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Original Research

Evaluation of effective strategies to improve the management and exploit of irrigation networks (Case study: Miandoab Plain)

Authors:
Ramin Shadkam, Soleiman Rasouliazar and Loghman Rashidpour

Institution:
Department of Agricultural Management,
Mahabad Branch,
Islamic Azad University,
Mahabad, Iran.

ABSTRACT:

Restriction of water resources and intensification of restrictions arising from the continued increase and the amount of demand in various sectors of agriculture has led the management of irrigation networks more important to increase the water use efficiency. The main objective of this study was to evaluate effective strategies to improve the management and exploit irrigation networks (Case study: the farmers in Miandoab Township). The statistical population in this study is farmers in Miandoab Township which were about 2581 people. Through Cochran formula the sample size was calculated as 150 people. This research was carried out by descriptive- survey method and data were ranked, analyzed and identified. The results showed that from the viewpoint of farmers, the use of reliable local people in cooperatives related to irrigation networks has many advantages. From the perspective of farmers to improve the operation management of irrigation networks, the region needs to be improved in terms of irrigation canals.

Keywords:
Strategy, irrigation network, Miandoab.

Corresponding author:
Solieman Rasouliazar

Email ID:
rasouli88s@yahoo.com

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INTRODUCTION

Optimal management of irrigation and improvement of irrigation networks can lead to solve the problems. They include: reducing the problem of water shortage, supplying water during phases of plant growth, increasing crop yields and supply surplus of water and therefore optimal utilization of water resources and increase the performance and earnings (Wijesundara, 2007), increasing productivity of agricultural production, improve land productivity, increasing plant density, ensuring farmer in terms of food security and income (Balderama and Domingo, 2007), reducing migration, improving economy conditions of people, increasing crop production and economic activities, fair distribution of water and poverty reduction (Aryal and Rajouria, 2010), reducing the cost of operation and maintenance and personnel, increasing spirit of cooperation and collaboration between the farmers and the farmers and the government, increasing the sense of responsibility and ownership of farmers to use irrigation network as well as protecting it and a better distribution of water (Munoz *et al.,* 2007).

Currently, the networks of irrigation and drainage of agricultural sector is faced with two major challenges. First, the growing scarcity of agricultural water and second, irrigated agriculture with the financial burden of operation and maintenance of infrastructure which is added to its cost continuously. Therefore, participatory irrigation management is the optimal way to reduce government spending through development of beneficiary's management instead increasing water right (Dastjerdi *et al.,* 2009). So that in recent years the planners of agriculture and water resource have reviewed development of water utilities and irrigation and drainage networks in order to cope with the loss of excessive water and increase water productivity (Hajjari and Gorji, 2007).

Due to the lack of these networks in the vast range of this country, water waste is extremely high and large part of it goes to waste. Despite this situation and in order to ensure permanent and sufficient water, minimizing water losses in its lowest level and collect excess water or land drainage, design, construction and development of the networks mentioned seems inevitable and is considered as the most important factor against the development of the water sector, the development of the agricultural sector and socio-economic development (Soleimani *et al.,* 2009). But the physical development of irrigation networks and drainage, without regard to population of local beneficiaries will follow both the problem of reduced irrigation efficiency to less than 30% and the destruction and deterioration of networks, because the farmers are regarded as the main and most important factor in water management and any process and action on irrigation and drainage networks without regard to role of farmers will not be important and desirable return (Chizari, 2008). So in order to reduce the problems in the irrigation and drainage networks on the one hand and increase the efficiency of agricultural water on the other hand, we need to provide a national commitment for the effectiveness of the role of farmers in management planning, operation and maintenance of irrigation and drainage networks.

One of the successful ways to achieve this purpose is a gradual exit from the current trend of governmental management toward participatory irrigation management through the creation of Water User Associations (WUAs) in the irrigation network (Chizari, 2008). According to the World Bank definition, participation is a two-way process, through which people who are affected by the project, are able to intervene in the directing and development projects actively. In other words, participation is a dynamic process through which beneficiaries in addition to sharing in the benefits of plan also affect on the main tendency of the project, Implementation and operation of it (Ebrahimi *et al*., 2009).

