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Prioritization of The Economic Sectors of Isfahan Province from The Perspective of The Importance of Water Resources and Considering The Three Goals of Social, Environmental and Economic Sustainable Development

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ABSTRACT

The purpose of this research, study seeks to prioritize the activities of Isfahan Province with sustainable criteria and by emphasizing the importance and limitation of water resources. For this purpose, first, the national input-output table of 2016 published by the Central Bank of Iran and the SFLQ method is used to prepare an input-output table for Isfahan Province. Then, the economic sectors of the province are prioritized with the TOPSIS method and six criteria including water consumption, energy consumption, pollution, job creation, inter-sector linkages, and value added. The results of the study show the importance of water consumption as a criterion. Prioritization with and without this criterion taken into account yields significantly different results. For example, in the prioritization of the sectors according to the water intensity criterion, the agriculture sector was in the twentieth place, while this rank was the second in the prioritization without considering that criterion. Also, in the sector of "manufacture of leather apparel", this criterion was downgraded from the ninth to the thirteenth rank considering the water intensity criterion. Similarly, the sectors of "manufacture of textiles" and "manufacture of rubber and plastic products" were ranked 7th and 9th, respectively, while the ranks of these sectors without considering the water intensity criterion were fifteen and twelve.

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1- INTRODUCTION

Scarcity and justice have always been the concerns of human beings. To make a choice between these two concepts, capitalist systems have given priority to scarce resources and the optimization of their use in the hope that economic growth will also provide justice. In recent decades, environmental degradation, increasing pollution, extinction of various animal and plant species, climate change and global warming have cast doubt on the unbridled growth approach adopted by the capitalist system. This approach has proposed the idea of ‘sustainable development’ as a solution to those problems. The concept of sustainable development, which was proposed in 1980, was actually a response to the destructive environmental and social effects and to the concept of economic growth in general, in such a way that this opinion originated from environmental trends (Zakerian et al., 2014). Also Sustainable developmrnt instead of focusing only on the economic aspect of development, considers the social and environmental aspects of development along with its economic dimesion and takes into account the goal of economic growth in countries along with maintaining the conditions required for sustainable growth (maddah & mohamadnia sarvi, 2017). Based on this idea, it is possible to take advantage of development opportunities through the interaction and adaptation of social, environmental and economic goals. The approach focuses on sustainable development, which gives importance to the equitable distribution of economic growth benefits (social and environmental goals) and pays attention to scarcity (economic goals). On this basis Sustainable development is development that can continue for a long period of time without causing damage to the environment (Shafiei, 2018). These points bring one to the conclusion that, to exploit resources, not only economic interests but also social, environmental and economic goals should be taken into consideration.

Sustainable development is more important for developing countries, where achieving development is a priority and modern technological advancements have increased their distance from the developed world. In fact, with the consensus of the great powers to maintain environmental security and possibly lay future restrictions on the exploitation of environmental resources, on the one hand, and the negative consequences of ignoring environmental protection, on the other hand, it has become a necessity not a choice to pay attention to sustainable development. Because the needs and capabilities of different regions are different, it is not justified to use national plans at a regional level. Due to the dependence of all sustainable development goals on water resources, it can be said that water is at the heart of all aspects of sustainable development (Ait-Kadi, 2016). Since in recent years, the continuation of economic growth along with the development of urbanization and population growth has led to further destruction of the environment and the reduction of scarce natural resources, including water resources, this issue has led researchers to pay more attention to the environmental aspect of sustainable development. From the perspective of sustainable development, priority is given to activities that, while providing the most economic benefits, put the least pressure on water resources and the environment of the region (Nasrollahi & Zarei, 2017). In Iran as a developing country, environmental issues took on a wider and more visible dimension. Although Iran has devised measures to overcome environmental challenges, the gap with global indicators is large, and according to many activists in this field, Iran is approaching a multi-faceted environmental crisis (Rezayan ghayehbashi & Marzban, 2020). In fact, economic, political, cultural and social issues have a two-way relationship with the environment, and any policy adopted for the environment will have significant consequences on other areas. It is also clear that a lack of attention to environmental challenges brings irreparable costs to society. Therefore, the prioritization of economic activities is also considered by examining environmental issues. However, a review of the studies conducted in this field shows that most of these studies have emphasized the pollution aspect of economic activities and less have addressed the scarcity of natural resources, including water. Meanwhile, according to many researchers, the lack of water can endanger the growth and development of water-scarce areas (Okadera et al., 2015).

The location of Iran in the arid and semi-arid climatic region and the uneven distribution of rainfall have led to the aggravation of the water shortage in Iran, so that the increase in demand has faced the country with the limited supply of water resources. Due to the lower rainfall than the global average and the low efficiency of using water resources, the situation will become more complicated in the future. The importance of this issue in Isfahan province due to its economic status and its location in the arid and semi-arid region of Iran is much higher than other provinces of the country, so that the water supply of this province has become one of the main concerns of the provincial officials. But the efforts that have been made in this field in previous years have been directed towards water supply (including water transfer plans from Chaharmahal and Bakhtiari, Khuzestan and Lorestan provinces), while today, in order to have sustainable access to water resources, demand-side management that improves water distribution and consumption as an alternative approach instead of increasing supply, has been considered (United Nations, 2006).

