FARMERS' PARTICIPATION IN IRRIGATION WATER MANAGEMENT IN NORTHEAST IRAN

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ABSTRACT

The purpose of the present study was to investigate the farmers' participation in irrigation networks management with an approach to compare two groups of farmers in the irrigation networks with Water Users' Cooperative (WUC) and without it. The methodological approach was a descriptive-correlational and causal-comparative study of the survey type. The target population in the study consisted of 2551 farmers of irrigation networks in Razavi Khorasan Province, Iran. By using stratified random sampling technique, 335 participants were chosen. Data were collected through a questionnaire and were analyzed using SPSS, V. 13. Content and face validity of the instrument obtained by the faculty members of Agricultural Extension and Education, Agronomy and Irrigation Departments at Tarbiat Modarres University and also Specialists Board of Agricultural Jihad Organization and Regional Water Joint-stock Company in Razavi Khorasan Province. The reliability analysis was conducted and Cronbach's alpha values for the various sections of instrument were estimated to be between 0.73 and 0.86. The results of t-test with independent samples showed that there were significant differences in relation to the averages of the variables of status of farmers' participation in irrigation management, annual income, farmers' perception of rural irrigation status, social solidarity, social participation, farmers' attitude toward the WUC, extension contacts, social confidence, farmers' behavior regarding farm water management, their age, experience in agriculture, communication channels and education level between two groups of water users, i.e. those who were in irrigation network with WUC and those who did not, which the magnitude of statistical differences were arranged for these variables, respectively.

Keywords: Participatory irrigation management, water users' cooperative, farmer, farm water management, sustainability

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INTRUDUCTION

Irrigation has played and will continue to play an important role in the provision of the food supply for the rapidly expanding population of the world (Wijayaratna, 2004). In this connection, water resources limitation is one of the most serious problems in Middle Eastern countries, especially in arid and semi-arid countries (Skaggs *et al*., 2006). This dazzling benefit encouraged many countries, especially developing countries, to create more and more irrigation facilities. The results of those irrigation development projects did not achieve 100% success, as most of them were managed by the government where farmers' participation was ignored. During the 1980s and early 1990s, government responsible officials started to realize the significance of farmers' participation in the management of irrigation systems from the stand point of sharing the costs and contributing to maintenance. This kind of concept was adopted by many countries as a "Participatory Irrigation Management (PIM)". The purpose of PIM was to involve farmers in irrigation management including operation and maintenance. The merits of PIM are decrease in wasteful use of water, enhanced durability of irrigation facilities, reduction of government burden, facilitation of cost recovery and equitable water delivery. Some countries, such as Turkey and Mexico, have made success in establishing PIM-based projects, while other countries, especially monsoon-Asian countries, are yet to achieve their goal (Tanaka and Sato, 2005).

Water scarcity is the most limiting factor in agricultural productivity in Iran. Considering that about 90% of the country is climatologically arid and semi-arid, the fresh water resources are limited. Iran is an area of 165 million hectares (Mha). The average amount of precipitation over the country is 252 mm/ year or 413 billion cubic meters (bcm), which are less than one-third of worldwide average precipitation (831mm). Based on the studies performed by United Nations (UN) and also International Water Management Institute (IWMI) experts, the per capita water resources of Iran are projected to be about 726-860 m^3 in 2025, compared with 2200 m^3 in 1990 (Ehsani and Khaledi, 2003).

Unfortunately, the lack of proper management, operation, maintenance, system efficiency, and illegal extraction in the irrigation system have remained major problems since the existence of the irrigation network that have resulted in inequitable and unreliable distribution, thus the poor tail-enders are always faced with the shortage of water. In addition, because of low irrigation efficiency, about 50 to 60 percent of the renewable water is lost in agriculture, and this has led to agricultural water productivity (ratio of yield per unit of water) a very low. Therefore, the economic value per cubic meter is 0.75 kg/ m^3 (Keshavarz et al., 2005).

A clear incentive for self-organization among tail and head enders in an irrigation system was found by Ostrom and Gardner (1993). Statistical evidence on data from Nepal supports that self-organized irrigation systems work better than those which are organized by the government. However, success in self-organized groups came about after a struggle. Initially, self-organization led to conflicts and confusion, but when the initiative to self-organization was accepted by some villagers, other villagers followed as well. This ultimately led to a management system for the whole irrigation canal.

WUAs can play an important role in assisting users to adopt new techniques and technologies for more efficient water use and increased production (Smith and Munoz,

2002). In investigations of studies identified that WUAs could been improved (1) Human capital: education, knowledge/ understanding, skills (agricultural, technical, organizational, financial), labour/ time; (2) Social capital: values and norms, organization, power; (3) Physical capital: access to infrastructure, standards of maintenance, appropriateness of design; (4) Natural capital: access to water and land, protection of resources; and (5) Financial capital: income from employment, other economic activities, ability to contribute resources for management and maintenance (Howarth *et al*., 2002).