The aim of this study was to investigate effective strategies to improve the management and exploitation of

Table 1. Personal characteristics of farmers

Classification of ages	Frequency	Percent	Average	Mode	Lowest	Highest
Less than 30	48	32	-	-	-	-
30-35	22	14.7				
35-40	17	11.3	39	40	19	73
Older than 40	63	42				
Sex		**Frequency**			**Percent**	
Male		146			97.3	
Female		4			2.7	
Literacy level		**Frequency**			**Percent**	
Literate		134			89.3	
Illiterate		16			10.7	
Grade		**Frequency**			**Percent**	
Elementary		39			26.2	
Secondary		32			21.5	
Middle		23			15.4	
Diploma		26			17.4	
Collegiate		29			19.5	
Access to water		**Frequency**			**Percent**	
River		25			16.7	
Well		118			78.6	
Rainwater		7			4.7	
The size of agricultural land	**Frequency**	**Percent**	**Average**	**Lowest**		**Highest**
Less than 3 hectares	103	69.6				
4 to 6 hectares	25	16.9	2	1		15
7 to 9 hectares	12	8.1				
More than 10 hectares	8	5.4				

irrigation networks (Case study: Miandoab Plain). Also Specific objects of the study include: identifying personal characteristics of farmers, investigate strategies of participation, infrastructure, social, agronomic, geographic, government support, technical, educational to improve the management of irrigation networks, that all these issues have been studied from the viewpoint of farmers.

MATERIALS AND METHODS

The research method in this study is a descriptive - survey method and survey instruments in this research are a questionnaire. The questionnaire included both open-ended and fixed-choice questions. A 5-point Likert scale ranging from 1 (very low) to 5 (very high) was applied as a quantitative measure. The questionnaire included questions about the identity of respondents to questions such as personal characteristics and also the main part of the questionnaire to evaluation of effective

Table 2. Prioritization of strategies for government support in relation to evaluation of effective strategies to improve management and exploitation of irrigation systems in Miandoab Plain from the viewpoint of farmers

Rank	Variables	Mean	Standard deviation	CV
1	Carrying out promotional activities from government's plan before the implementation of the project to create awareness and encourage beneficiaries to collaborate	3.94	1.174	0.297
2	Introduce reputable and reliable companies to farmers to implement irrigation projects	3.71	1.123	0.303
3	Provide facilities to farmers to improve their irrigation networks	3.49	1.063	0.304
4	Reduce or eliminate heavy laws and regulations, and cumbersome administrative regulations to implement Irrigation networks projects	3.61	1.167	0.323
5	Hiring companies for the implementation of irrigation projects and complete monitoring on them	3.36	1.140	0.339
6	Encourage and attract real and legal investors the private sector	3.11	1.060	0.340
7	Implementation of soil and water operations in agriculture sector and methods of modern irrigation and optimizing water and energy consumption	3.07	1.069	0.348
8	Accelerating the construction and completion of unfinished projects	2.74	1.036	0.378
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

strategies to improve management and exploitation of irrigation systems in Miandoab Plain from the viewpoint of farmers (Government support strategies, technical strategies, participatory strategies, educational strategies, infrastructural strategies, social mechanism strategies, agricultural and geographical strategies) as given in table 1-8. The validity of the questionnaire was done by giving several copies of it to a group of professionals, including teachers and experts; and based on their recommendations, the questionnaire was approved. Also, in order to measure the reliability of the questionnaire, thirty questionnaires were completed by the experts and Cronbach alpha coefficient 0.81 was calculated. Population size were farmers of the Miandoab township up to 2581. To calculate the sample size, Cochran formula was used and were determined to be equal to 150 people. The analysis of quantitative data was carried out using descriptive statistics Coefficient of Variation (CV). In conjunction with descriptive statistics mean, variance, standard deviation, maximum and minimum variables carried out by using SPSS 21 software.

Table 3. Prioritization of technical strategies

Rank	Variables	Mean	Standard deviation	CV
1	Uniform distribution of water through modern systems	3.60	1.075	0.298
2	The use of equipment needed in relation to high-quality irrigation systems pressurized	3.58	1.091	0.304
3	Use of high-quality water distribution networks	3.72	1.136	0.305
4	Design and implementation of irrigation system by Executing company as appropriately	3.54	1.100	0.310
5	Create supply stores of equipment needed in relation to irrigation	3.63	1.179	0.324
6	The problem of filing and the provision of facilities	2.91	1.100	0.378
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

