karami. 2012. Measurement of Decrease of Agricultural Output to the Total Output in the Framework of Supply-Driven SAM. The Journal of Economic Policy, 7(4): 1-30.
6. Berrittella, M., A.Y. Hoekstra, K. Rehdans, R. Roson, and R.S.J. Tol. 2007. The economic impact of restricted water supply: A computable general equilibrium analysis. Water Research, 41(8): 1799-1813.
7. Cosgrove, W. and F. Rijsberman 2000. World water vision: making water everybody's business, Earthscan Publications, London.
8. Faridzad, A., A.A. Banouei, F. Momeni, and Kh. Amadeh. 2013. Investigating the Economic and Social Impacts of Petroleum Products Supply Constraints Using Mixed Social Accounting Matrix. Journal of Economic Modeling Research, 3(10): 99-123.
9. Faridzad, A. and P. Mohajeri. 2016. Quantitive Analysis of Economic and Social Impacts of Industrial Sub-Sectors Supply Constraint Using Supply-Driven Social Accounting Matrix Mixed Approach. Applied Economic Studies in Iran, 5(19): 155-185.
10. Farzin, M.R. N. Abbaspour, Y. Ashrafi, and H. Zargham. 2020. The effects of incoming tourism development on income distribution between households and companies. Journal of Social Tourism Studies, 8(16): 1-26.
11. Gakuru, W.R. and N.M. Mathenga. 2015. Poverty, growth and income distribution in Kenya: A SAM perspective, AGRODEP working paper 0001.
12. Ghahramani, F. 2012. Measurement of the Socio-Economic Effects of Drought in the Framework of Supply- Driven SAM (Case study of agriculture and gardening), MA Thesis, Faculty of Management and Economics, Tarbiat Modarres University.
13. Hortono, D. and B.P. Resosudarmo. 2008. The Economy-Wide Impact of Controlling energy Consumption in Indonesia: An Analysis Using a Social Accounting Matrix Framework. Energy Policy, 36: 1404-1419.
14. Kershner, K. and K. Hubacek. 2009. Assessing the suitability of input- output analysis for enhancing our understanding of potential economic effects of oil peak. Energy, 34: 284-290.

