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Research Article

The Effects of Delegating the Management of Sistan's Irrigation Network to Private Sector Operators and Government Agencies

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Abstract
The current research was an attempt to investigate the use and maintenance of Sistan's irrigation network from the point of view of local experts and farmers. Gray system theory was used to find the appropriate operation and maintenance model for irrigation networks. The results indicate the positive effect of delegating network management on increasing employment, reducing rural migration, increasing the productivity of agricultural products, increasing farmers' confidence in providing food and income, proper distribution of water, increasing the use of irrigation networks, reducing wastage of water resources, increasing the sense of responsibility and confidence of the irrigation network systems was under the management/protection of the farmers. Also, the results showed that the most basic adverse consequences include lack of trust in carrying out responsibilities, lack of understanding and cooperation of water users, differences of opinion among farmers in water distribution, insufficient attention to training and development, lack of experience, lack of optimal use of resources and It was attention. Among the economic issues faced by water users, we can mention the lack of understanding and cooperation of the users. Since neither the main farmers nor the established cooperatives have enough knowledge about their obligations in the field of management, operation and maintenance of irrigation networks and taking necessary measures, the best possible solution is comprehensive training of farmers. Progress in this area depends on delegating the irrigation network management to proper alternatives.
Keywords: Participatory management, Appropriate Model, Grey system theory, Real awareness, Legal protection

Introduction

Poor performance of irrigation networks arising from improper management and operation of irrigation canal structures has drawn the attention of managers to improve the operational management of these structures. The regulation of in-line reservoirs can significantly improve the performance of the operational management of irrigation systems (Monem et al., 2018). The history

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of inter-basin water transfer schemes in the world is replete with disastrous ramifications, including rapid and unbalanced population growth in destination basins, drying and/or sharp declines in the river flow rates in springs and groundwater tables, the destruction of swamps and wetlands, the occurrence of irreversible environmental disasters in the origin regions and their huge costs, the emergence of social problems, and the displacement of basin residents and their pathways (Arab et al., 2018).

The Sistan Plain covers an area of about 255,000 hectares in the Sistan River delta in the southeast of Iran, with 105,000 hectares of arable land. The irrigation and drainage networks of this plain consist of the modern Chahnimeh (reservoirs) network, modern Miankangi network, and traditional irrigation networks. The region has 250,000 hectares of fertile land, over 50% of which has been allocated to agricultural and horticultural activities. Relying on its agricultural and horticultural potentials, the plain accounts for 75% of the grains, 81% of summer crops, and over 70% of grape production of Sistan and Baluchestan province and is one of the high-potential regions for oilseed production.

A key problem in the region is inadequate water for crop irrigation and other applications. The main problem is how to manage the resources to make a balance between water demand and supply. Since water supply is always limited, but demand continuously grows with population growth and lifestyle improvement, it is crucial to develop plans for the appropriate operation of water resources. To date, the traditional solution to coping with water scarcity in Iran has been increasing water supply through investment in the development of water resources. However, since such investments have not been successful in crop production, demand management has recently been regarded as a wise approach to realizing sustainable water consumption. Given the recent 20-year droughts, there is no alternative but to use solutions to enhance water consumption management in this sector and region. Considering the effective participation of farmers in the water use system of the agricultural sector, a mechanism to improve water use management in the region was to implement water transfer schemes in the Sistan region by piping and using water-pumping systems, as one of the biggest water transfer projects in Iran. After it was completed, the scheme covered 17 regions in the Sistan Plain, serving 46,000 hectares of arable lands. The water resources supplying the water in this scheme include the Chahnimeh reservoirs and the Helmand River (Mohammadghasemi et al., 2021).

As was already discussed, since a good way to optimize the operation of agricultural water systems in the world is to delegate their management, operation, and maintenance to the farmers, this research mainly aimed to explore how to delegate irrigation management in the water use system of the Sistan Plain.

Below is a review of experiences in Iran and other countries regarding the delegation of irrigation network management to non-governmental organizations.

