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Analysis of Factors Affecting Adoption and Application of Sprinkler Irrigation by Farmers in Famenin County, Iran

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Abstract

Due to its location in the dry belt, the vast country of Iran has always been faced with the problem of water shortages. In such a climate one should take measures to increase the productivity and improve the efficiency of irrigation through expansion of water-conserving technology in the agricultural sector, as this is the largest and most important consumer of water. Therefore this study aimed at investigating factors affecting the adoption and application of sprinkler irrigation technology by farmers in the county of Famenin, Iran. Survey research was the dominant approach. The statistical population consisted of farmers in the Famenin County, and, using Cochran's formula, 280 of them were selected through multi-stage stratified random-sampling equally among adopters and non-adopters. In order to assess the validity of the questionnaire the opinions of experts were used and to measure the reliability of the questionnaire Cronbach's alpha statistic was used (82%). The results showed the adoption of sprinkler irrigation systems to be influenced by environmental factors such as the area under cultivation, access to water, water quality, and non-environmental factors such as the workforce number in the family, employment diversity, and participation in extension education and courses on agricultural water management. Ultimately the logit model is estimated in this paper. Adopters have also expressed reasons such as failure to adequately train farmers for maintenance after system installation, scientific and practical justifications, lack of availability of efficient repairs, inappropriate design and implementation by companies, low-quality components and fittings, clogging of sprinklers due to salty water, non-compliance with environmental conditions, difficulty using machines, the large area occupied by these systems, transportation, parts shortage, lack of security and the possibility of the theft of parts and fittings, and communal ownership of water resources as their dissatisfaction factors.

Keywords:
Adoption, Sprinkler Irrigation, Beneficiaries, Famenin County

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INTRODUCTION

The agricultural sector is the largest consumer of water worldwide, constituting approximately 70% of total water exploitation from surface and groundwater resources (Frenken and Kiersch, 2011). Thus, for more than a decade, the main objective of farm management especially in countries with limited land and water resources is centred on increasing food production using less irrigation (FAO, 2002). In Iran, due to being in the arid to semi-arid areas of the Earth belt, water scarcity has always been one of the main problems towards development and economic development. The average annual precipitation in Iran is about 225 mm, which is much lower than the global average rainfall (860 mm) (Farzande Vahy, 2002). This volume of precipitation disperses in an unsuitable way, and rainfall often occurs during the non-agricultural seasons (Hasheminia, 2004). On the other hand, 59% of land needs to be irrigated. This figure, compared with the worldwide average, i.e., 17%, is very high (Information Center of World Bank, 2006); also in addition, it is estimated that fertile, suitable land for agriculture about 35 to 50 million hectares covers roughly 20 to 30% of the country's total area (Ghasemzadeh, 2001). In these conditions, traditional methods of irrigation with a low efficiency of only 32% on farms has interrupted the balance between groundwater aquifer exploitation (55 billion m3) and nutrition (46 billion m3), and the underground water balance sheet is negative (UL Hassan *et al.,* 2007). In addition, the rate of water loss in transmission channels exceeds 85% (Keshavarz and Sadeghzadeh, 2000). Therefore, investment in pressurized irrigation systems, designed to achieve up to 70% efficiency in sprinkler irrigation and 95% efficiency of trickle irrigation, encourages and trains farmers and provides the necessary inputs and credits to help the country to produce more food through increasing the irrigated cultivation area and water conservation (Abdolmaleki and Chizari, 2009).

In recent years, due to low rainfall, Hamedan Province has experienced groundwater and surface water resource shortages. Aquifers a thick layer of rock and soil at a depth of 10 m that can store water in the plains of the Province have been severely deficient in groundwater resources. Famenin, Kabudarahang and Qahavand plains in the northern parts of the Hamedan Province are among the plains that are facing sharply declining groundwater levels. The Famenin plain, which starts from south of Razan County and extends to Qahavand to embrace Famenin County has 1341 deep wells, 904 semi-deep wells (excluded from unauthorized wells), 106 aqueducts and 95 springs that provide the required water for manufacturing and service activities. However, following uncontrolled exploitation and power plant activity with 200 wells and high discharge, the Regional Water Organization of Hamedan declared this plain as a 'Banned plain' in 1993 (Water Organization of Hamedan Province, 2011). However, unfortunately despite this valuable declaration, both authorized and unauthorized digging activities have largely continued. In this regard, one of the most important and effective ways to tackle the water crisis and water management in the county is to increase irrigation efficiency through the application of pressurized irrigation systems.