Table 4. Prioritization of the participatory strategy

Rank	Variables	Mean	Standard deviation	CV
1	Delegating administrative tasks to own farmers	3.91	0.972	0.248
2	Establishment of NGOs in the villages	3.87	0.975	0.251
3	Selecting someone as white beard to do and deal with problems of irrigation	3.88	1.019	0.262
4	The direct supervision of farmers from work process of the irrigation networks	3.53	1.121	0.317
5	Selecting personnel of executing companies involved in irrigation schemes from among the regional literate people	3.60	1.161	0.322
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

RESULTS

Farmers' personalization features

Table 1 shows the average age of farmers studied and was equal to 39 years that the highest and lowest age among farmers was equal to 73 and 19 years, respectively. As well as the results showed that most participants (63 people) are older than 40 years. Most farmers studied (97.3 percent) were male, in fact, what can be concluded from Table 1 is that, among the 150 farmers studied, 146 farmers were men. Most farmers who were regarded as 'studied' (26.2 percent) had an elementary degree, in fact, it can be concluded from the table that the educated farmers (39) had a high school degree. Most farmers who had studied at school (52.3 percent) use water from wells and rivers for agricultural activities. Average studied agricultural land was equal to 2 hectares that the highest and the lowest of land among farmers were equal to 15 and 1 hectare, respectively. The results showed that the largest number of participants (103 people) had less than 3 hectares of land.

Prioritization of the variables in relation to evaluation of effective strategies to improve management and exploitation of irrigation systems in Miandoab plain

The views of respondents in the field of effective strategies to improve the management and exploitation of irrigation systems in Miandoab Plain was evaluated. From the viewpoint of farmers in Miandoab township and to identify the most important variable and among other variables Coefficient of Variation (CV) is also used. In fact, variables that have a lower Coefficient of Variation (CV) are more important and thus we have prioritized variables from the viewpoint of farmers.

Prioritization of strategies for government support

As shown in Table 2, among the strategies for government support, variable of carrying out promotional activities from government's plan before the implementation of the project to create awareness and encourage beneficiaries to collaborate (CV=0.297), introduce reputable and reliable companies to farmers to implement irrigation projects (CV=0.303) and provide facilities to farmers to improve their irrigation networks

Table 5. Prioritization of educational strategies

Rank	Variables	Mean	Standard deviation	CV
1	Use of radio and television to educate farmers about optimal management of irrigation networks	4.46	0.652	0.146
2	Training of farmers in relation to time and manner of irrigation to increase the efficiency of water	4.20	0.918	0.218
3	Use of educational CDs about the optimal management of irrigation networks	3.74	1.036	0.277
4	Use of experienced experts to train farmers of how optimal management of irrigation networks	3.51	1.084	0.308
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

Table 6. Prioritization of infrastructural strategies

Rank	Variables	Mean	Standard deviation	CV
1	Having a well on the farm	3.78	0.989	0.261
2	Price support of products	3.68	1.125	0.305
3	Consideration of justice in distribution of water	3.01	1.111	0.369
4	Existence enough water	3.17	1.186	0.374
5	The variety of products in the field	2.77	1.110	0.400
6	The region need to build new channels of water	2.38	1.318	0.553
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

(CV=0.304) have gained most importance and value compared to other items, respectively. This means that respondents expressed these three items as the most important government' support to improve irrigation networks as well as accelerating the construction and completion of unfinished projects (CV=0.378) compared to the other items that possess less importance and value.

Prioritization of technical factors

As shown in Table 3, from among the variables related to technical strategy the items such as uniform distribution of water through modern systems (CV=0.298), the use of equipment needed in relation to high-quality irrigation systems pressurized (CV=0.304) and use of high-quality water distribution networks (CV=0.305) have gained more than any other item of significance and value, respectively. That is, respondents stated that these three items are most important variables in relation to technical factors to improve the management of irrigation networks. And also the problem of filing and the provision of facilities (CV=0.378) received less importance and value compared to other items.

Prioritization of participatory strategies

As shown in Table 4, among the variables, participatory strategy items such as delegating administrative tasks to own farmers (CV=0.248), establishment of NGOs in the villages (0.251) and selecting someone as white beard to do and deal with problems of irrigation (CV=0.262) have gained more than any other item of significance and value, respectively. That is, respondents stated that these three items are the most important variables in relation to participatory factors to improve the irrigation networks. And also selecting personnel of executing companies involved in irrigation schemes from among the regional literate people (CV=0.322) received less importance and value compared to other items.