Glushkova et al. (2021) modeled an irrigation system in a virtual physical space by adopting an ambient-oriented approach in which the calculus of context-aware ambients formalism was used as the basic tool for modeling agriculture processes. In addition, they briefly discussed the supporting platform whose active components were applied as smart agents known as assistants.

In a study on using smart farm irrigation for appropriate irrigation of farms (Cáceres et al., 2021) developed a predictive controller composed of a multi-layer agro-hydrological model and an economic cost function to optimize irrigation at the farm scale. The economic cost function was composed of four terms, i.e., deviation of the soil moisture from an operational point, minimization of energy costs, minimization of water costs, and a term for maintaining the potential crop evapotranspiration to guarantee the maximum yield.

In an effort to improve sustainability in a rural area (Ragkos et al., 2021) adopted four objectives of maximizing economic gain (economic sustainability) and employment (social sustainability) and minimizing agrochemical use and irrigation water consumption (environmental sustainability). The researchers sought an agreement through different cropping patterns by either restructuring existing crops (Scenario 1) or introducing new crops (Scenario 2). They reported that solutions in Scenario 2 outperform in all dimensions of sustainability, but large increases in economic performance and employment are at the expense of lower environmental gains. A cost-benefit analysis revealed that very few solutions could lead to positive net present value and the investment could be stopped if benefits relating to social and environmental sustainability were overlooked. The researchers discussed the results and proposed a new governance scheme in which broader roles would be assumed for supporting sustainable development.

Er-Rami et al. (2021) used an integrated approach with Sentinel-2 satellite images to analyze the performance of irrigation system. A good agreement was reported between the estimated and the recorded volumes on a large time scale for 10 days and a 30-day period, while the difference was large on a daily time scale. The performance was analyzed at the whole system and hydrant levels. The estimated discharge was lower than the recorded discharge, reflecting better performance. The paper makes some suggestions for performance improvement in critical zones.

Bang et al. (2019) focused on the appropriate operation of an irrigation canal network in Anseong, South Korea. They reported the runoff studied during a farming season (from April to September) for about 16 years from 2002 to 2017. Both Yongsul and Mansoo reservoir had received an average of 400 mm in inflow over the past five years, which was 10-20% less than that in the other years. So, less water had flown into the reservoirs due to low precipitation in the spring preceding the irrigation period.

Ha et al. (2019) studied the improvement of the operational performance of an irrigation canal network system for drought risk management using a hydraulic model in South Korea. They observed that the irrigation water operation and allocation were often managed non-professionally by local residents. To cope with this lack of management resources, efficient irrigation water management requires the development of improved operational methods for the irrigation canal network system.

Mukhtarov et al. (2015) used operational efficiency and financial performance indicators to assess water-user associations in a free region in India. They concluded that although associations had resorted to social pressure to motivate farmers to pay irrigation service costs, they had failed to achieve financial independence, and farmers' debt on water fees was significant.

Parhizkari et al. (2015) argue that successful and unsuccessful experiences in Iran have taught us lessons that can be useful in developing an integrated approach tailored to the intricacies of operation, maintenance, and management problems of the irrigation networks in this country. The instrumental use of public participation in fulfilling some network management tasks is not consistent with the features of success in irrigation management decentralization. This problem will be resolved if the government sector shifts its attitude from instrumental use to the belief in its intrinsic development and a balance is made between delegated responsibilities and authorities.

In summary, despite the extensive use of irrigation management decentralization and cooperative irrigation management to resolve the poor performance of irrigation networks, the effectiveness of the decentralization programs has been questioned in improving irrigation, agriculture efficiency, and its management. Also, the management reform programs will be a mix of success and failure stories depending on how reforms are implemented and how prepared the society is. Reviewing the background of past research confirms that the role of the government in the management and maintenance of irrigation networks has been colorful. So that 99% of the decisions of this department are made and implemented by the government. If 97% of farmers have to implement these decisions, which do not have any point of intersection. Given the fact that the operation of agricultural water can be optimized by delegating water resource operation, maintenance, and management to farmers, the present study aimed to explore and present an appropriate model for the operation and maintenance of the irrigation networks in the Sistan Plain and shed light on the advantages, disadvantages, and the challenges of decentralizing the operation, maintenance, and management of irrigation and drainage network systems of this plain to appropriate alternatives based on the opinions of local experts and farmers.