Wang (2008), in a study aimed at the economic analysis of areas accepting water conservation measures in northern China, concluded that when the availability of water is low, farmers tend to be more likely to use water-saving techniques, and access to water has a major impact on the probability and intensity of this adoption. In addition, government actions such as agricultural extension-education, demonstration farms, and the provision of loans and subsidies, leads to a higher rate of adoption. In addition, farmers with more arable land are pioneers in this field. Michailidis *et al.* (2011) examined the past, present and anticipated behaviours of farmers in relation to sprinkler irrigation technologies. The results show that yield levels and product quality has a decisive impact on the adoption of irrigation types, and the paper ultimately recommended that if decision-makers give more attention to the attitudes and perception of farmers and improvement of irrigation management rather than the type of technology can achieve more favourable results towards improving water productivity. Nguyen (2008) concludes that factors such as income, farm size, the education level of farmers and extension services influence the satisfaction of farmers in relation to the use of pressurized irrigation technology. Adeoti (2009) reported that access to employment and higher attendance in extension-education courses are among the factors that increase the probability of adoption, and, in areas with a higher number of adopters, there exist signs of poverty reduction. Kohansal *et al.* (2009) examined the factors affecting the adoption of sprinkler irrigation in Khorasan Razavi, concluding that variables such as farm size, education level, agriculture being the main form of employment, land slope, soil heterogeneity and access to credits and facilities have a significant and positive impact on the adoption of sprinkler irrigation. Yigezu *et al*. (2013), in a study considering changes in irrigation technology and its impact on the effectiveness of resource use in Syria, stated that farmers' education and their familiarization with modern irrigation methods increases their efficiency compared to traditional methods, and protects water resources through the wider adoption of these systems. Dinar and Yaron (1990), in a study investigating the impact of the quality and scarcity of inputs on the adoption of modern irrigation technology, demonstrated that this type of technology is being adopted faster in regions with poor quality soil and high evaporation, and areas with sensitive root plants and limited water resources. The consequences stated include the impact of management, private capital, and farm size on the adoption rate; finally the authors acknowledge the price of water to be an effective tool towards increasing the adoption rate. According to Jahannama (2001) personal and social characteristics such as age, work experience, education level, knowledge and financial options are effective in the adoption of pressurized irrigation systems. He also enumerates rigid loan terms and conditions, poor performance of design and implementation firms, and low quality of receiving equipment as reasons for the rejection of these systems. He notes also that the major reason for the dissatisfaction of adopters is the mismatch of irrigation systems with farm and climate conditions. Pezeshkirad *et al.* (2011), examined the factors affecting the discontinuation of the use of sprinkler irrigation systems by Mahabad County farmers, and using discriminate analysis concluded that five variables including rivers as water resources, the rate of economic implications of systems, level of educational and extension support, maintenance services and age, placed 99% of farmers into two groups: either those continuing, or those discontinuing, sprinkler irrigation systems. Nowruzi and Chizari (2006), using stepwise multivariate regression, showed variables including irrigated wheat yield, technical expertise in agronomic water management, use of communication channels and the age of farmers to determine approximately 70.7% of changes in the attitudes of farmers to the development of sprinkler irrigation. Shrestha and Gopalakrishnan (1993) found increasing yield and income, water and labour-saving to be the most important factors contributing to the rapid adoption of trickle irrigation in Hawaii State in the US.

In fact, several factors affect behavioural change and the acceptance of new ideas by people. According to Lionberger and Gwin (1995), these agents vary from one person to another and from community to community. Among these factors, they state the role of the situations that the people in question are experiencing whether real or imagined) types of help that they can receive from professionals and external agencies, resources at their disposal, instructional strategies that have been exposed to the treatment and behaviour of the social system, and values that refer people to change. Swanson (1991) argues that the factors associated with the adoption of new innovations and technologies include personality characteristics as well as the characteristics of the environment in which people are working.

According to the above-mentioned details, this paper is going to demonstrate which factors are effective for the adoption and application of pressurized irrigation systems by farmers in Famenin County.

