

Investigating the Role and Effectiveness of Local Water Use Association (WUAs) in Managing Water Resource

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Abstract: One of the main problems in all over the world, especially in part of agricultural development, is lack of water, drought and climate change. Iran is one of the dry and semi-arid regions of the world, in which a big problem is in now and future. This study was conducted on evaluating the role of WUAs in Iran in 2023. The necessary data was collected by questionnaire from the members and managers of WUAs. In this research, Iran's water situation was divided into red and yellow areas, in terms of rainfall indicators, water resources balance rate and other climatic indicators. Then the role and performance of WUAs in these areas have been investigated. The results showed that the problem of water management is not only a technical problem, but also includes the social, political and cultural aspects of the society. The reasons for the success and failure of WUAs in these areas were identified and ranked.

Keywords: Water Resource • Management • Water Use • Association.

INTRODUCTION

Water is one of the biggest national valuable assets that play a fundamental role in the development of country. Many experts predict that water will increase international tensions and challenges in the future, and it will play a more important role in international crises [7]. The problem of water scarcity will be trouble maker certainly in hot and dry areas in the future.

Iran is an arid and semi-arid country, and water is the limiting factor for development, especially in the agricultural sector. The most important issue in the management of water resources in Iran is to establish a balance between supply and water demand. On the one hand, the amount of water supply is always limited, on the other hand, the increase in population and improvement of standards of living increase water demand. Therefore, planning for optimal use of water

resources is very important. Agricultural sector uses more than 90 percent of the accessible water in Iran. Therefore, it is necessary to use mechanisms and methods to improve the management of water resources [3]. In recent decades in Iran, while the government has emphasized on the development of water resources, not much attention has been paid to the creation and development of irrigation networks. Studies show that in farms where irrigation networks are used, the management and maintenance of the irrigation network and the possibility of farmers' participation in its improvement have not yet been considered by government.

According to the most experts' idea, the low efficiency of irrigation in developing countries is due to the lack of real participation of users in decision-making, implementation, management and maintenance of irrigation networks. Since 2000, the participation of farmers in the implementation of irrigation networks has been taken seriously [5]. The reason for that was the inability of government organizations to organize the water sector, as well as the lack of funds for the maintenance and operation of irrigation systems. This method is based on the experience of more than 20 countries in the world to motivate and encourage users to participate in the construction of networks. Therefore, by creating new and appropriate exploitation systems, it is possible to provide the basis for farmers' cooperation and organization [1]. They should be encouraged to cooperate and collaborate with each other in order to

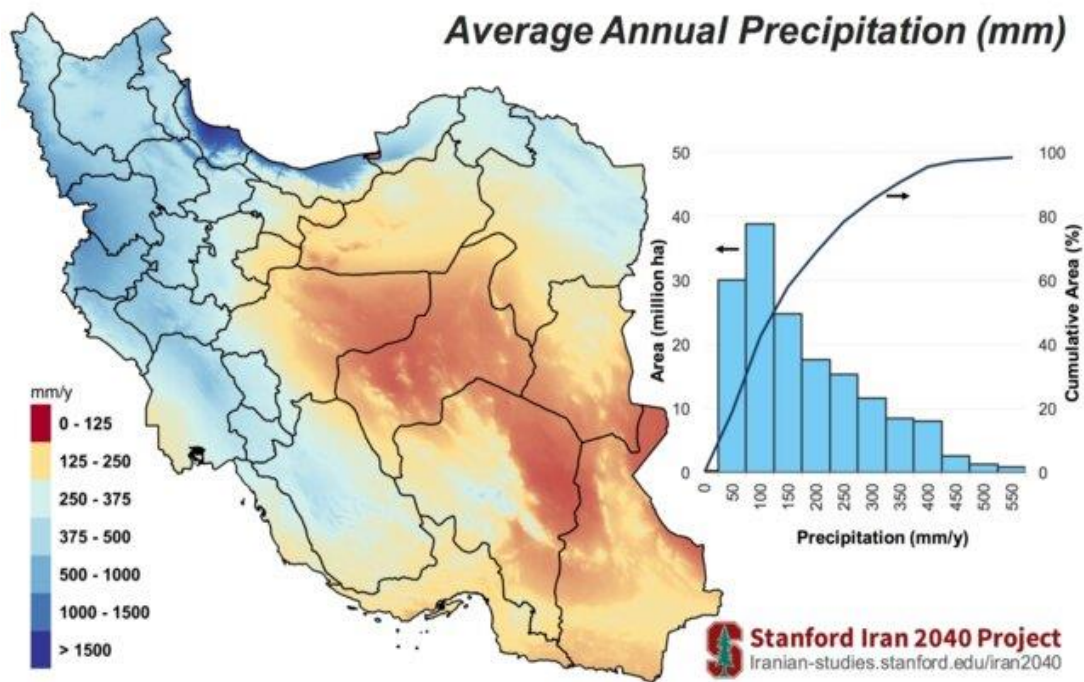
remove the obstacles to agricultural and rural development. In order to create sustainability in farm irrigation, the total water management system should be designed in such a way that all farmers are enthusiastic to participate in the efficient use of water resources. Their attitude towards water resources should be conservation and sustainability. In this regard, they should have the necessary knowledge of irrigation and drainage networks and how to use them. Since 2010, WUAs is actually a local organization that provides services and maintenance of irrigation and drainage networks in rural communities. The task of this organization is to improve the efficiency of agricultural water consumption by increasing the knowledge, attitude and skills of farmers [3, 4].