Therefore to prioritize the economic activities, it is necessary to pay attention to the water shortage issue and the other environmental considerations. In this regard, the present study has identified and prioritized the economic activities of Isfahan Province by using the criteria for different dimensions of sustainable development and with an emphasis on the importance of water resources. To this end, input-output models and the TOPSIS method are innovatively combined to provide a proper picture of prioritizing the economic activities in the province. The rest of this article is organized in several sections. The second section provides the research background. The third section presents the Background studies, and the forth section research method and the data. The findings of the study are put forth in the five section. The last section is dedicated to the conclusion of the study and suggestions for future research.

2- Research background

Limitation of resources is the main reason for the idea of prioritizing economic activities. Due to this problem in the economy, the growth and expansion of no economic sector is cost-effective. It causes a waste of capital at the national level, with the natural consequence of failing to achieve economic growth and development. The speed and quality of achieving this goal depends on the amount of investment and the economic sectors in which the investment is made. Certainly, the correct identification of the capable and efficient sectors that have priority helps to attain the goal. In fact, the first step to optimal resource allocation is to identify the key and prioritized sectors.

However, identifying key sectors is not easy. Is a key sector the one with the highest output or the one that creates the most exports or employment? It is quite clear that the choice of a measurement criterion greatly affects the results. Different sectors become 'key' ones under different assumptions and for different purposes. In the development literature, one of the criteria for selecting the priority sectors for investment is the amount of backward forward linkage of economic sectors. These sectors, as key sectors, should be prioritized in economic development programs due to their deep impact on the economy. Therefore, based on this point of view, the sectors that have high backward and forward links are known as key sectors of the economy, and in fact, the concentration of investment in key sectors provides the possibility of creating more incentives for faster growth of production, income and employment (Opera jouneghani & Nasrollahi, 1400).

In fact, what should be considered is that identifying key economic sectors is not a static process but a dynamic one. This is because, in addition to resource scarcity, which is always a challenge for societies, there is a change of priorities for various reasons. The over-exploitation of the environmental resources as a result of competition in production and consumption has caused a wide range of environmental problems. The increasing importance of environmental issues arising from economic activities has recently led to the expansion of traditional methods to calculate links by using the parameters of the environment and natural resources (Lenzen, 2003). One of the environmental parameters is water resources.

A review of the literature shows that most of the studies in the field have only used one or two criteria to prioritize economic activities. Also, as far as the authors of this study know, the research ever done in Iran has ignored the sustainable development criteria. The innovation of the present study is the use of sustainable development criteria to prioritize economic activities.

Based on the foregoing and due to the severe shortage of water resources in Isfahan Province, ignoring the limitations of these resources in the development plans and investment priorities of the province can lead to decisions that are not in line with the goals of sustainable development in the region. Considering the dimensions of sustainable development, this study consists of the three categories of economic, social and environmental criteria, as depicted in **Figure 1**.

These criteria have been evaluated based on their importance. For example, considering the place of water in the 17 goals of sustainable development, which consider water as the heart of sustainable development, it is necessary to consider the water criterion.

Regarding the criteria of energy consumption and pollution, since the increasing dependence on energy has caused the interaction of this sector with other economic sectors and has made the speed of economic growth and development dependent on the level of energy consumption, and as a result of that and their consumption, the emission of greenhouse gases and pollution Increased, it is important to consider these indicators. On the other hand, since employment is one of the most important issues that must be considered as the first condition to achieve growth and development, then it is important to examine it. Also, the economic criteria of comparative advantage and inter-sectoral linkages as growth drivers in every region are important.

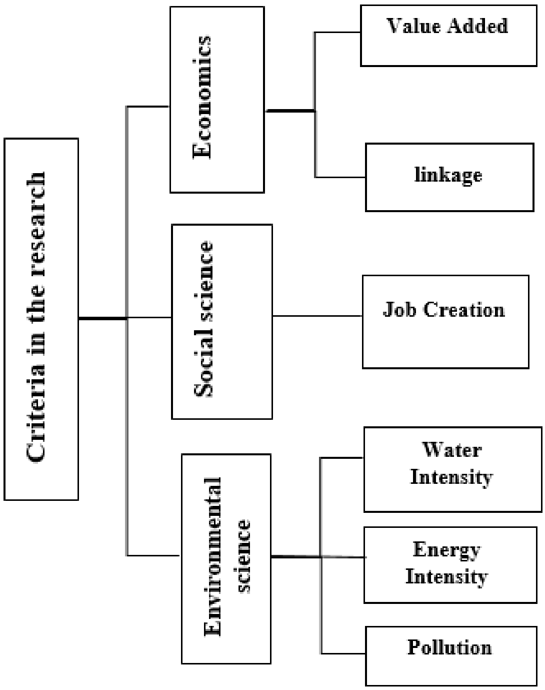

Figure 1. Criteria studied in the research based on the dimensions of sustainable development

3- Literature review

A review of previous studies in the field of prioritization of economic activities indicates that most of these studies have determined the priorities according to the theory of unbalanced growth and based on financial constraints (Nasrollahi & Zarei, 2017). In the continuation of this research, a review is presented of some internal and external studies conducted in the field of prioritizing economic activities according to sustainable development indicators.