Prioritization of educational strategies

As shown in Table 5, from among the variables of educational strategies, items such as use of radio and television to educate farmers about optimal management

Table 7. Prioritization of strategies for social mechanisms

Rank	Variables	Mean	Standard deviation	CV
1	Encouraging farmers to participate in the management of irrigation networks	4.19	1.013	0.241
2	Versatility of water user cooperatives	3.85	1.045	0.271
3	The presence of influential local leaders	3.92	1.183	0.301
4	Use of local people to manage cooperatives related to management of irrigation networks	3.39	1.104	0.325
5	Less interference of the government in internal affairs of cooperatives	2.74	1.281	0.467
6	Satisfaction of the performance of Regional Water Organization	3.05	1.462	0.479
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

Table 8. Prioritization of agricultural and geographical strategies

Rank	Variables	Mean	Standard deviation	CV
1	Farmers and experts familiar with the geography and climates all areas covered	3.91	1.081	0.276
2	Integrity of agricultural lands	3.76	1.138	0.302
3	Dependence on irrigation networks among farmers	3.67	1.190	0.324
4	Increasing the area under cultivation among farmers	3.77	1.268	0.336
5	Water supply in areas that are faced with the problem in terms of underground waters and surface water.	3.38	1.278	0.378
6	Distribution of main water supply in the entire region	3.16	1.233	0.390
7	Water supply to lands that are inappropriate in terms of topography	2.59	1.062	0.410
8	Having enough land among farmers	2.75	1.187	0.431
	Likert Spectrum Very low = 1 Low = 2 Medium = 3 High = 4 Very high = 5			

of irrigation networks (CV=0.146), training of farmers in relation to time and manner of irrigation to increase the efficiency of water (CV=0.218) and use of educational CDs about the optimal management of irrigation networks (CV=0.277) have gained more than any other item of significance and value, respectively. The respondents stated that these three items are most important variables of the educational factors to improve management of irrigation networks. And also the use of experienced experts to train farmers of how optimal management of irrigation networks (CV=0.308) received less importance and value compared to other items.

Prioritization of infrastructural strategies

As shown in Table 6 from among infrastructural strategies, items such as having a well on the farm (CV=0.261), price support of products (CV=0.305) and consideration of justice in distribution of water (CV=0.369) have gained more than any other item of significance and value respectively. The respondents stated that these three items are the most important variables in relation to infrastructural factors to improve of irrigation networks. And also the region need to build new channels of water (CV=0.553) received less importance and value compared to other items.

Prioritization of strategies for social mechanisms

As shown in Table 7, from among mechanisms for social strategies, items such as encouraging farmers to participate in the management of irrigation networks (CV=0.241), versatility of water user cooperatives (CV=0.271) and the presence of influential local leaders (CV=0.301) have gained more than any other item of significance and value, respectively. That is, the farmers argued that these three are most important variables to improve the irrigation networks. And also satisfaction of the performance of regional water organization (CV=0.479) received less importance and value compared to other items.

Prioritization of agricultural and geographical strategies

As shown in Table 8, from among agricultural and geographical strategies, items such as farmers and experts familiar with the geography and climates at all areas covered (CV=0.276), integrity of agricultural lands (CV=0.302) and dependence on irrigation networks among farmers (CV=0.324) have gained more than any other item of significance and value, respectively. The respondents stated that these three items are most important variables in relation to agricultural and geographical factors. And also having enough land among farmers (CV=0.431) received less importance and value compared to other items.

DISCUSSION

From the viewpoint of farmers, state aid in relation to agricultural activities can transform this industry into a major economic hub. State aid should be designed in such a way that the farmers are not the problem and they can be successful in either ways. Long-term loans with low interest could be successful in the development of agriculture. Supports and government policies to improve the situation of irrigation networks can be very influential. Reducing production costs by giving subsidies to farmers and facilitate market conditions is one of the important issues and problems in the field.

Completion of unfinished projects will also cause an increase in trust in government and related departments from farmers. Also hiring companies executing irrigation projects and complete monitoring on their will cause farmers see the government on your side and practices that were traditionally done with a useful monitoring be done better, faster and more useful. All these cases can to make clear the role of government and its policies. The government has a tremendous role as executer of project and creates the right conditions for doing the job on the field. The results of this research are consistent with research conducted by Tabaraey *et al*. (2011) and Totonchi and Ommani (2010).