Methodology

The study area for this research was Sistan and Baluchistan province. Sistan and Baluchistan province with an area of about 502,187 square kilometers, is located in the southeast of Iran at the geographical coordinates of 25 degrees and 3 minutes to 31 degrees and 28 minutes of north latitude and 58 degrees and 47 minutes to 63 degrees and 19 minutes of east longitude. It this vast province shares a 900-kilometer border with Pakistan and a 300-kilometer border with Afghanistan. In the southern part, it has a water border with the Oman Sea, which is approximately 270 kilometers long, and it is adjacent to Khorasan province, which is 190 kilometers long, and Kerman province, which is 580 kilometers long, and Hormozgan province, which is 165 kilometers long, in the north and northwest (Figure 1).

The study aimed to explore how to decentralize irrigation management in the Sistan Plain's water use system. Decision-making involves expressing objectives correctly, determining possible solutions, assessing their feasibility, evaluating their consequences, and finally, selecting and implementing one option. In most cases, decisions are appropriate and satisfactory when they are made based on several criteria. Criteria may be quantitative or qualitative. In multi-criteria decision-making methods that have been considered in recent decades, several criteria are used instead of a single criterion to measure appropriately (Kalantari & Ebrahimi, 2005).

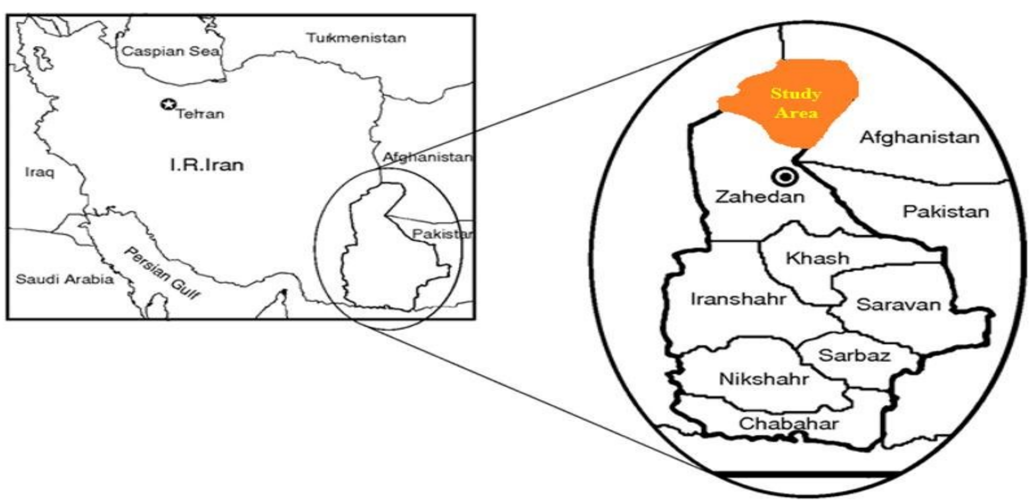

Figure 1. Location of the study area.

In multi-criteria decision-making cases, especially in multi-attribute decision-making ones, the assignment of relative weights to the existing indicators is a key and necessary phase of the problem-solving process (Balderama et al., 2007). Some weight assignment methods include the use of expert responses, LINMAP, the use of least-squares, the application of the eigenvector, and the grey system theory. The multi-criteria decision-making process is implemented based on Figure 2 (Aryal et al., 2007).