With an emphasis on the theory of unbalanced growth and by considering environmental pollution, Jahangard (2015) used the input-output table of 14 sectors in 2006 to prioritize the economic activities in Iran. The researcher first identified the key sectors of the Iranian economy according to the concept of backward and forward linkages and then calculated the backward and forward linkages of the environment by measuring the amount of pollutants emitted from the consumption of fossil fuels. Next, using a multi-criteria decision-making model, the backward and forward linkages of the economic activities were maximized and the environmental links were minimized. On this basis, the high-priority sectors were identified. The results showed that the "textiles", "clothing and leather", "oil refineries" and "other industries" sectors had the highest priority for investment. Also, considering the environmental pollution, the results of prioritization were different from the findings of traditional methods, which only consider inter-sector linkages.

Nasrollahi and Zarei (2017) integrated an input-output model to the analytic hierarchy process (AHP) to prioritize the industrial activities in Yazd Province. They did it with an approach to sustainable development and an emphasis on the importance of water resources. The prioritization was conducted with five criteria including water use, employment, inter-sector linkages, pollution and value added. According to the results, the sector of manufacturing electrical equipment and office machinery had a higher priority for investment than the other sectors.

Guo et al. (2018) used the input-output model and the demand elasticity approach to define the key sectors driving the energy consumption and CO_2 emissions in China. The results indicated that the key economic sectors consuming substantial fossil energy and emitting tremendous amounts of CO_2 were the manufactures of basic chemicals, building constructors, wholesale and retail trades, road transportation and real estate.

In their study, Teymouri et al. (2018) prioritized the investment in economic sectors with the aim of minimizing the emission of carbon dioxide and maximum the economic growth. For this purpose, they used the social accounting matrix of 2011 and calculated the direct and indirect carbon dioxide emitted from the production processes in the economic sectors and the production multiplier. Also, by normalizing these indicators and combining their indices, they determined the priorities for investment. The results showed that, in terms of the combined index, the sectors of food production, agriculture, construction and metal products had the highest production multiplier and the lowest amount of carbon dioxide emissions.

Alvandizadeh et al. (2019) identified investment bottlenecks and priorities in Sistan and Baluchestan Province. The numerical taxonomy and the Topsis model served to compare and rank those investment priorities. The numerical taxonomy was applied to 25 indicators of investment. Fishing, education and real estate sectors were found to be of the highest investment priorities, and hotels and restaurants had the next rank. The negative indices were eliminated, and the other 21 indicators had different weights according to their special status in the province and the theoretical foundations of investment. As the Topsis model suggested, fishing, real estate and agricultural sectors were of a higher investment priority than hotels and restaurants

Solangi et al. (2019) used the Analytic Hierarchy Process (AHP) and the fuzzy technique to evaluate the energy strategies for sustainable energy planning. It emerged that providing low-cost and sustainable electricity to residential, commercial and industrial sectors (WO5) was a highly prioritized energy strategy. In contrast, the use of coal resources to generate electricity (WO2) was prioritized as the least favored energy strategy.

Rahimdel and Nofarasti (2020) emphasized the importance of mines in economic growth and the high added value of this sector in investment. As they stated, it would be impossible to create a proper strategic vision and determine investment preferences in this vital economic sector without considering internal constraints such as water and energy resources. The present study aims to investigate the preferences of investment in Iranian minerals. To this end, hybrid models (MADM) are used, and energy consumption efficiency, water consumption efficiency and labor productivity are considered as the main decision criteria. The combined fuzzy-DEMATEL-TOPSIS and fuzzy-DEMATEL-PROMETHEE methods are also used to investigate the comparative advantages in the exploitation of the mineral resources in Iran. According to the results of this study, water efficiency and the value added of production are the most important in prioritizing the mineral resources of the country. Moreover, gold, coal, copper, iron, kaolin, refractory clay, lead and zinc minerals are found to be of priority in succession

Pavlović et al. (2021) used FAHP[1] to assess the potential of renewable energy sources in the Serbian electricity sector. The weights were estimated according to the values of the energy indicators and expert judgments. It was shown that hydropower and biomass have the highest potentials among the available renewable energy sources.

In the review of the studies conducted in this field, it is clear that most of the studies have investigated the aspect of pollution and energy consumption of economic sectors and only one or two criteria are investigated, but in the current research, in addition to the pollution criterion, five other criteria of water and energy consumption, intensity of inter-sectoral communication, job creation and value added have also been investigated. On the other hand, in the studies conducted in this field, the issue has been investigated from the national dimension, and the regional dimension has been neglected. Therefore, according to the mentioned weaknesses, The present research has prioritized the economic activities of Isfahan province by combining the input-output approach and the TOPSIS method and by considering the six criteria of water consumption, energy consumption, pollution, intensity of inter-sectoral communication, job creation and added value, and emphasizing the importance of water resources.

4- Methodology

Therefore, the present study prioritizes the economic activities in the province of Isfahan by combining an input-output model and the TOPSIS method as well as considering the six criteria of water abstraction, energy consumption, pollution, intensity of inter-sectoral relations, job creation, and value added. **Figure 2** shows the research process.