From the viewpoint of farmers, technical problems which in relation to the improvement of existing irrigation networks is at filing case, because according to farmers, paperwork problems and long-time complaints handling and also requests are so high that farmers be dissuaded from doing work. This issue causes that majority of farmers solutions own problems between themselves and as participatory because in this regard they have no facilities, capital and knowledge and for this reason, they are doing your own designs as unsystematically. Implementation of projects related to irrigation networks needs to be with full equipment and accessories, modern as well as accessible. In this regard, if designs and planning are done that farmers can obtain the necessary equipment at the lowest cost and in the shortest time, they can better manage and improve irrigation networks that the results of this study are consistent with the previous results of Khalkhali and Hosein (2009).

The results showed that farmers believe on this topic that existence of local managers is of great importance in agricultural systems to advanced agricultural activities. Because managers who are from rural society itself with existing conditions in the community are better and more aware and for this reason can pursue policies to advance that non-native managers would not be able to do it. More problems of farmers are always about water allocation, fair timely distribution of water. So if in the water user cooperatives provide conditions through good management that farmers use water resources for agricultural activities properly and fairly and monitor to it directly can be persuaded them on participation in improving the management of irrigation networks and incentives to create in them that this result is consistent with research conducted by Heydarian (2006), Tabaraey *et al*. (2011) and Totonchi and Ommani (2012).

Education is an issue that has particular importance for a farmer because every day studies get more in the fields of agriculture and develop more and better technologies and information that informing and training farmers to improve farming is an important matter and valuable until it is able to advance your industry by all modern facilities. The management of irrigation networks is an issue that requires education and explanation because farmers irrigate agricultural products for many years traditionally. Always to insert a new idea or technology in a society is essential to increase knowledge in that community. In fact, as long as our agricultural community in terms of knowledge about the marketing is at a low level will not be able to accept new technologies in the areas of production for market-friendly of its products. Because accepting it, requires a series of skills and these skills comes with education and

training. Building educational institutions and counseling to increase knowledge and skills among farmers and getting to know the benefits of management of irrigation networks and how work in this regard can be important and useful that results of this research are consistent with Heydarian (2006) and Soltani and Shahraki (2013).

From the perspective of farmers to improve the operation management of irrigation networks, the region needs to be improved in terms of irrigation canals. Because from their perspective, a lot of water is lost in time starting from the water point till the entry to farm by inappropriate channels and the amount of water that will be available to farmers is less than the amount of water that enters to irrigation network from the beginning. So the first step is the improvement of irrigation canals by piping or concreting channels. After that, as always and often farmer's disputes have been over unfair distribution of water, for this reason, it should be one law and local custom in the village that each farmer will have to share from water fairly. The next item is having a well on the farm. This issue should also be based on amount of underground water and avoid of creating unauthorized wells with a proper management in the region that the results of this research is consistent with Khalkhali and Hosein (2009), Heydarian (2006) and Soltani and Shahraki (2013).

The results showed that from the viewpoint of farmers, the use of reliable local people in cooperatives related to irrigation networks has many advantages. Because local people know better than anyone the problems of irrigation, irrigation canals, the amount of share each farmer and the amount and type of cultivation of agricultural crops of farmers and this makes the work of the cooperatives better, faster and correct that in total it raises satisfaction of the farmers from cooperatives. The results of this study are consistent with Khalkhali and Hosein (2009), Tabaraey *et al.* (2011) and Soltani and Shahraki (2013).

From viewpoint of farmers as long as the agronomic characteristics and regional geography is not clear, then the irrigation projects can be implemented. So to help this, one must first determine the region in terms of the amount of underground water. And then integrate the agricultural land because small plots do not bargain in terms of economic efficiency and this feature has been making progress in agriculture in developed countries and finally, distribution of water resources should be fair in the area where the project is done. Because the water in the region cannot be found in abundance and farmers in the region suffer from water scarcity. Results of this study are consistent with the Soltani and Shahraki (2013).

SUGGESTIONS

- Uniform distribution of water through modern irrigation systems in the region
- Observance of justice in water distribution among farmers to avoid disputes
- Appropriate design and implementation of irrigation system by executer companies
- The presence of local influential leaders in cooperatives and participation of them in the implementation of irrigation projects
- Less interference of government in cooperative matters and entrusting activities to own farmers
- Encourage and attract natural and legal investors from private sector
- Building supply stores for equipment required in relation to irrigation in rural areas
- The appointment of executor companies of irrigation projects and full monitoring over them
- Conducting operations of water and soil to agricultural and implementation of modern methods of irrigation and using optimization of water and energy.

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