Transfer of irrigation management responsibilities from government agencies to farmers is now an important policy in a large number of countries (Howarth et al., 2002). In the agricultural sector of Kazakstan's current conditions, there are also clearly identifiable benefits for governmental agencies from the formation of Water Users' Associations including: (1) WUAs provide a single point of contact for negotiations, contracts, and dispute resolution between water users and local water management authorities, thereby significantly easing the latter's increased administrative burden caused by the break-up of the Soviet farm system; (2) WUAs can ease the introduction of water pricing which is at present complicated by the lack of measuring devices for water deliveries to individual farmers. Water deliveries could be measured at the point of delivery to the WUA, which would then handle deliveries to and fee-collection from its members, based on an individual's irrigated acreage, for instance; and (3) Strong WUA can in the future be made the owners of existing irrigation and drainage systems, which the government authorities are no longer able to manage and maintain (Burger, 1998).

To sum up, the farmers' role in development is crucial in enhancing water use efficiency. The creation of new management mechanisms, which give more responsibility and more incentives to farmers to improve the condition of water systems and to economize the use of irrigation water, is an important step (Burger, 1998). Therefore, The most common and effective tool to encourage Water Users (WUs) organized participation, which is used in several countries of the world is the formation of WUCs. The overall aim of this study was to examine and analyze the farmers' participation in irrigation networks management with an approach to compare of two groups of farmers in irrigation networks with WUC and without it. To achieve this purpose, this survey research was performed with the following specific objectives: (1) determination of the professional and individual characteristics; (2) assessment the level of water users' involvement in WUC and non-WUC participatory systems; and (3) comparison of two groups of farmers in relation to the professional and individual characteristics (those who were in participatory system with WUC and without WUA, viceversa).

MATERIALS AND METHODS

This study used descriptive-correlative and causal-comparative survey methodology to investigate the farmers' participation in irrigation networks management with an approach to compare two groups of farmers in irrigation networks with WUC and without it. The methodological approach was a descriptive-correlational and causal-comparative study of the survey type. The target population for the study consisted of 2551 farmers of irrigation networks during the 2005-2006 that conducted in three

irrigation networks of Razavi Khorasan Province at villages level, including: "Shahid Yaghubi" Dam of Torbat-Heydarieh with WUC and "Shahid Karde" and "Trogh" Dams of Mashhad without WUC. Through stratified random sampling technique, a group of 335 participants of irrigation networks (166 farmers for participatory system with WUC and 214 farmers for participatory systems without WUC) was selected as the sample out of the above-mentioned population using the method of Krejcie and Morgan (1970) for the determination of sample size. A questionnaire was prepared to gather the data needed for this study. The questionnaire consisted of four parts: part one of the questionnaire was relation to the information about individual characteristics of WUs, including: age, education level, experience in agriculture, distance from farm to agricultural services center. Part two of the instrument was designed to gather data on technical characteristics of WUs, including: farmers' behavior regarding farm water management and farmers' perception of rural irrigation status. Part three of the instrument was designed to gather data on the socio-cultural characteristics of the WUs, including: extension contacts, communication channels, social confidence, social solidarity, social participation, farmers' attitude toward the WUC, and farmers' participation status concerning irrigation networks management. In this part of the questionnaire, items consisted of five-point likert type scale with responses ranging from zero to 4. Also, the information about economic characteristics of WUs was considered in the third part of the instrument, including: annual income and size of the irrigated cultivation. Data were collected through a questionnaire and were analyzed using SPSS, V.13. Content and face validity of the instrument were obtained by the faculty members of Agricultural Extension and Education, Agronomy and Irrigation Departments at Tarbiat Modarres University and also by the Specialists Board of Agricultural Jihad Organization and Regional Water Joint-stock Company in Razavi Khorasan Province. To assess the reliability of the instrument, a pilot test (N= 30) was performed, and Cronbach's alpha coefficients were computed for each part and were found in a range from 0.73 to 0.86.

RESULTS AND DISCASION

Objectives 1: The first objective of this study was to describe the characteristics of farmers. The findings of this part showed that 18.4% of the farmers were of an age below 30 years. Those that fell within the age of 30 to 49 years accounted for 46.4%, about 19.5% of the respondents were of the age between 50 to 59 years, while about 15.7% of the respondents were 60 years old or even elder. The findings of this part showed that the age of respondents ranged from 21 to 80 years with a mean age of 45.23 years (SD = 13.8). It was also evident that 23.6% of the farmers had not taken part in any formal education. About 37.6% of the respondents attended primary school, 20.6% had attended secondary school education, about 11.8% of the respondent had high school diploma and the remaining 6.4% attended post-secondary school. The mean of the size of the irrigated cultivation by farmers was 3.45 ha; the minimum and maximum land areas were 0.5 and 15 ha, respectively. Farmers were asked to indicate the number of years they have experienced working on farm. Years of farm experience ranged farm 3 to 65 years (M= 25.26; SD= 13.9). The average distance from the farm to agricultural service center was 5.44 Km. Farmers' annual income ranged from 7 to 90 million rials (M= 3.15; SD= 1.59) (Table 1).