[1] Fuzzy Analytical Hierarchy Process

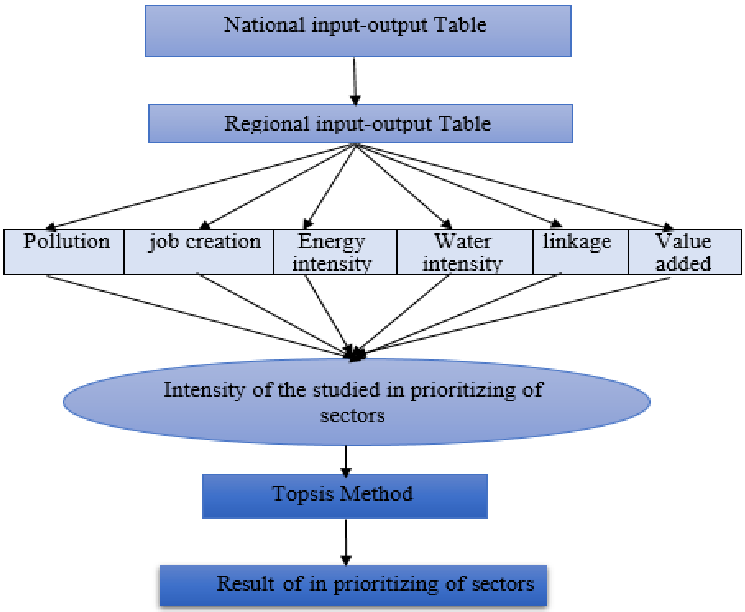

Figure 2. The general structure of the article and the research process

To achieve the objectives of the research, first, the national input-output table of 2016, the Central Bank data and the SFLQ quota method were used to prepare a twenty-sector input-output table for Isfahan Province. The sectors are introduced in **Tabel 1** The advantage of preparing a regional input-output table is that it is possible to identify each region's facilities and limitations of production and economical construction by relying on them and using them in the region’s development and achieving national development with regional development (javaheri, Moradi & Fehgheh Majidi, 2023).

Tabel 1. Economic sectors in Isfahan Province
Source: Research findings

Sector	Activity number	Sector	Activity number
Manufacture of basic metals	11	Agriculture	1
Manufacture of fabricated metal products except machinery and equipment	12	Oil, natural gas and other mines	2
Manufacture of machinery and equipment not classified elsewhere	13	Food products, beverage and tobacco	3
Manufacture, repair and installation of subsidized products as well as electronic, optical and electrical equipment	14	Manufacture of textiles	4
Manufacture of motor vehicles and other means of transportation	15	Manufacture of leather apparel	5
Manufacture of furniture and n. c. e	16	Wood and its products	6
Electricity, gas and water supply	17	Manufacture of paper, paper products and printing devices	7
Construction	18	Manufacture of coke, refined oil products, nuclear fuels, and chemical materials and products	8
Transportation	19	Manufacture of rubber and plastic products	9
Other services	20	Manufacture of non-metallic mineral products	10

Then, using the internal multipliers of the province, the forward and backward linkages, direct and indirect water intensity, direct and indirect energy intensity, and direct and indirect employment of the economic sectors of the province were calculated. Shannon weighting method was also used to weight the criteria. Finally, the prioritization of the sectors in Isfahan Province was done with the TOPSIS method and the desired criteria. In the following sections, more details are provided on the methods and materials as well as the data collection in this research.

4-1- Shannon Entropy Method

Shannon entropy method served to determine the weight of each criterion in the study. This method is an alternative to using the opinions of experts, and it is advantageous in that the opinions and personal judgments of individuals are not involved in it; the weight of each criterion is determined based on a decision matrix (Dorostkar Ahmadi & Dehghani, 2020). There were a number of steps to determine the weights by Shannon entropy. First, all the decision matrices were normalized through Equation(1) and the value of E (entropy) was estimated using Equation(2).

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \forall\, i, j \quad (1)$$

$$E_j = -h \sum_{i=1}^{m} r_{ij} \times log\, r_{ij} \quad (2)$$

$$h = \frac{1}{ln(m)} \quad (3)$$

In Equation(1) and Equation(2), x_{ij}, the values studied in the research and *m* and *n* represent the number of the sectors and indicators studied in the research.

Next, the weight vector was calculated, and the weight of each criterion was determined using Equation.

$$W_j = \frac{(1-E_j)}{\sum_{j=1}^{n}(1-E_j)} \quad (4)$$

The results of these calculations are presented in Table (3).

4-2- Topsis Model

The TOPSIS model, as a multi-criteria decision-making method, is a simple but efficient method of prioritization. It is one of the best methods in which *m* options are evaluated by *n* methods (Fallahi et al., 2017).

This technique, which is a compensatory model based on MCDM methods, follows a mathematical logic. This logic first introduces a "positive ideal solution" and a "negative ideal solution". The positive one is a solution that increases the profit criterion and decreases the cost criterion. In other words, the negative ideal solution has the opposite value of the positive one. Then, all the examined options are compared with the best and the worst options, and the linear distance of each option from the best option and the worst option is measured. Finally, the option at the most distance from the worst option and the least distance from the best option is selected as the best or the optimal option (Khatami Firouzabadi et al., 2013).

This technique is used to prioritize the identified options and select the best option. The important advantage of this technique is the use of criteria and indicators with different measuring units, which can be positive or negative in nature and intrinsic value, in other words, negative and positive indicators can be used in a combined form in this technique (Kiani Ghaleh no, 1400). In addition, in the TOPSIS method, the weight of all options and criteria is involved in decision-making, and no weight is ignored in this method, which is another advantage of this method (Khatami Firouzabadi et al., 2013). In the current research, because the investigated criteria have different units and include both positive and negative criteria, the TOPSIS method is considered a suitable method for prioritization.

The TOPSIS method can be described as a sequence of steps as follows:

1) Calculate the normalized decision matrix. This regards the formation of a decision matrix with a number of criteria and options. The criteria are placed in the columns and the options in the rows of the matrix.