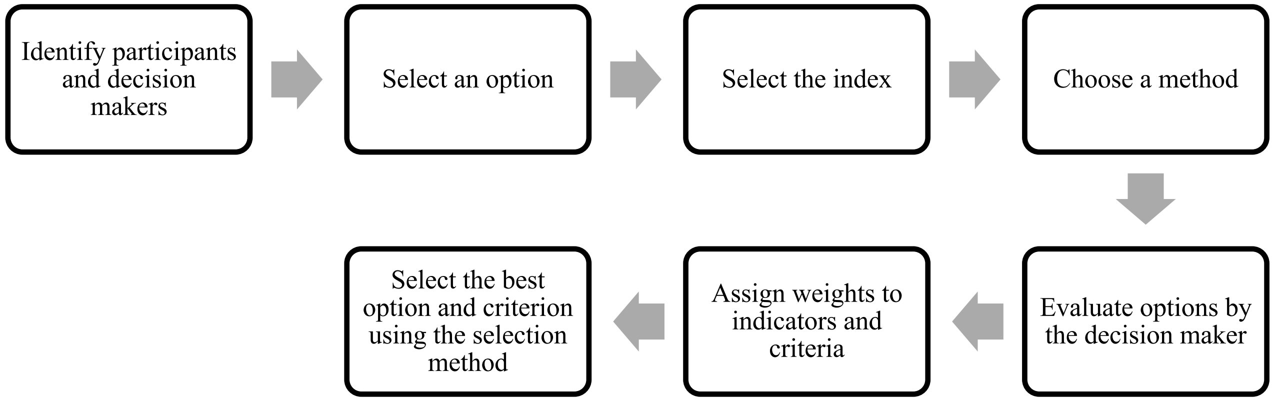

Figure 2. The steps of the multi-criteria decision-making process

This study examined the outcomes of delegating irrigation network maintenance and management in the Sistan Plain from the viewpoint of local farmers and experts to introduce an appropriate model for its operation, management, and maintenance in this plain. Therefore, the assignment process was assessed with a questionnaire that was based on the Shannon entropy technique. Due to the limited number of experts in the given subject, the census method was used to collect their opinions. The predominant approach used in this research was the questionnaire survey methodology.

The sample size was determined using Eq. (1) (Mohammadghasemi, 2021).

$$n = \frac{Nt^2 * pq}{Na^2 + t^2pq} \tag{1}$$

Where, n is the questionnaire sample size (105 questionnaires were completed in 2023 from government managers, irrigation network experts and representatives of farmers related to this network in the crop year 2017-2018), N is the total population size of the target group (46,000 farmers), a is the tolerable error value (0.53), t is the sample confidence level (1.96 at 95% confidence level), and P is the proportion of people in the community who are satisfied with agricultural services (Mohammadghasemi et al., 2012).

Researchers have traditionally used various methods, e.g., linear weight assignment, AHP, TOPSIST, fuzzy logic, and mathematical programming. Since the grey system theory method only assigns weights to the indicators and ranks them, not the alternatives, this research proposes a new method based on this theory to solve the issue of the selection of performance indicators by strategic planning criteria in which the criteria and alternatives are ranked. First, each strategic planning criterion is assigned with a weight and rank for all alternatives (indicators) through lingual variables expressed by grey figures. Then, the grey possibility degree allows for ranking the indicators and determining the key indicators. Finally, the key indicators of the strategic programs are specified to clarify and measure the model (Perelomov et al., 2006).

Steps of the grey system theory

- Step 1. Assigning weights to effective components

It is assumed that there are k decision-makers, so the component weights Q_j can be calculated by:

$$\otimes w_j = \frac{1}{k}\left[\otimes w_j^1 + \otimes w_j^2 + ... + \otimes w_j^k\right] \tag{1}$$

In which, $\otimes w_j^k (j = 1, 2, ..., n)$ represents the weight of component j for the kth decision-maker and can be expressed by the grey number $\otimes w_j^k = \left[\underline{\alpha}_j^k \bar{\alpha}_j^k\right]$.