15. Miller, R.E. and P.D. Blair. 2009. Input-Output Analysis: Foundations and Extension. Cambridge University Press, New York (Second Edition).
16. Nokkala, M. 2000. Social accounting matrices and sectoral analysis: The case of agricultural sector investment in Zambia. Proceedings of 13th international conference on input-output techniques. Macerata, Italy. August 21-25.
17. Permeh, Z., B. Maleki, A.A. Banouee, Y. Andayesh, and M. Karami. 2011. Estimation of Energy Subsidy Targeting on Commodity Price Index. Iraniian Journal of Trade Studies, 58: 1-32.
18. Pyatt, G. 1988. A SAM Approach to Modeling. Journal of Policy Modeling, No. 10.
19. Pyatt, G. and J. Round. 1979. Accounting and Fixed Price Multiplier in a Social Accounting Matrix. The Economic Journal, 89(356): 850-873.
20. Rocchi, B., D. Romano, and G. Stefani. 2002. Agriculture and income distribution: Insights from a SAM of the Italian economy. Proceedings of 8th joint conference on food, agriculture and the environment. August 25 28, Red Cedar Lake, Wisconsin.
21. Sadeghi, S.K., Z. Karimi Takanloo, M.H. Motafakker Azad, H. Asgharpour qourchi, and H. Andayesh. 2015. Measuring the water ecological footprint of Iranian economic sectors: by emphasis on social accounting matrix (SAM) approach. Scientific Journal Management System, 11(3): 81-111.
22. Sahabi, B., A.A. Banouee, and F. Ghahramani. 2016. Measurement of the Socio-economic Impact of Drought in the Framework of Modified Supply-Side Social Accounting Matrix (SAM): Case Study of Farming Sector. Agricultural Economics and Development, 24(94): 95-121.
23. Salami, H. and Z. Parmeh. 2001. The effects of increasing exports of agricultural and industrial sectors on the Iranian economy: An analysis in the context of the social accounting matrix. Journal of Economic Research, 59: 149-181.
24. Seyedmashhadi, P.A., F. Ghalambaz, and A.A. Esfandiary. 2011. The importance of oil industry in the output and employment of Iran’s economy and its influence on other economic activities. Economic Growth and Development Research, 1(2): 133-161.
25. Social Accounting Matrix of Iranian Economy 1999. Methodology and Structure of Social Accounting Matrix, 1999, Central Bank of Islamic Republic of Iran.
26. Sotoodeh Nia, S., M. Ahmadi Shadmehri, S.M.J. Razmi, and M. Bahnameh. 2020. Studying the Effect of Green Tax on Iran’s Energy Consumption and Social Welfare Using Recursive Dynamic Computable General Equilibrium (RDCGE) Model, Journal of Economic Growth and Development Research, 10(20): 15-34.
27. Yang, H., P. Reichert, K.C. Abbaspour, and A.J.B. Zehnder. 2003. A water resources threshold and its implications for food security. Environmental Science and Technology, 37: 3048-3054.
28. Zand, P., H.R. Mirzaei, H. Mehrabi, and S. Nabieian. 2019a. Socio-economic of the Investment Development Polici on Agriculture Sector. Internanal Journal of Agricultural Mamagement and Development, 9(4): 347-362.
29. Zand, P., H.R. Mirzaei, H. Mehrabi, and S. Nabieian. 2019b. Analysis of Economic and Social Impact of Investment Development Policy in Agricultural Sector, Journal of Agricultural Science and Technology, 21(7): 1737-1751.

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چکیده

آب گرانبهاترین ثروتی است که در اختیار بشر قرارگرفته، امروزه جوامع بین‌المللی از اهمیت آب در جهت داشتن رشد اقتصادی پایدار در زمان حال و آینده آگاه‌اند. در این مطالعه، تأثیر کاهش منابع آب بر بخش های اقتصادی و زیرشاخه های کشاورزی از طریق یک مدل ماتریس حسابداری اجتماعی بررسی شد. نتایج آن در قالب آثار مطلق و نسبی ارائه شده‌است. آثار و تبعات مستقیم و غیرمستقیم کاهش ۱۰ و ۵۰ درصد منابع آب منجر به کاهش تولید ۳/۴ و۲۲ درصد از دید تقاضا کننده، ۴/۷ و ۲۴ درصد از دید عرضه کننده برای محصولات کشاورزی شده است. از منظر تقاضا کننده کاهش منابع آب به میزان ۱۰ درصد، ۱۰/۵درصد کاهش تولید در سایر بخش‌های اقتصادی داشته است. آثار نسبی کاهش۱۰ درصدی آب از منظر عرضه کننده نشان می‌دهد که بیشترین کاهش مربوط به بخش‌های آب و سایر معادن بوده است. کاهش نسبی منابع آب از منظر تقاضا کننده بیشترین تاثیر را بر بخش آب و دامپزشکی می‌گذارد. از منظر آثار مطلق تقاضا کننده و عرضه کننده، میزان آسیب پذیری خانوارهای شهری ناشی از کاهش منابع آب بیش از خانوارهای روستایی بوده است. از منظر آثار نسبی عرضه کننده ، بیشترین تاثیر کاهش درآمد بر خانوارهای کم درآمد شهری از منظر تقاضا کننده مربوط به خانوارهای کم درآمد روستایی می‌باشد.کاهش نسبی منابع آب از منظر تقاضا کننده بر روی عامل سرمایه تاثیر بیشتری از عامل کار دارد.

واژه‌های کلیدی: تولید، ماتریس حسابداری اجتماعی، منابع آب

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