(5) $$N_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}{}^2}}$$

2) Calculate the weighted normalized decision matrix. The weighted normalized value V_{ij} is calculated with Equation(5) where W_j is the weight of j criteria, and $\sum_{j=1}^{n} w_j$=1.

(6) $$V_{ij} = W_j N_{ij}{}_{\ldots\ldots\ldots i=1,\ldots\ldots,m,j=1,\ldots\ldots,n}$$

3) Determine the positive ideal and negative ideal responses:

(7) $$A^{+} = \{(V_1{}^{+}, V_2{}^{+}, \ldots\ldots, V_n{}^{+})\} = \left\{\left(max_{V_{ij}} \middle| i \in O\right), \left(min_{V_{ij}} \middle| i \in I\right)\right\}$$

$$A^{-} = \{(V_1{}^{-}, V_2{}^{-}, \ldots\ldots, V_n{}^{-})\} = \left\{\left(min_{V_{ij}} \middle| i \in O\right), \left(max_{V_{ij}} \middle| i \in I\right)\right\}$$

Thus, the best response (A^+) is selected as the option that contains the highest values of the criteria, and the worst response (A^-) contains the smallest values. In Equation(6), O corresponds to the utility criteria, and I corresponds to the cost criteria.

4) Calculate the Separator Dimensions: Using the Euclidean criterion, the distance of each point from the ideal response (positive and negative) is estimated through Equation(7):

(8) $$d_i^{+} = \left[\sum_{j=1}^{n}\left(V_{ij} - V_j^{+}\right)^2\right]^{1/2} i = 1, \ldots\ldots, m$$

(The distance of option i from the positive ideal)

(9) $$d_i^{-} = \left[\sum_{j=1}^{n}\left(V_{ij} - V_j^{-}\right)^2\right]^{1/2}, i = 1, \ldots\ldots, m$$

(The distance of option i from the negative ideal)

5) Calculate the relative proximity to the ideal response. The relative proximity of option A_i to A^+ is as Equation(8). There is also $R_i \in$ [0 to 1].

(10) $$R_i = \frac{d_i^{-}}{d_i^{-} + d_i^{+}}, i = 1, \ldots\ldots, m$$

6) Rank the priorities. Using R_i, the options can be ranked in a descending order. In other words, any option with a larger R_i has a higher priority (Moazzami Gudarzi et al., 2014).

5- The Data and Their Collection

The data of this research were of a library type and included the statistics of the economic sectors in Isfahan Province. They were analyzed in terms of six criteria. In order to match the data with the input-output table of the Central Bank in 2016, the statistics of that year was used. The method of collecting and calculating the data of each criterion is explained below.

5-1- Water Intensity and Energy Intensity

This research provides a more realistic picture of the water intensity of the sections by calculating the direct uses and the amount of the indirect water intensity. The direct water intensity of each activity was calculated as the quantity of the consumed water was divided by its output (Equation(9)). Then, the total water intensity (direct and indirect) for each activity was calculated with the input-output table of the province and Equation (10) (Zhao et al., 2009) as follows:

$$w_j^d = \frac{w_j}{x_j} \qquad (11)$$

$$w_j^t = \sum_{i=1}^{n} w_i^d l_{ij} \qquad (12)$$

where w_j ، x_j ، w_j^d w_j^t and n represent the amount of water consumption, output, direct water, the total water of each section j and the number of the sections in the input-output table of the province, respectively. The same procedure was used to estimate the amount of energy consumption.

The data on the water consumption in non-industrial sectors, including "agriculture", "services" and "mining", were obtained from the Jihad Agricultural Organization of the province, the Water and Sewerage Company of the province, and the reports from the Statistics Center of Iran. Also, water consumption in the two sections of "building" and "water, electricity, gas" was estimated by the adjustment of the national data to the output, assuming the same water productivity (ratio of output to water consumption) at the national and provincial levels. In the case of the industrial sectors, a share of water was allocated to each sector with the assumption that the consumption of each industrial sector in the province was the same as that in the whole country (announced by the Planning Deputy of the Ministry of Industry, Mines and Trade).

Regarding the amount of energy consumption in these sectors, the statistics on the consumption of five energy carriers including diesel, natural gas, gasoline, kerosene and liquefied gas were extracted for various economic activities at the national level and on the basis of the hydrocarbon balance in 2016. Moreover, to calculate the amount of energy consumed by the economic activities of the province, the national data were adjusted to the output. After the data collection, due to the existence of different units in each energy carrier, the units in the energy consumption sector were unified in terms of MMBTU. At this stage, the energy consumption of each sector was multiplied by the values in **Tabel 2** so as to obtain the amount of the energy consumption in each sector in terms of MMBTU.

Tabel 2. Conversion coefficients of all types of energy carriers per million BTU
Source: Deputy Minister of Electricity and Energy - Office of Planning and Macroeconomics of Electricity and Energy

Liquid gas	Kerosene	Gasoline	Natural gas	Diesel
42.69	34.11	31.89	40.93	35.82

Energy is consumed in two types of industries including workshops with 10 or more employees and those with fewer than 10 employees. Energy consumption in the former was extracted directly from the corresponding census in 2016. In the latter case, since the last corresponding survey was made in 2002, the energy productivity was assumed to be constant, and then the energy consumption of those industries in 2016 was estimated at a national level. Finally, the data were adjusted with regard to the output, and the energy consumption in the province was estimated.