- Step 2. The use of lingual variables (e.g., very low, low, moderate, and very high) to specify the component values

According to these variables, the component values can be estimated by:

$$\otimes G_{ij} = \frac{1}{k}\left[\otimes G_{ij}^1 + \otimes G_{ij}^2 + ... + \otimes G_{ij}^k\right] \tag{2}$$

in which $\otimes G_{ij}^k (i = 1, 2, ..., n; j = 1, 2, ..., n)$ is the value of component ij for the kth decision-maker and can be represented by the grey number $\otimes G_{ij}^k = \left[\underline{\alpha}_{ij}^k \bar{\alpha}_{ij}^k\right]$ (Li et al., 2007).

- Step 3. Building a grey decision matrix

$$D = \begin{bmatrix} \otimes G_{11} & \otimes G_{12} & \cdots & \otimes G_{1n} \\ \otimes G_{21} & \otimes G_{22} & \cdots & \otimes G_{2n} \\ . & . & \cdots & . \\ . & . & \cdots & . \\ . & . & \cdots & . \\ \otimes G_{m1} & \otimes G_{m2} & \cdots & \otimes G_{mn} \end{bmatrix} \tag{3}$$

In which, ⊗G's are the lingual variables converted into grey numbers.

- Step 4. Normalizing the grey decision matrix

$$D^* = \begin{bmatrix} \otimes G_{11}^* & \otimes G_{12}^* & \cdots & \otimes G_{1n}^* \\ \otimes G_{21}^* & \otimes G_{22}^* & \cdots & \otimes G_{2n}^* \\ . & . & \cdots & . \\ . & . & \cdots & . \\ . & . & \cdots & . \\ \otimes G_{m1}^* & \otimes G_{m2}^* & \cdots & \otimes G_{mn}^* \end{bmatrix} \tag{4}$$

In which, $\otimes G_{ij}^*$ is represented as follows for the incremental components

$$\otimes G_{ij}^* = \left[\frac{\underline{\alpha}_{ij}}{G_j^{\max}} \frac{\bar{\alpha}_{ij}}{G_j^{\max}}\right] \tag{5}$$

$$\otimes G_j^{\max} = \max_{1 \le i \le m}\left\{\bar{\alpha}_{ij}\right\}$$

$\otimes G_{ij}^*$ is represented as follows for the decremented components.

$$\otimes G_{ij}^{*} = \left[\frac{G_j^{\min}}{\bar{\alpha}_{ij}} \frac{G_j^{\min}}{\underline{\alpha}_{ij}} \right] \tag{6}$$

$$\otimes G_j^{\min} = \max_{1 \le i \le m} \left\{ \underline{\alpha}_{ij} \right\}$$

- Step 5. Building a normalized weighted decision matrix

Assuming different significance of the component, the normalized weighted matrix is represented by

$$D^{*} = \begin{bmatrix} \otimes N_{11} & \otimes N_{12} & \cdots & \otimes N_{1n} \\ \otimes N_{21} & \otimes N_{22} & \cdots & \otimes N_{2n} \\ . & . & \cdots & . \\ . & . & \cdots & . \\ . & . & \cdots & . \\ \otimes N_{m1} & \otimes N_{m2} & \cdots & \otimes N_{mn} \end{bmatrix} \tag{7}$$

in which $\otimes N_{ij} = \otimes G_{ij}^{*} \times \otimes w_j$ (Dong et al., 2006).

- Step 6. Selecting the best alternative

The best possible alternative $C = \{C_1, C_2, \ldots, C_m\}$ for m different criteria $M^{\max}\left\{\otimes G_1^{\max}, \otimes G_2^{\max}, \ldots, \otimes G_n^{\max}\right\}$ can be estimated by (Sardar Shahraki & Karim (2020):

$$M^{\max} = \left\{ \left[\max_{1\le i\le m} \underline{a}_{i1} \max_{1\le i\le m} \bar{\alpha}_{i1} \right] \left[\max_{1\le i\le m} \underline{a}_{i2} \max_{1\le i\le m} \bar{\alpha}_{i2} \right] \cdots \left[\max_{1\le i\le m} \underline{a}_{in} \max_{1\le i\le m} \bar{\alpha}_{in} \right] \right\} \tag{8}$$

- Step 7. Calculating the grey possibility degree

It is represented by Eq. (14) for different alternatives:

$$P\left\{ M_i \le M^{\max} \right\} = \frac{1}{n} \sum_{j=1}^{n} P\left\{ \otimes N_{ij} \le \otimes G_j^{\max} \right\} \tag{9}$$

- Step 8. Ranking different alternatives

The lower the grey possibility degree of an alternative, the higher its rank (Li et al., 2007).