Table 1. Professional and individual characteristics of WUs.

Variables	Mean	S.D.	Max.	Min.
Age (year)	45.64	13.98	22	82
Education level (year)	4.37	3.78	0	14
Experience in agriculture (year)	25.26	13.90	3	65
Size of the irrigated cultivation (ha)	3.45	2.18	0.5	15
Distance from farm to agricultural services center (km)	5.44	2.73	1	11
Annual income (million Rials*)	3.15	1.59	0.7	9

* 8000 Rials= 1USD.

As shown in Table 2, social characteristics of WUs were categorized three levels including: low, medium and high. The usage level of extension contacts was low (50.9%; n= 168) with an overall mean score of 9.00 (SD= 5.08). The usage level of communication channels by WUs in drainage and irrigation networks was medium (52.1%; n= 172) with an overall mean score of 20.97 (SD= 9.35). Also, social capital components among WUs were evident within the confidence (mean= 12.09), solidarity (mean= 12.27) and participation (mean= 17.49) that each of they were assessed at medium level (Table 2).

Table 2. Socio-cultural characteristics of WUs.

Variable	Low	Medium	High	Mean	S.D.	Min.	Max.	Range
	Percent of respondent							
Social confidence	28.8	45.5	25.8	12.09	5.87	1	24	0-24
Social solidarity	26.7	48.8	24.5	12.27	5.54	2	24	0-24
Social participation	28.5	49.1	22.4	17.45	7.96	3	34	0-36
Extension contacts	50.9	39.7	9.4	9.00	5.08	1	23	0-24
Communication channels	27.3	52.1	20.6	20.97	9.35	5	41	0-44

Objective 2: In order to assess the rate of WUs' involvement in irrigation networks management, 9-item with summated likert-type format was designed in different stages of planning, decision-making, implementation, operation, maintenance and evaluation in relation to irrigation water management so that they could expresses their level of participation by selecting the options. The findings of Table 2 indicates that the respondents' participation levels in irrigation networks with WUC was medium with an overall mean score of 19.92 (S.D. = 6.7). But the level of WUs' participation in irrigation networks without WUC was low with an overall mean score of 12.72 (S.D. = 6.6). In general, it was evident that the status of WUs' participant in participatory system of WUC was better than those who were not in cooperative. Nevertheless, the respondents of irrigation networks with WUC were reported that they have a better

status from the view point of in-farm and on-farm water management, solution of irrigation problems, cooperation with other farmers and irrigation experts, the prevention of water losses, rehabilitation and reconstruction of canals, giving the water rights for improvement of operation and maintenance of networks and programming the water business than those who were in irrigation system without WUC.

Table 3. Status of WUs' participation regarding irrigation networks management

Network type		Very low	low	medium	high	Very high	Mean	S.D.	Min.	Max.
WUC	*f*	2	31	69	37	19	19.92	6.7	5	35
	%	1.3	19.6	43.7	23.4	12				
Non-WUC	*f*	47	61	45	16	3	12.72	6.6	3	30
	%	27.3	35.5	26.3	9.3	1.7				
Overall	*f*	49	92	114	53	22	16.16	7.5	3	35
	%	14.8	27.9	34.5	16.1	6.7				

Objective 3: A t-test with independent-samples was conducted to evaluate the differences between two groups of water users of irrigation networks with WUC and without it. As shown in Table 3, statistically significant differences were found among the individual characteristics investigated in the present study between two groups of WUs, i.e. those who were in irrigation network with WUC and those in non-WUC irrigation networks, with respect to the variables of age, education level, and experience in agriculture, excluding distance from farm to agricultural services center. Among the economic characteristics, there was a significant difference (at a 0.05 level) between two groups of respondents in relation to annual income, except for size of the irrigated cultivation. Significant differences were found between the two groups of respondents with the entire socio-cultural characteristics, namely with extension contacts, communication channels, social confidence, social solidarity, social participation, farmers' attitude toward the WUC, and farmers' participation status concerning irrigation networks management. In addition, with technical factors, there was a significant mean difference between farmers' behavior regarding farm water management and farmers' perception of rural irrigation status in two groups of respondents.

Table 4. Comparison of the two groups of water users in WUC and non-WUC irrigation networks in relation to their characteristics.

