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# Water resources assessment in Hashtgerd study area based on the system of environmental-economic accounting for water

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**ABSTRACT:** Considering the role of water in the socio-economic development of countries as well as the quantitative and qualitative problems of water resources that cause crises, it is necessary to take a comprehensive approach in this field. Accordingly, the use of integrated water resources management in the planning and policy-making of water resources has been considered. Water accounting is used to provide an integrated assessment of water resources by the provision of needed data set. Among the various water accounting frameworks, the system of environmental-economic accounting for water is a suitable tool that, with its information system and support for integrated water resources management, can help policy-makers to make informed decisions in various fields, such as water allocation, improving water efficiency, and so on. In this study, by the mentioned framework, water accounts related to Hashtgerd study area in 2006 and 2016 have been compiled. Then, by calculation of water resources, economic and social indicators, the assessment of the water resources system in the area has been conducted. The results indicate the critical status of water resources in the study area in such a way that the agricultural sector with 95.5% of water consumption has the greatest impact on the high values of relative water stress and water consumption intensity and although water consumption has increased, economic water productivity in this sector has declined. In addition, despite the state of water scarcity and the low per capita amount of renewable water resources, water consumption is still increasing.

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## 1- Introduction

1. Introduction

Since water is closely linked to socio-economic development, countries need to move towards a holistic approach for managing water resources. One of the limitations in implementing integrated water resources management is the need for various types of information through which the status of water supply and consumption can be analyzed as a key part of making appropriate decisions in future policies. Water accounting, which is developed to organize water-related statistics and information, helps to overcome the limitation mentioned, by compiling an integrated data set and establishing links between physical and economic information [1].

Ideally, water accounting provides a supportive tool for determining changes in water levels and provides an opportunity to examine how water resources are allocated to different purposes and economic sectors. Several frameworks have been developed for recording and reporting water issues, among which the SEEA-Water[1] is more comprehensive than others [2]. In this regard, previous studies have shown that SEEA-Water, can assist policymakers in evaluating water resources systems and making informed decisions on issues such as efficient water allocation, improving water efficiency, and etc. [3, 4].

In this study, according to the SEEA-Water framework, the water accounts associated with 2006 and 2016 have been compiled. Then, by extracting economic, social and water resources indicators, the relevant assessments have been completed on the status of water resources in Hashtgerd study area.

## 2- Methodology

### 2- 1- Study area

Hashtgerd study area is located in the northern part of the Namak lake basin in Iran. The most important river in this area is Kordan river which enters the plain from the northeast and after crossing the whole plain exits from the southwest to the Qazvin plain (Figure1).

1 System of environmental-economic accounting for water

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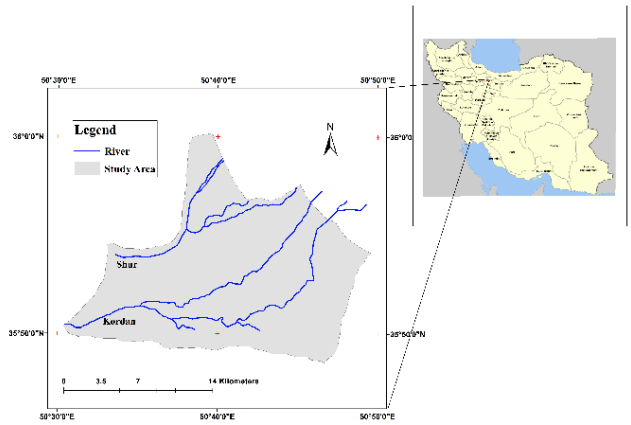


**Fig. 1. Hashtgerd study area**

## 2- 2- SEEA-Water

The system of environmental-economic accounting for water includes a set of standard and supplementary tables. Standard tables are designed to organize hydrological and economic information in a systematic and consistent manner that reflects the relationship between water, economic and the environment which enable the analysis of the interactions between water and the economy. Supplementary tables contain information on social aspects, and since they are not approved by different countries, this information is reported at the discretion of analysts and policymakers. The required accounts are classified into four categories as: 1) Physical use and supply accounts; 2) Hybrid use and supply accounts; 3) Asset accounts; and 4) Socio-economic accounts (Supplementary accounts).

## 3. Results and Discussion

Considering that in this research, uses are classified into the three types of agricultural, domestic and industrial activities, water accounts have been prepared for Hashtgerd study area based on SEEA-Water for the years 2006 and 2016, and the proposed indicators have been derived. Some of the most important indicators are shown in Table 1.