The results of the calculations indicated that the agriculture sector was the greatest consumers of water. Also, the sectors of manufacture non-metallic mineral products and transportation in Isfahan Province emerged to be the greatest consumers of energy.

5-2- Linkages

Linkage indices show the severity of intermediary dependencies with other sectors (Banouei et al., 2007). In the present study, a traditional method has been used to estimate the linkages. With regard to conventional input-output relationships, the basis for measuring a backward or forward linkage in the traditional method is Equation (11), where $x = [x_1, \dots \dots x_n]^t$ is the column vector of the gross output, z is the intermediary exchange matrix, $e = [1, \dots \dots, 1]^t$ is the identity matrix, $A = \lfloor a_{ij} \rfloor$ is the matrix of technical coefficients and $f = [f_1, \dots \dots . . f_n]^t$ is the final demand vector.

(13) $$x = ze + f \Rightarrow x = Ax + f$$

(14) $$a_{ij} = {}^{z_{ij}}/_{x_j}$$

Assuming that the technical coefficients are constant, the direct linkage is obtained based on the $A = \lfloor a_{ij} \rfloor$ matrix. The direct linkage index(13), called DBL, is obtained from the column of matrix A. This index indicates how much activity J should increase its purchase from the supply sectors if it wants to increase its outdated unit.

(15) $$DBL_j = \sum_{i=1}^{n} \frac{x_{ij}}{x_j} = \sum_i^n a_{ij}$$

Next, the Leontief inverse matrix is used to estimate the direct and indirect backward linkage indices. The sum of the column for each sector shows how much the output of that sector will increase directly and indirectly in the whole economy. It is calculated in terms of a one-unit increase in the final demand of sector j. This linkage index is obtained using Equation(14).

(16) $$DIBL_j = \sum_i^n l_{ij}$$

(17) $$L = (I - A)^{-1} \quad , \; L = [l_{ij}]$$

The Gosh supply-oriented matrix is used to estimate the forward linkage index. Its production level is formulated as Equation(16):

(18) $$x' = \acute{e}z + \acute{v} \Rightarrow \acute{x} = \acute{x}B + \acute{v}$$

where $\acute{x}$ is the row vector of GDP, B is the output matrix, and $\acute{v}$ is the line vector of the production factors. Assuming that the output coefficients are constant, the above relation can be turned into Equation(17).

(19) $$\acute{x} = \acute{v}(1 - B)^{-1}$$

The parameter $G = (1 - B)^{-1}$ is called the inverse Gosh matrix. Similarly, DFL and DIFL, which represent the direct backward linkage and the direct and indirect backward linkages, are obtained from the sum of the rows in matrices $B = [b_{ij}]$ and $G = [g_{ij}]$. The normalized forms of the backward and forward linkage indices, which are used to identify the key sectors and activities in the economies of countries, are introduced in Equations(18) and (19).

(20) $$DIBL_j^n = \frac{\frac{1}{n}\sum_{i=1}^{n} l_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}}$$

normalized direct and indirect forward linkage

(21) $$DIFL_i^n = \frac{\frac{1}{n}\sum_{j=1}^{n} l_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}}$$

normalized direct and indirect backward linkage

The existence of normalized backward and forward linkages greater than one for a sector means that the average performance of that sector is greater than the average performance of the economy as a whole. In other words, sectors with $DIBL^n$ and $DIFL^n$ greater than one are considered as key sectors. Therefore, in this study, the three sectors of "manufacture of rubber and plastic products", "manufacture of fabricated metal products except machinery and equipment" and "transportation" were found to be the key sectors of Isfahan Province.

5-3- Job Creation

In order to provide a more realistic picture of job creation, in addition to direct employment, indirect employment was also calculated through the internal input-output table of the province. To this end, Equation (22(was used as follows:

(22) $$L_j = \sum_{i=1}^{n} e_i l_{ij}$$

where e_i and L_i represent direct employment and the total of each sector, respectively. The data about the employment in the industrial sectors were based on the census on industrial workshops and the adjustment of national to provincial data. The data related to the other sectors were also obtained from the census of the labor force taken by the Statistics Center of Iran. As the calculations indicated, among the activities in Isfahan Province, agriculture, construction, transportation and other services were found to have the highest total employment.

5-4- Pollution

Ever since the industrial revolution, the intense need for energy has led to the excessive use of fossil fuels. The exploitation and easy access to fossil fuels compared to other energies has caused these fuels to be considered relatively cheap and economical, but considering the external consequences of fossil fuels, these types of energies can no longer be considered as the best option (Faraji Dizaji & et.al, 2023). since the increase in energy consumption in the world leads to the increasing emission of greenhouse gases, especially CO_2 due to the counsumtion of fossil fules. Considering the destructive effects of carbon dioxide (CO_2) as the most abundant greenhouse gas (Bazazan and Pourbagher, 2013) on the environment and climate change, the criterion for the pollution of economic sectors in this study is the amount of carbon dioxide emission. Thus, after the consumption of energy carriers was calculated with the emission coefficients recommended by the International Committee on Climate Change (IPCC), the amount of CO_2 emission was estimated in all the sectors. The results showed that the sectors of "manufacture of coke, refined oil products, nuclear fuels, and chemical materials and products", "manufacture of non-metallic mineral products" and "manufacture of basic metals" were the most polluting ones.