The following points show the objectives of the research:

Identify the personal and professional characteristics of adopters and non-adopters of the sprinkler irrigation system.

Identify the effects of non-environmental factors age, education, technical knowledge, the labour force number within a family, agriculture as the main job, participation in the education and extension courses and environmental factors soil type, land slope, area under cultivation, water access, and water quality on the adoption of sprinkler irrigation systems and estimation of logit model.

Identify factors contributing to dissatisfaction of adopters.

MATERIALS AND METHODS

This study from the point of view of nature ,goal and evaluation method is a quantitative-qualitative ,applied and descriptive-correlative study respectively. The statistical population consisted of 280 farmers in the Famenin County, were selected using the Cochran formula and through multi-stage, stratified sampling from both groups of adopters and non-adopters equally with each group comprising 140 farmers. The required data were collected using questionnaires through structured interviews in summer 2014.

The questionnaire was designed in two parts: the first part included the personal and professional characteristics of farmers and agricultural factors associated with the acceptance and use of sprinkler irrigation systems. The second part of the questionnaire included some open-ended questions to determine the causes of dissatisfaction with the operation of sprinkler irrigation systems: the respondents in this section were those only farmers who accepted sprinkler irrigation systems.

In order to measure the validity of the questionnaire the comments and recommendations of university professors and experts in the Famenin Soil – Water Deputy of Agricultural Jihad Ministry were sought, and modifications were made to the questionnaire accordingly. To determine the reliability of the survey instrument, the questionnaires were distributed to and completed by 30 farmers in both groups in the sample villages. Then, using SPSS software, a Cronbach's alpha coefficient of 82% was obtained, which represents the acceptable reliability of the research tool. Data analysis includes descriptive and inferential statistics. Descriptive statistics included frequency percentage, cumulative percentage, standard deviation, and mean average. In this study, in order to assess the technical knowledge of farmers in agricultural water management practices, 18 items were used, and correct answers and incorrect answers were assigned the numbers 1 and 0, respectively. Therefore, the total scores of farmers' technical knowledge were between 0 and 18. Then, to describe the variables qualitatively the standard error of the mean was calculated (Sedighi and Mohammadzadeh, 2003). Scores obtained in this way were divided into four levels:

A = Poor: A < Mean – SD

B = Average: Mean – SD < B < Mean

C = Good: Mean < C < Mean + SD

D = Very good: Mean + SD < D

Inferential statistics including the Chi–squared test, Cramer's and Phi correlation coefficients were used to investigate the relationship between variables and logistic regression analysis was performed. The condition for multiple regression usage is that the dependent variable should be quantitative. The dependent variable was nominal, and so was dichotomized with a value of 1 if the farmer was an adopter of the sprinkler irrigation system and 0 if he was not an adopter. In this case logistic regression should be used instead of multiple regressions. In the logistic regression the concept of odds ratio the ratio of presence or absence a property ($P_i /1-P_i$) was used: the logarithm of the Odds ratio is calculated according to equation 1, and is known as the logit model (Momeni, 2007).

$$\mathrm{Ln}\,(P_i /1-P_i) = \beta_0+\beta_i x_i \quad (1)$$

To investigate the factors with the greatest impact on adoption of sprinkler irrigation system, backward conditional logistic regression was used. In the qualitative part of the research, in order to determine the causes of dissatisfaction of adopters, first open-ended questions were asked, the results analysed, and then tabulated. The units of analyses include words, phrases or sentences hidden within the text, with the researcher intending to fit them into a value (Holsti, 1994).

Research Study Area

The studied area was one of the nine counties of Hamedan Province, which is located in the northeast of the province. This county is limited to Razan in the North, Hamedan in the South, Markazi Province in the East, and Kabudarahang in the West (Figure 1). Famenin, with an area of 1360 km^2, comprises 6-7% of the total area of Hamedan Province (Famenin's Census Bureau, 2011), and according to Census if Statistical Centre on Iran in 2011, the population of the county is estimated at 42,485 (Statistical Centre of Iran, 2011), of which 6,000 are engaged in agricultural activities. Of a total 88,200 ha of arable land in Famenin, with 73% dry farming and 23% irrigated farming, only 6,500 ha i.e., 21% of the land in this county is covered by a pressurized irrigation system, which includes 268 adopters (Agricultural Jihad of Hamedan Province, 2012).