Data

The dominant approach in this research was a survey methodology. After several meetings and interviews with the relevant officials, experts, and pioneering farmers in 2018-2019, the possible alternatives for allocating irrigation network management of the Sistan Plain were ranked as presented in Table 1.

Study site

The rural area of Sistan includes 930 villages with a total population of 270,000 people whose main job is agriculture, animal farming, and related jobs. The population resides in five counties of Zabol, Nimruz, Hamun, Zehak (Markazi and Jazink districts), and Helmand (Markazi and Qorqori districts).

Farmers' social characteristics

As presented in Table 1, the age group of 15-30 accounted for 50% of the rural population in Sistan in 2008, which reduced to 30% in 2018. The counterpart figures were 30% in 2008 and 26% in 2018 for the age group of 30-45, and 20% in 2008 and 44% in 2018 for the age group of >45 years. This statistic clearly indicates the crisis in the region because the age group of young people has decreased sharply in 2008 compared to 2018 and the age group of adults has increased. The reason for the decrease in the age composition of young people is the lack of stable jobs and sufficient income in rural areas and the reason for the increase in the age composition of adults is their inability to perform physical work and insufficient income for migration.

Table 1. Age composition of rural population per year

Age category	Absolute frequency		Relative frequency		The cumulative frequency	
	2008	2018	2008	2018	2008	2018
15-30	25	15	0.5	0.3	25	15
30-45	15	13	0.3	0.26	40	38
Above 45	10	22	0.2	0.44	50	50

Development sites

The big project of transferring water through pipes in the Sistan Plain started in 2014 to supply water to 46000 hectares of land at a very high cost. There are 16 development sites in the Sistan region for water transfer by pipelines. Table 2 presents the number of these sites in each county of the region.

Table 2. Development areas in the counties of the Sistan region

Row	City	Number of development sites
1	Hamon	4
2	Helmand	4
3	Zabol	2
4	Nimrooz	3
5	Zahak	3

Results and Discussion

In general, irrigation and drainage can be managed by three sectors: the public sector (government), the private sector, and private organizations (water supply). The third method has now become the mainstream of irrigation management because management by the public sector has been inefficient and management by the private sector is not commensurate with the current irrigation management structure, which includes a large number of small farmers. On the other hand, participatory irrigation management, which is based on irrigation and drainage management through the Water Users Organization, emphasizes that water users and reservoirs should be involved in all stages and levels of water management (Sardar Shahraki & Karim, 2020).

Proper alternatives for irrigation network management decentralization in the Sistan plain

As described in the methodology section, the research team held several meetings and interviews with the relevant officials, experts, and pioneering farmers in 2019 at different development sites in the Sistan region to rank the proper alternatives for decentralizing irrigation network management in the Sistan Plain. The results are presented in Table 3 and Figure 2.

Table 3 present the weight of proper alternatives for decentralizing irrigation network management in the Sistan Plain from the farmers' perspective by the grey system theory. Accordingly, the first priority relates to delegating the irrigation network management to the project executive for 3-5 years (EP). Agriculture Jihad Organization (AO) is in the second and cooperatives (CC) are in the third ranks.