Since it is difficult to consider all the data at the same time, radar diagrams according to Figure 2 and Figure 3 are used to compare the indicators of the study area in 2006 and 2016 with the normal values. As can be seen, the results indicate that there is a large difference between the calculated values of the indicators and their normal values, because of high water consumption in comparison with the small volume of water resources.

The value obtained for relative water stress, which represents the total amount of water consumption relative to the volume of natural renewable water resources, is higher than the normal global value, and there is severe water stress in the region. The value calculated for the water consumption indicator, which indicates the sustainability of water resources, is also higher than the normal value so it shows the unsustainability of the region due to high water consumption relative to the amount of available internal renewable water resources, that the agricultural sector with the highest amount of water consumption, has the greatest impact on this indicator. The value of per capita renewable water resources indicator is much lower than the Falkenmark Index, which is 1700 $m^3$ /yr per capita for water stress and 1000 $m^3$ /yr per capita for water scarcity [5]. So the region is in a state of water scarcity.

**Table 1. Indicators derived from the water accounts**

| Indicator | 2006 | 2016 |
|---|---|---|
| Internal renewable water resources volume (MCM) | 46.45 | 40.24 |
| External renewable water resources volume (MCM) | 93.65 | 102.3 |
| Outflows to the outside of the basin (MCM) | 49.73 | 31.75 |
| Total natural renewable water resources (MCM) | 90.37 | 110.79 |
| Dependency to external water resources ratio (%) | 1.04 | 0.92 |
| Dependency to Groundwater ratio(%) | 0.74 | 0.98 |
| Relative water stress index | 1.79 | 1.64 |
| Consumption index | 3.49 | 4.52 |
| Per capita renewable water resource (m3/person) | 330.08 | 336.70 |

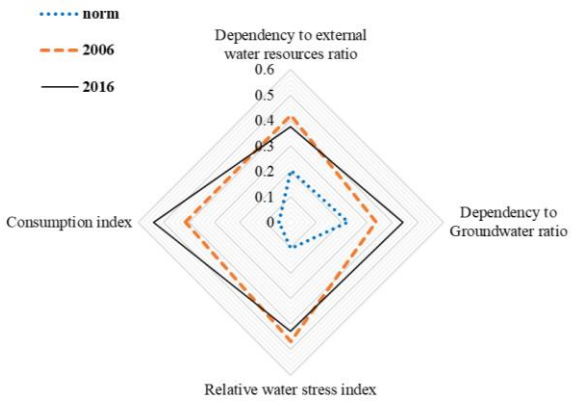


**Fig. 2. Radar diagram of water resources indicators**

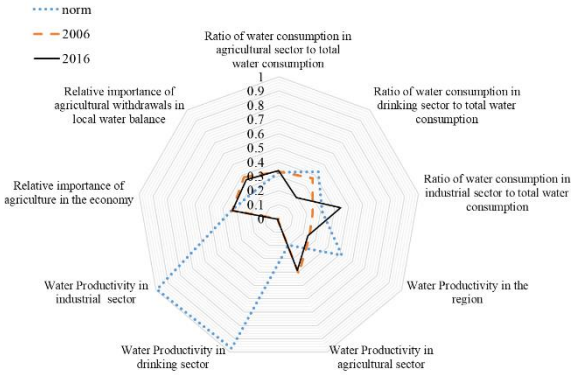


**Fig. 3. Radar diagram of economic indicators**

The results show that the water productivity of the agricultural sector is higher than the domestic and industrial sectors. The value of this indicator in the agricultural sector is more than the relevant normal value and in the domestic and industrial sectors is much lower than their normal values. Owing to the high water consumption and the reduction of water productivity in the agricultural sector from 2006 to 2016, it is recommended to reduce the activity of the agricultural sector in this study area and boost industrial activities.

## 4. Conclusions

In this study, using the system of environmental-economic accounting for water, which is one of the newest frameworks for the evaluation of water resources, the status of water resources in the Hashtgerd study area was assessed. The results of physical use and supply accounts showed that water consumption in the agricultural and industrial sectors has increased from 2006 to 2016. As the results of water resources indicators showed, in this area, dependence on external water resources and groundwater resources is high. Also, the area is in a state of severe water stress and the amount of relative water stress is higher than normal. The value obtained for the indicator of water consumption intensity indicates the unsustainability of the region, which means that the amount of water consumption is much higher than the volume of internal renewable water sources. Per capita renewable water resource as one of the most important social indicators, shows the status of water scarcity in the study area.

Finally, due to the decrease in water productivity in the agricultural sector, despite the increase in water consumption, it is suggested to reduce agricultural activity in the region and as the water productivity in the industrial sector has increased significantly, it is recommended to shift the focus of economic activities from the agricultural sector to the industrial sector.

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