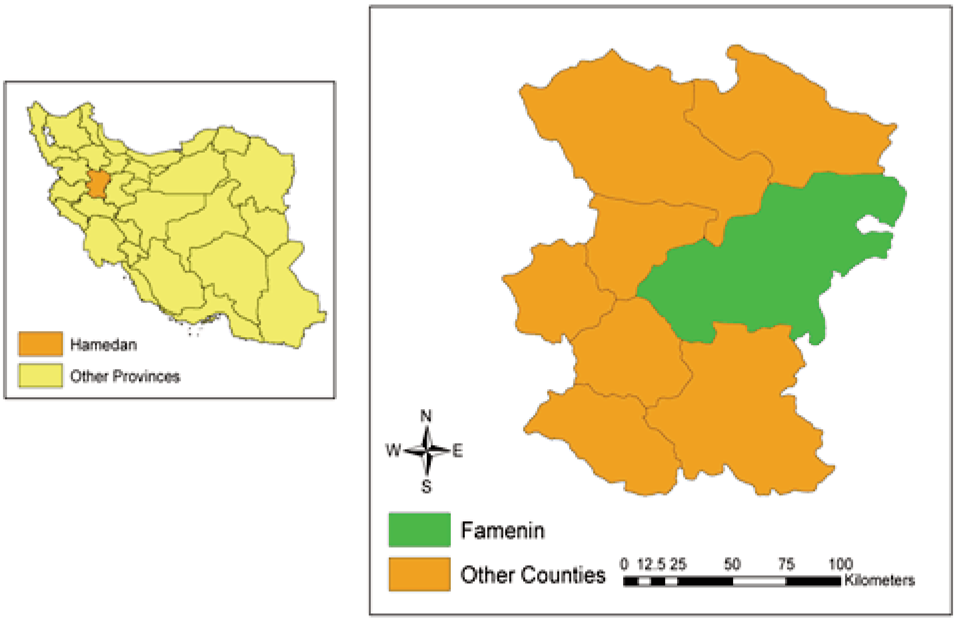

Figure 1: Site of study

RESULTS

Personal and professional characteristics of the respondents

Farmers' age is variable between 25 (minimum age) and 80 years (maximum age). Therefore, the study population in terms of age covers a wide range of young to old people. The average age is 50.54 (SD=11.34). Findings indicated a low level of education among farmers, so that considering a variety of education ratings (Illiterate, primary, secondary school, Diploma and Higher education); approximately 2.17% achieved a maximum of elementary level. More than half of the farmers (76%) stated agriculture to be their main business and main source of income without any side or second jobs. The average area under cultivation is 11.58 ha and 87% of the sites have no product diversity. The major crops are alfalfa, barley, wheat, and beets, respectively. In order to assess the technical knowledge of farmers regarding agricultural water management practices, in this study 18 items (Table 1) were used, with a value of 1 for correct answers and a value of 0 for incorrect or no answers.

As Table 2 shows, the technical knowledge of

Table 1: Items related to the evaluation of technical knowledge of agricultural water management.

Rank	Items	M	SD
1	What should be done to reduce water waste in traditional brooks and streams?	0.93	0.246
2	What positive impact does land smoothing have in a region with less water?	0.89	0.309
3	What is the relationship between ploughing the field and weeds with soil moisture?	0.85	0.356
4	What is the effect of the density of plants and sown seeds in low-water seasons on agricultural products?	0.75	0.434
5	In low-water seasons, what kind of seeds should be used depending on the type of the agricultural product?	0.72	0.447
6	In low-water seasons, how should fertilizers be used depending on the type of crop?	0.66	0.473
7	Which irrigation method is widely used on dry and low-water land?	0.61	0.488
8	What is the advantage of early-maturing cultivars in low-water conditions?	0.57	0.496
9	When is the most critical time of water requirement depending on the crop type?	0.51	0.501
10	During low-water seasons, what kinds of fertilizers should be used to increase plant resistance?	0.44	0.497
11	What is the difference between irrigation in the early- and late-maturing cultivars?	0.32	0.468
12	What is the relationship between burning of agricultural residues after harvesting and soil moisture?	0.29	0.457
13	What is the effect of grazing the previous season's plant residues in low-water seasons on soil moisture?	0.23	0.423
14	In drought conditions, what are the benefits of stubble in farms after harvesting?	0.15	0.361
15	What is the role of the supplemental irrigation of dry farming for plant growth?	0.07	0.252
16	What kind of plough should be used in low-water seasons?	0.04	0.203
17	In low-water seasons, which kind of spraying should be used against weeds?	0.04	0.203
18	In weed control, to reduce soil stirring and the evaporation of moisture, what kind of cultivators should be used?	0.03	0.177

Table 2: Frequency distribution of farmers according to their technical knowledge of water management.