Table 3. Priority ranking of proper alternatives to delegate irrigation network management in the Sistan Plain based on the grey system theory from the perspective of leading agricultural operators

Priority	Proper alternatives	W_j
1	Project executive for 3-5 years	0.26
2	Agriculture Jihad Organization	0.19
3	Agriculture cooperatives	0.17

As shown in Table 3, the irrigation network management should be assigned to the project executive for 3-5 years. The inconsistency between the farmers and experts in allocating the irrigation network management to cooperatives arises from the fact that the farmers are unaware of the duties of the cooperatives at the regional level. However, after the project executives, the network management can be assigned to the cooperatives with proper planning and training. and reported in a number of other studies, observed that the irrigation water operation and allocation were often managed non-professionally by local residents. To cope with this lack of management resources, efficient irrigation water management requires the development of improved operational methods for the irrigation canal network system (Ha et al., 2019; Bang et al., 2019).

Table 4 and Figure 3 present the priority ranking of various activities needed for irrigation network management assignment to the proper alternatives from the perspective of leading agricultural operators based on the grey system theory.

Based on Table 4 and Figure 2, the criteria weights from the farmers' perspective show that the top priority relates to confidence in the timely water delivery and the provision of facilities for leveling. Determining the volume of water required based on the type of cultivation (DV), creating a water storage pool (CW), maintaining equipment and facilities (ME), determining the appropriate planting pattern according to the amount of water (DA), ensuring fair water distribution (EW), and preparing a novel irrigation program (PI) are in the next ranks. and reported in a number of other studies, which timely application of water is essential to maintain potential evaporation and transpiration of the crop to ensure maximum yield (Cáceres et al., 2021)

Table 4. Priority ranking of various activities needed for irrigation network management assignment to proper alternatives from the perspective of leading agricultural operators based on the grey system theory

Priority	Activity	W_j
1	Determining the volume of water required based on the type of cultivation	0.14
2	Creating a water storage pool	0.13
3	Maintaining equipment and facilities	0.11
4	Determining the appropriate planting pattern according to the amount of water	0.10
5	Ensuring fair water distribution	0.10
6	Preparing a novel irrigation program	0.08

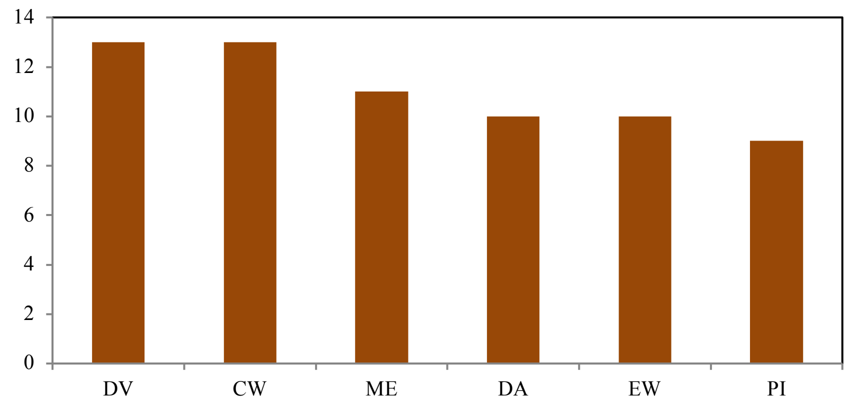

Figure 3. Priority ranking of various activities needed for network management assignment to proper alternatives from the perspective of leading agricultural operators based on the grey system theory

Ranking activities for decentralization from the experts' viewpoint based on the entropy index

Finally, Table 5 and Figure 4 show the ranking of the problems of assigning the management of irrigation network operation and maintenance based on the grey system theory.

Table 5. Ranking of the problems of assigning the management of irrigation network operation and maintenance based on the grey system theory

Priority	Activity	W_j
1	Lack of financial resources to use	0.185
2	High project implementation costs for agricultural operators	0.181
3	Uncertainty of leading agricultural operators of government programs	0.180
4	High project implementation costs for leading agricultural operators	0.169