The main sources of water in Iran are rain and snow (rain is 70% and snow is 30%). The amount of rain water is about 417 billion m³. In Iran, where the amount of water evaporation is very high (72% or 299 billion m³). While the total flow of water in the irrigation network is 118 billion m³, 25 billion m³ of it penetrates the soil [8]. Therefore, the amount of water available will be only 93 billion m³. Also, 13 billion cubic meters of water comes to this country from outside the borders and it is added to the amount of water available, which unfortunately the neighboring countries have recently limited by building dams [9]. These waters come from Hirmand River from Afghanistan, Aras River from Azerbaijan and other streams from neighboring countries. The amount of drinking water in

Iran is estimated at 130 billion m³. In the natural process, 29 billion m³ of consumed water returns to underground and surface reserves. By calculating the total water balance, the amount of water obtained in Iran reaches 159 billion m³. The share of drinking water is 82% of the total water and the share of circulating water is 18% of the

total available water. The amount of water that flows from Iran to the sea or other countries is about 55.9 billion cubic meters per year [6]. Every year, 24.7 billion m³ of water flows into Iraq from the Karun River. The figure below shows the average annual rainfall in different regions of Iran [2].

Figure 1- Distribution of mean annual precipitation in Iran.



In 2000, the annual water consumption in Iran was 93.1 billion m³, of which more than 92.3% was in the agricultural sector, and the total consumption in the household and industrial sector was about 7.1%. The total water consumption in 2020 was equal to 113.2 billion m³, which shows the same consumption trend in the previous years in the agricultural, domestic and industrial sectors [10].

Table 1- water consumption in the country and the country's water supply plan (billions m³)

Consumption	1990	2000	2020
Household	5.5	6	7.8
Industry	0.9	1.1	2.4
Agriculture	81.4	86	103
SUM	87.7	93.1	113.2
Environment	-	-	5
hydroelectric energy (GWh)	6000	6500	36000

Source: Agricultural Ministry

One of the major issues and problems related to water in Iran is the unconventional extraction of underground water resources, which is usually more than the annual input to underground water reserves. Unofficial statistics indicate that there are more than 400,000 wells in the country, of which more than 130,000 are unauthorized wells that are extracting more than five billion m³ of water [5].

In 2015, the United Nations examined the water status of the countries of the world, some of the Middle East countries (11 countries) were in a water shortage situation. It is predicted in this report, Egypt, Ethiopia, Iran, Libya, Morocco, Oman and Syria will join this list by 2025 and if the current situation continues.

Table 2- Per capita water consumption in Middle East

Country	Per Capita	Agriculture	Household	Industry
Iran	1298	1233	82	18
Iraq	1482	1367	47	68
Afghanistan	779	765	14	0
Pakistan	1072	1030	21	22
Turkey	544	404	80	59
Azerbaijan	2051	1385	99	567
Saudi Arabia	705	628	69	8
Armenia	977	642	293	43
Turkmenistan	5104	4978	86	39
Kuwait	164	86	73	3

Source: FAO report 2020

Currently, per capita water consumption in Iran has reached about 1700 cubic meters, which is critical. This is despite the fact that in the past few years it was 1800 cubic meters. The reason for this is the population growth and the continuous increase in excessive water consumption in

Iran. Iran is trying to solve the problem of water shortage and quality by modernizing agricultural irrigation methods, developing water transfer projects between basins, building dams and storages to collect water and cooperating with its eastern countries through water diplomacy [2, 8].