5-5- Value Added

The comparative advantage index of the value added was calculated with the ratio of the value added of each sector to the total value added of the province compared to the corresponding ratio in the country. This was done through the following equation as also used by Jafari Samimi (2012):

(23) $$VARCA_i = \frac{\frac{RVA_i}{TRVA}}{\frac{NVA_i}{TNVA}}$$

where $VARCA_i$ is the obvious comparative advantage of the value added in industry i, RVA_i is the value added of sector i in the province, $TRVA$ is the total value added (GDP) of the province, NVA_i is the value added of sector i in the country, and $TNVA$ is the total value added of the country. According to this criterion, the sectors with a comparative advantage were of a higher priority for investment. The results showed that Isfahan Province has a significant comparative advantage in the activities of "making basic metals" and " manufacture of textiles."

6- Findings

In the present study, first, the national input-output table of 2016 issued by the Central Bank of Iran, the regional accounts of Isfahan Province, and the generalized spatial quota method of SFLQ were used to provide the input-output table of the province. Then, using the TOPSIS method, the economic activities of Isfahan Province were prioritized. After the calculation and normalization of all the quantitative criteria in different parts of the province, they were weighted, and the final results were evaluated. For this purpose, first, a national table was prepared with twenty sections compiled together in accordance with the production structure of Isfahan Province and its water consumption data. Then, the normalized values of the studied criteria were examined (**Tabel 3**). These values were, in fact, the relative weights of the options based on each criterion. Based on the results of **Tabel 3**, in the case of considering the water intensity criterion, the highest weight is related to this criterion, and if the water intensity criterion is ignored, the pollution criterion is given priority.

Tabel 3. Shannon entropy output results
Source: Research findings

Job creation	Linkage	Value added	Pollution	Energy intensity	Water intensity	Intensity type
0/001	0/059	0/189	0.210	0.110	0.428	Weights considering the water intensity criterion
6	5	3	2	4	1	Ranking

0/003	0/104	0/331	0/368	0/192	-	Weights without considering the water intensity criterion
5	4	2	1	3	-	Rank

To show the importance of the simultaneous consideration of different criteria, the results of the study were prioritized once with the water intensity criterion and once without it. This was done with regard to the significance of water resources.

According to the results of the TOPSIS method, taking into account the criteria of water intensity, respectively, "construction", "Other Services" and "Water, Electricity and Gas" sectors have the least distance from the best option, and in the same way, the "construction" sectors, " Other services" and "Clothing manufacturing, processing and dyeing of fur, tanning and polishing of leather and other leather products" are the farthest away from the worst option. Based on the final weight index, the "Construction" and "Other Services" and "Water, Electricity and Gas" sectors are in first to third priority respectively. In examining the results of the calculations without taking into account the waterintensity criterion, which shows more different results, respectively, the "construction", "agriculture" and "other services" sectors have the least distance from the best option, and in the same way, the "agriculture" sectors, "Construction" and "other services" are farthest from the worst option. According to the final weight index, the sectors "construction", "agriculture" and other services" are in the first to third priority respectively.
The results are compared in **Tabel 4** As it can be seen, the values obtained based on the water intensity criterion are different from those obtained without this criterion. Indeed, this method yielded a different set of priorities for most of the sectors. This change of priority was very noticeable in some sectors.

For example, in the prioritization of the sectors according to the water intensity criterion, the agriculture sector was in the twentieth place, while this rank was the second in the prioritization without considering that criterion. Also, in the sector of "manufacture of leather apparel", this criterion was downgraded from the ninth to the thirteenth rank considering the water intensity criterion. Similarly, the sectors of "manufacture of textiles" and "manufacture of rubber and plastic products" were ranked 7th and 9th, respectively, while the ranks of these sectors without considering the water intensity criterion were fifteen and twelve. In the meantime, the priorities for the sectors of "wood and products of wood", "manufacture of machinery and equipment not classified elsewhere" and "construction" remained constant.

As it can be seen in **Tabel 4,** with the elimination of the water intensity criterion, the priority of the sectors with higher water intensity, such as "agriculture" or "manufacture of leather apparel", was shifted to lower categories. This means that ignoring the water supply criterion in prioritizing the economic activities of the province, can put pressure on the limited water resources in the long run and jeopardize the future development of the province although it may provide economic benefits in the short run.

Tabel 4. Comparison of the research results gained with and without the water intensity criterion

Source: Research findings

Sector[2]	Prioritization by considering the water intensity criterion				Prioritization without considering the water intensity criterion			
	Distance from the positive ideal	Distance from the negative ideal	Final weight	Rank	Distance from the positive ideal	Distance from the negative ideal	Final weight	Rank
1	0/428	0/237	0/356	20	0/058	0/414	0/876	2
2	0/104	0/470	0/817	5	0/183	0/355	0/660	6
3	0/110	0/460	0/806	15	0/191	0/345	0/643	14
4	0/108	0/469	0/812	7	0/189	0/339	0/642	15
5	0/111	0/476	0/810	13	0/195	0/367	0/653	9
6	0/110	0/473	0/810	11	0/193	0/359	0/649	11
7	0/113	0/458	0/801	16	0/198	0/327	0/623	17
8	0/127	0/452	0/780	18	0/222	0/269	0/547	19
9	0/109	0/472	0/811	9	0/192	0/355	0/649	12
10	0/223	0/429	0/657	19	0/390	0/098	0/200	20
11	0/119	0/457	0/792	17	0/209	0/285	0/576	18
12	0/111	0/471	0/808	14	0/195	0/348	0/640	16
13	0/109	0/470	0/811	8	0/190	0/359	0/653	8