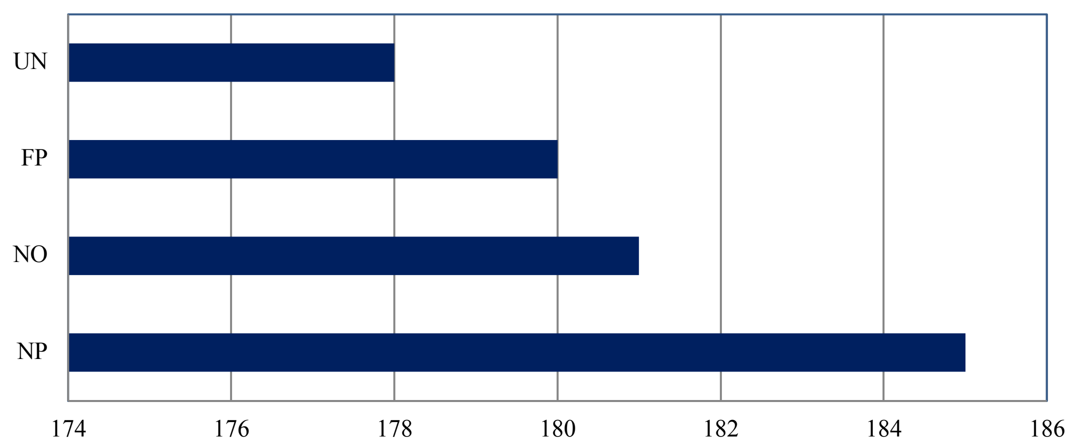

Figure 4. Ranking of the problems of assigning the management of irrigation network operation and maintenance based on the grey system theory

As shown in Table 5 and Figure 3, the lack of financial resources to use (NP), high project implementation costs for agricultural operators (EP), the uncertainty of leading agricultural operators of government programs (FP), the high project implementation costs for leading agricultural operators (UN), the lack of financial resources for irrigation network operation (NM), and the high project implementation costs for leading agricultural operators (HC) are the main problems in implementing the program of transferring the irrigation network management and maintenance to proper alternatives, especially non-governmental options and reported in a number of other studies, that although associations had resorted to social pressure to motivate farmers to pay irrigation service costs, they had failed to achieve financial independence, and farmers' debt on water fees was significant (Mukhtarov et al., 2015; Ha et al., 2019).

Conclusions

The results generally lead us to the conclusion that the farmers and experts presently believe that neither the farmers nor their cooperatives are informed enough about their duties to be delegated the responsibilities of managing and maintaining the network and performing the desired activities. If the profit of the project is maximized and if the necessary knowledge is provided for the leading farmers and experts, the priority will be to hand over the management of the irrigation networks of the Sistan Plain for 3 to 5 years. The Agricultural Jihad Organization was ranked second, and cooperatives were ranked third. The most important positive consequences of handing over the management of irrigation and drainage networks from the point of view of farmers and experts are job creation, reduced migration, the use of the irrigation network to a greater extent, and the reduction of water waste. However, its most important negative consequences from the viewpoint of the farmers and experts are the lack of confidence in the fulfillment of responsibility, lack of adequate understanding and collaboration among water users, disputes among farmers, insufficient attention to education and extension, the lack of experience, the loss of resources, the lack of care to economic problems of farmers, and the loss of legal support of the organization.

The best possible solution is to comprehensively train the advanced farmers to assign the irrigation network to proper alternatives. It should be noted that presently, neither the chief farmers nor the established cooperatives have sufficient knowledge of their duties in delegating the irrigation network maintenance and management and carrying out the desired activities.

- Training farmers about delegating irrigation network management to proper alternatives is the main approach. It should be noted that neither farmers nor cooperatives are adequately aware of their duties for managing and maintaining the irrigation networks and the relevant activities.
- Selecting motivated managers for cooperatives
- Training farmers about their water rights based on the land ownership documents. It should be noted that the farmers are not aware of how much of their owned lands have water rights, which is a source of family conflicts in the region due to the fragmentation of the lands by the heritage laws.
- Motivating farmers to cooperate by adopting policies to produce crops with high potential production and high potential income. This is possible only through contract farming and/or the support of a value change.
- Motivating farmers to cooperate in meeting the maintenance costs of the transfer networks

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