MATERIALS AND METHODS

There are several methods for factorial analysis of correlation matrix. Two methods of principal component of analysis and common factor analysis are the most widely, used methods. The choice of each of these models depends on the research's goal. The principal component of analysis model is used when the researcher's goal is to summarize the variables and reach a limited number of factors for forecasting purposes. On the other hand, factorial analysis is used when the purpose of research is to identify factors. In the current research, these factors cannot be easily identified. Therefore, summarizing the questionnaire questions and ranking them based on frequency is used. The main purpose of factorial analysis is actually to summarize the data. In other words, the purpose of factorial analysis is to extract a few factors from a large number of overlapping variables. Factorial analysis uses are divided into two general categories [4, 1].

1- Exploratory cases: It is used to discover the pattern of variables in order to reveal new concepts and reduce data as much as possible.

2- Confirmatory factor analysis: It is used to test hypotheses about the creation of variables and determine the expected number of important factors and their factor load. In confirmatory factor analysis, a clear hypothesis is stated about the number of factors. The fit of the covariance structure of the measured variables is compared with the assumed factor structure.

In the current research, due to the large number of variables in the theoretical framework, suitable variables were identified from a wide set of variables as a confirmatory factor analysis.

According to the nature of this research, descriptive and inferential statistics were used. A questionnaire was used to collect data. In the questionnaire, questions were prepared to identify the variables related to individual characteristics, economic, social, environmental, supportive, and cooperative and field of activity variables. This questionnaire was selected regarding the importance of variables, conditions and background in previous studies. The statistical population of this study is the entire agricultural and rural sector of Iran, and the sample selection method was completely random cluster

scientific method based on Morgan's table, which were 675 samples.

RESULTS AND DISCUSSION

According to previous studies regarding to optimal agricultural water management methods, there are three main determining factors, including that: the issue of water ownership (ownership), the issue of the right to make decisions and self-determination, and the macro management of water exploitation (water governance). Collaborative water management system, organizing from the bottom to the top, and organizing the influential factors (Providers) have a main and influential role. In different countries and based on studies, different classifications of agricultural water management styles have been presented. Some studies have introduced four main styles, which include: public management method, private management, cooperative method and participatory method in agricultural water management. The fourth style, which is the desired style of this research, is the management of agricultural water resources based on water users association (WUAs). Some researchers believe that this management method is a special type of collaborative management. In this management method, the ownership, governance and effectiveness of agricultural water use is entrusted to the representative of the farmers and the decision-making group on behalf of the water beneficiaries. In other words, in this management style, interaction is established between water as a valuable asset and its real beneficiaries. In

Iran, the imbalance between water supply and demand has put water resources in a critical condition. The most important solutions of this management method are: monitoring the amount of water resources and consumption in a region, preventing arbitrary withdrawals of water resources, informing farmers and beneficiaries, reducing the responsibility of the government and leaving water management to the beneficiaries.

In this regard, WUAs units have been established and expanded in areas of Iran, which were part of the statistical population of the study. The goal of this organization is the management and optimal use of water resources, relying on the participation of all stakeholders' engagement. The establishment of WUAs increases the productivity and profitability of agricultural activities. This is a strong economic incentive for farmers to adopt it. Recently, there has been an increase in water demand due to the increasing population growth, the expansion of industries, and as a result, the increase in water demand in the household, agriculture and industry sectors, as well as the occurrence of phenomena such as drought and extreme climate changes. On the other hand, reducing the amount of healthy and accessible water causes excessive exploitation of resources, especially underground water. One of the ways to prevent arbitrary harvesting of water resources is to inform farmers and beneficiaries, reduce government ownership and transfer water management through the creation of WUAs.

Figure 2- Effective factor on WUAs development in Iran.



The figure above illustrates the factors on the development of WUAs in Iran. This information obtained from questionnaire that is 7 important factors including: participation, individual characteristics, farmer awareness, education, member satisfaction, motivation and effectiveness. These factors had the highest frequency in the answers to the questionnaire.

The increase of water demand in the agricultural sector makes it necessary to include planning for the future in order to ensure food security and reduce the water shortage crisis. In this context, water consumption optimization management

should be created in the form of integrated management and all agricultural water users should be used in this management method. In this regard, the main players in water management were considered as one of the basic strategies. The results obtained from the components of the research questionnaire were examined in terms of technical, economic, cultural and legal aspects. The prioritization of the necessity of establishing WUAs is as follows:

A. Technical requirements:

- 1- Quantitative and qualitative reduction of underground water level due to unauthorized

withdrawal of underground water resources by farmers

2- Improper use of water facilities and low irrigation efficiency

3- Salinity of agricultural land and destruction of water and soil resources

4- Improper supply and delivery of water at the required time and place

B. Cultural needs:

1- Ensuring that food security.