Independent variable / Dependent variable	WUC irrigation network (n=158)		Non-WUC irrigation network (n=172)		t	P value	Effect Size (d)
	Mean	S.D.	Mean	S.D.			
Age of the farmer	47.85	13.63	43.61	14.04	2.78**	0.006	0.30
Education level	4.86	4.23	4.06	3.57	2.27**	0.024	0.20
Experience in agriculture	27.51	13.93	23.36	13.85	2.71**	0.007	029
Size of the irrigated cultivation	3.38	2.42	3.51	1.95	-0.539	0.590	-0.05
Distance from farm to agricultural services center	5.58	2.80	5.31	2.67	0.870	0.385	0.09
Annual income (million rials)	3.94	1.73	2.43	0.99	9.79**	0.000	1.07
Extension contacts	10.25	5.18	7.84	4.70	4.43**	0.000	0.48
Communication channels	22.32	9.68	19.73	8.89	2.53*	0.012	0.27
Social confidence	13.50	5.56	10.74	5.84	4.39**	0.000	0.48
Social solidarity	13.92	5.32	10.80	5.35	5.29**	0.000	0.58
Social participation	19.65	7.46	15.44	7.89	4.96**	0.000	0.54
Farmers' perception of rural irrigation status	14.68	4.89	10.80	4.85	7.21**	0.000	0.79
Status of farmers' participation in irrigation management	19.92	6.70	12.72	6.60	9.82**	0.000	1.08
Farmers' behavior regarding farm water management	75.27	22.25	65.24	20.51	4.25**	0.000	0.46
Farmers' attitude toward the WUC	61.46	16.06	53.27	16.75	4.52**	0.000	0.49

* T-test significant at $p < 0.05$

** T-test significant at $p < 0.01$

To assess the magnitude of statistical differences, effect sizes were calculated, interpreted, and reported using Cohen's procedures (Zhai and Scheer, 2004). Interpretations for t-tests were based on the Cohen conversion: negligible size; $d< 0.20$, small effect size; $0.20\leq d< 0.50$, medium effect size; $0.50\leq d< 0.80$, and large effect size; $d\geq 0.80$ calculated through the following formula:

$$d = \frac{Mean_1 - Mean_2}{\sqrt{\frac{SD_1^2 + SD_2^2}{2}}}$$

The analyses revealed that the annual income (Cohen's d= 1.07) and status of farmers' participation in irrigation networks management (Cohen's d= 1.08) had the largest magnitude of difference than other variables (large effect size). Therefore, WUCs were of the most abundant influences on these variables. Also, farmers' perception of rural irrigation status (Cohen's d= 0.79), social solidarity (Cohen's d= 0.58) and social participation (Cohen's d= 0.54) were found inside the range of medium magnitude of statistical differences (medium effect size). Magnitude of the statistical differences of age, education level, experience in agriculture, extension contacts, communication channels, social confidence, farmers' behavior regarding farm water management, and farmers' attitude toward the WUC were the lowest (negligible effect size).

CONCLUSION

According to the study findings, it was found that WUCs as the considerable social capital can improve the level of farmers' participation in irrigation water management. Significant differences was statistically found between two groups of WUs, those who involved in irrigation network with WUC and those in non-WUA networks in relation to the individual variables of age, education level, and experience in agriculture. Among the economic characteristics, there was a significant difference between two groups of respondents in relation to their annual incomes. This finding concurs with that of Pradhan (2002). Significant differences were found between two groups of respondents from the stand point of all their cultural and social characteristics, namely extension contacts, communication channels, social confidence, social solidarity, social participation, farmers' attitude toward the WUC, and farmers' participation status concerning irrigation networks management. This means that WUAs enhance social capital components among farmers. This conclusion is consistent with others studies (Wijayaratna, 2004; Howarth *et al*., 2002; Pradhan, 2002). In addition, the results indicated that among technical factors, there was a significant difference between farmers' behavior regarding farm water management and farmers' perception of rural irrigation status in two groups of respondents. Thus, the establishment of WUCs provides the most suitable mechanism for the human resource development. Accordingly, several studies have shown that the WUC plays an important role in the improvement the WUs' knowledge, attitudes, and skills regarding farm water management (Wijayaratna, 2004; Carter *et al*., 1999). Therefore, in order to improve the PIM in irrigation networks, decentralization and devolution of water networks management increase WUs' participation in decision-making and investment, and improve management incentives, accountability, agricultural and economic productivity and cost recovery which is the most effective and promising way toward the sustainability of the water resources. The development and implementation of improved water management policies through the formation of WUCs in the irrigated agricultural sector is an important element to achieve the water management objectives. Hence, agricultural policies in Iran must aim at raising the potential of water management technologies through the development of multi-functional WUCs to enhance agricultural water productivity, promote equitable access to water and to conserve the natural resource.

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