Technical knowledge level	Frequency	%	Cumulative percentage
Poor	54	19.3	19.3
Average	122	43.6	62.9
Good	65	23.2	86.1
High	39	13.9	100
Total	280	100	-

Minimum: 3, Maximum: 16, Mean: 7.13, SD: 2.91

more than half of the farmers is good and moderate and only 19.3% of farmers have poor technical knowledge.

Relationship between variables

Table 3 shows the results concerning the relationship between the dependent variable adoption of the sprinkler irrigation system and independent variables. According to Table 3, two variables age and education level among environmental factors have no effect on the adoption of sprinkler irrigation system by farmers, and three variables of agriculture being the main job, education participation and extension courses and technical knowledge of adopters on water management have significant and positive effects on the adoption of the sprinkler irrigation system. The family labour force number has a negative and significant impact at the 0.01 (1%) significance level, and among the environmental factors two variables soil type and land slope have been ineffective. The variable area under cultivation, at the 0.01 (1%) significance level, has a significant and positive effect. Two variables access to water and irrigation water quality have a significant negative effect on adoption.

logit model

Firstly, of a total of 11 variables, three of these the number of family members in the labour force, area under cultivation, and technical knowledge which are defined based on the interval scale, and four variables agriculture as the main job, participation in extension-education courses, access to water and water quality based on Table 4 are defined as dummy, and had a significant relationship with the dependent variable adoption of sprinkler irrigation system were entered into the logistic regression equation.

Based on the results (Table 5), and according to significance level by the Wald test, three-step regression analysis removed the independent variables with less impact at each stage, so that in the second step the variable of access to water, and in the third step, the variable of participation in extension-education courses, were removed from the regression equation. The indicator of the Chi-squared test in the third step

Table 3: The relationship between the research-dependent variable with independent variables.

	Independent variable	Dependent variable	χ^2	p value	V	p value	Phi	p value
Non environmental factors	Age	Adoption	2.133	0.545	-	-	-	-
	Education	Adoption	7.503	0.112	-	-	-	-
	Agriculture as the main job	Adoption	27.983**	0.000	-	-	0.316	0.000
	The number of labour force	Adoption	15.735**	0.001	-0.237	0.001	-	-
	Technical knowledge	Adoption	25.699**	0.000	0.303	0.000	-	-
	Participating in education & extension courses	Adoption	5.758*	0.012	-	-	0.143	0.016
Environmental factors	Soil type	Adoption	0.862	0.353	-	-	-	-
	Land slope	Adoption	1.400	0.237	-	-	-	-
	area under cultivation	Adoption	53.308**	0.000	0.428	0.000	-	-
	Access to water	Adoption	6.303*	0.012	-	-	-0.150	0.012
	Water quality	Adoption	48.557**	0.000	-	-	-0.416	0.000

Minimum: 3, Maximum: 16, Mean: 7.13, SD: 2.91

Table 4: Dummy variables affecting the adoption of sprinkler irrigation.

Variable	Value	
	1	0
Agriculture as the main job	Main job	Secondary job
Participation in education courses	Participating	Not participating
Access to water	High	Low
Water quality	Saline	Non-saline

Table 5: Regression

SteplevelFrequency	Nagelkerke R Square	Chi square	p value
1	0.618	156.994	0.000
2	0.625	155.932	0.000
3	0.632	154.967	0.000

is equal to 154.967, which is significant at the 0.01(1%) significance level and is indicative of the overall significance of the model. Nagelkerke R Square, which is equal to R^2 in linear regression, is 0.632 in the third step, indicating that 63.2% of the variability of the dependent variable (adoption) is presented by variables of labour force numbers, area under cultivation, technical knowledge, agriculture as the main job and water quality.