[2] Each number refers to the corresponding sector in **Tabel 1**

14	0/107	0/474	0/814	6	0/188	0/359	0/655	7
15	0/110	0/474	0/810	12	0/194	0/361	0/650	10
16	0/110	0/472	0/810	10	0/192	0/355	0/648	13
17	0/089	0/471	0/840	3	0/156	0/362	0/698	4
18	0/032	0/483	0/936	1	0/057	0/404	0/876	1
19	0/096	0/472	0/830	4	0/168	0/369	0/686	5
20	0/059	0/476	0/889	2	0/103	0/379	0/785	3

7- Discussion

Based on the results of the present research, in the case of considering the water intensity criterion, the most weight is related to this criterion, and if the water intensity criterion is ignored, the pollution criterion is given priority. According to the results of the TOPSIS method, taking into account the criteria of water intensity, respectively, "Building", "Other Services" and "Water, Electricity and Gas" sectors have the least distance from the best option, and in the same way, the "Building" sectors, " Other services" and "Clothing manufacturing, processing and dyeing of fur, tanning and polishing of leather and other leather products" are the farthest away from the worst option. Based on the final weight index, the "Construction" and "Other Services" and "Water, Electricity and Gas" sectors are in first to third priority respectively. In examining the results of the calculations without taking into account the water intensity criterion, which shows more different results, respectively, the "construction", "agriculture" and "other services" sectors have the least distance from the best option, and in the same way, the "agriculture" sectors, "Building" and "other services" are farthest from the worst option. According to the final weight index, the "construction", "agriculture" and other services" sectors are in the first to third priority respectively. Finally, the results of prioritizing economic sectors show that in the prioritization of the sectors according to the water intensity criterion, the agriculture sector was in the twentieth place, while this rank was the second in the prioritization without considering that criterion. Also, in the sector of "manufacture of leather apparel", this criterion was downgraded from the ninth to the thirteenth rank considering the water intensity criterion. Similarly, the sectors of "manufacture of textiles" and "manufacture of rubber and plastic products" were ranked 7th and 9th, respectively, while the ranks of these sectors without considering the water intensity criterion were fifteen and twelve. In the meantime, the priorities for the sectors of "wood and products of wood", "manufacture of machinery and equipment not classified elsewhere" and "construction" remained constant.

8- Conclusion

Due to the climate change and global warming, water resources are declining. Water resources have become so important that they affect that the strategic policies and international relations of many countries. So far, a considerable bulk of research has been done in this field to manage and control water resources and ensure their optimal use. Therefore, in the process of sustainable development, it seems necessary to choose a systematic method based on an optimal combination of different criteria. In line with it, this study was conducted to determine the priority of economic sectors in Isfahan Province.

For this purpose, input-output data models and the TOPSIS method were combined, and the corresponding criteria were set to be water intensity, energy intensity, pollution, job creation, intensity of inter-sectoral relationships and value added. Among them, water intensity seems to be an important criterion considering the role of water resources in sustainable development and the severe shortage of these resources in Isfahan Province. In this study, the TOPSIS method served to prioritize the key economic sectors of the province.

The results of this prioritization showed the importance of ranking the sectors in terms of water intensify as a criterion. As it occurred, through the TOPSIS method, the priority of most sectors emerged to be different from the results of prioritization with no water intensity considered. The difference was very significant in some sectors. For example, in the prioritization of sectors according to the water supply criterion, the agriculture sector was in the twentieth place, while it shifted to the second rank when prioritized without that criterion considered. Similarly, for the sector of manufacture of leather apparel, the involvement of the water intensity criterion downgraded the sector from the ninth to the thirteenth rank.

Conversely, the sectors of "making textiles" and "making rubber and plastic products" were prioritized with the criterion of water intensity, and they ranked seventh and ninth, respectively. Without this criterion, however, these sectors were prioritized and gained the fifteenth and twelfth ranks. Thus, the change in the rank of a sector depends on the water level of that sector. As it was found, the agriculture sector was in the second place in the prioritization without considering the water supply criterion, while the rank of this sector moved to twenty with the inclusion of the water supply criterion. This role of water intensity suggests the importance of paying attention to the water level. Therefore, it is necessary to prioritize the economic sectors in a region in accordance with the climatic conditions there. It is also advisable not to establish water-demanding activities such as steel industries and cultivation of highly water-consuming products in low-water areas.

Finally, considering that development plans should be in line with the ecosystem and environmental conditions, the following recommendations are in order:

a. Based on the studies of water consumption, the agriculture sector is the largest consumer of water. Therefore, considering the arid and semi-arid climatic conditions in Isfahan Province and the shortage of water there, it is very important to preserve the water resources in the region. The improper management of water resources and the problem of water shortage in the region may lead to food insecurity. Therefore, it is necessary to increase the productivity and improve the production methods in the agriculture sector.

b. Apart from modifying the production methods, employing modern technology directly leads to the reduction of water wastage in the agriculture sector and indirectly to the reduction of water consumption in agriculture-related industries.

c. To prioritize economic sectors at the national and regional levels, economic factors and cross-sectoral links as well as social and environmental aspects should also be taken into consideration.

d. To make development plans and upstream documents, the limitation of water resources should be taken into account, and the allocation of these resources to economic sectors should be done in line with the goals of sustainable development.

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