2- Increase in population and water consumption.

3- Transferring the culture of optimal use of agricultural water resources to the operators is weak.

4- The motivation for participation and cooperation and trust among water stakeholders is weak.

Economic needs:

1- Financial resources are limited and operation and maintenance costs are very high.

2- Extraction cost is high and water efficiency in agriculture sector is low.

3- The state of maintenance and optimal use of water infrastructure investments is not suitable;

4- The importance of the costs of production of agricultural products in the market is very important.

C. Legal requirements:

1- The executive regulations for the optimization of agricultural water consumption are promulgated in the form of a law.

2- Long-term development strategies for agricultural water resource management are formed;

3- The announcement of the Ministry of Agriculture is published regularly;

Currently, due to the formation of new WUAs and the unwillingness of farmers to participate in water management, the necessary incentives should be created for the operators. These cases can include the reconstruction of structures in use and the water network. In this research, the factors affecting the success and failure of establishing WUAs in Iran were analyzed and categorized.

1- Factors affecting the success of WUAs in Iran

-Improving the attitude of government managers towards participation, long-term planning in this field and basic attention to the role of farmers, their capabilities in decision-making and planning,

-Improving the existing structures of government-affiliated institutions, determining the duties of employees in line with participation, coordination between organizations and government-affiliated institutions have been in management transfer programs.

-In order to make organizations legal in order people, care should be taken in designing the regulations.

-All sponsors, governmental and non-governmental, should support the annual program of participation in WUAs.

-Each geographical region has culture and consumption behavior themselves. It should be planned according to behavioral cognition.

-Special attention should be paid to the role of women in participatory water programs

-Effective methods should be used in the educational programs of the participation process

-It should be mandatory to study public participation in all water development projects

-Necessity of using global experiences

2- Factors affecting the failure of WUAs in Iran

-WUAs do not have any role in the design, implementation and operation of water projects. Unless there is participation, these projects will fail.

-Instability of income of WUAs members and lack of confidence in improving the economic situation in the future.

-Absence and weakness in advertising-encouraging, educational and informing programs in public participation projects.

-Inadequacy of sociological studies and lack of justification of institutions related to water

to increase the participation and, rights of all

-Lack of legal status for WUAs in the country

-Lack of study-executive pilots

-Lack of responsible and accountable system for comprehensive and long-term water program

-Lack of necessary incentives for management sustainability based on farmers' participation

-Lack of special credit for studying, creating and organizing WUAs

-The difficulty of paying a large amount of subscription fee for farmers, especially small farmers

-Failure to provide capacity building and empowerment of beneficiaries

-The powers and responsibilities of each of the providers are not clear.

-Ignorance of WUAs managers about protective laws and financial resources to advance goals.-

The experiences of other countries in planning step-by-step and according to the capacities of society and providers in creating WUAs can be useful for relevant institutions in order to implement and carry out this important task. The experience of some countries shows that they first implemented one or more irrigation systems as a pilot and then chose the best one. These countries included: Egypt, Mexico and

Nepal. The participation of water users in irrigation management has been expressed in different ways in the countries of the world, for example, in Sri Lanka it is called participatory management, in Bangladesh it is called privatization, in Nigeria it is called commercialization, in Colombia it is called self-management, in China it is called accountability system. And in Indonesia it is called exploitation management. In Iran, it is also called water use association (WUAs) in managing water resource.

CONCLUSION

One of the main problems of third world countries, especially in the field of agricultural development, is water shortage, drought and water crisis. In Iran, which is one of the regions affected by climate change in the world, the adverse consequences of this restriction are increasing. The emergence of this problem has many political, social and economic consequences that Iran has faced and experienced in recent years. Considering these problems, researchers, planners and the government have come to the conclusion that the method of participation and creation of WUAs is the best way to manage water in Iran, which can solve many problems caused by the water crisis by handing over water-related matters to the people. In this research, while investigating the water crisis situation in different regions of Iran, in terms of rainfall indicators, underground water reservoir level and other climatic indicators, the role and performance of WUAs were also investigated and the reasons for their success and failure were identified. The survey showed that the issue

of water management is not only a technical issue, but also includes the social, political and cultural aspects of the society. In areas where WUAs have been formed, farmers' participation has increased and water crisis management has become easier. Therefore, the formation and development of cooperative organizations is recommended for all countries that are facing water problems.

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