Variable coefficients, the Wald test and significance levels are shown in Table 6. Based on the B-values in the table and constant value in the last step of the regression analysis equal to 2.998, the regression equation is obtained as follows:

$$\ln (p/1-p)=2.998-0.927x_1+0.870x_2+2.077x_3+1.578x_4-2.473x_5$$

Dissatisfaction factors among adopters

One way to encourage the increased participation of farmers is to attain a high level of satisfaction in current sprinkler irrigation users. Of the total 140 surveyed, 75% of farmers (105 in total) used a classical fixed underground system

Table 6: Independent variables with the most significant effects on the dependent variable (second step).

Independent variable	B	SD	Wald	df	p value
Labour force numbers (X_1)	-0.927	0.234	15.638	1	0.000
Technical knowledge (X_2)	0.870	0.202	18.450	1	0.000
Agriculture as the main job (X_3)	2.077	0.402	26.741	1	0.000
Area under cultivation (X_4)	1.578	0.337	21.949	1	0.000
Water quality (X_5)	-2.473	0.445	30.921	1	0.000

Table 7: Frequency distribution of reasons for adopter's dissatisfaction.

Responses	Priorities	Frequency	%
Failure to adequately train farmers as to maintenance after system installation and their scientific and practical justification	1	128	91.43
Non – availability of efficient repairs	2	69	49.28
Inappropriate design and implementation by companies	3	42	30
low – quality of components and fittings	4	34	24.28
Clogging of sprinklers due to salty water	5	32	22.86
Non-compliance with environmental conditions	6	24	17.14
Difficulty using machines& large area occupied by the systems	7	20	14.28
System transportation	8	15	10.71
Parts shortage	9	12	8.57
Lack of security and the possibility of the theft of parts and fittings	10	8	5.71
Communal ownership of water resources	11	6	4.28

(solid set) and the remaining 25% used either centre-pivot systems (20 farmers) or wheel move systems (15 farmers). The highest rate of satisfaction was for the classical fixed underground system due to its security and impossibility of the theft of its parts. A total of 85% of water sources are obtained from wells, followed by springs, aqueducts and rivers.

In order to investigate dissatisfaction factors among adopters, content analysis of open-ended questions is performed. According to Table 7 these include: failure to adequately train farmers as to maintenance after system installation and their scientific and practical justification, non-availability of efficient repairs, inappropriate design and implementation by companies for example system mismatch with the farms' size low quality of components and fittings, clogging of sprinklers due to salty water, non-compliance with environmental conditions for example installation of Wheel move systems in windy areas difficulty using machines and large areas occupied by the systems, system transportation, parts shortages, lack of security and the possibility of the theft of parts and fittings, and finally communal ownership of water resources had the greatest impact on the dissatisfaction of farmers.

DISCUSSION AND CONCLUSIONS

According to the results obtained among non-environmental factors, two variables of age and education had no effect on the adoption of the sprinkler irrigation system by farmers. The variable of the number of family members in the labour force had a significant and negative impact on adoption at the 0.01 (1%) significance level, which is due to the use of family labour force for irrigation in particular. The obtained results are in consistent with Bakhshudeh (2008) and Kohansal (2009). Agriculture being the main job of a participant had a significant and positive impact on adoption, so that this leads to their effort to improve their farming level which is in consistent with Shahpasand (1998) and Bakhshudeh (2008) studies as well. Participation in education and extension courses had a positive and significant impact on adoption at the 0.05(5%) significance level, which is consistent with studies performed by Adeoti (2009), Nguyen (2008), Pezeshkirad *et al*. (2011), and Yigezu *et al*. (2013). Among other variables that had a positive and significant influence on the adoption of the sprinkler irrigation system is technical knowledge of farmers regarding agricultural water management, and the results obtained in this study confirm those by Amirkhani *et al.* (2010) and Nowruzi and Chizari (2006). Among the environmental factors, soil type had no effect on adoption, despite, according to soil tests, there being cases where the high percentage of clay (over 48%) ruled out the possibility of using sprinkler irrigation. The variable of land slope appears to have no significant impact on adoption, because Famenin is located in the plains. The variable of the area under cultivation had a significant and positive impact on adoption at the 0.01(1%) significance level, mostly due to more efficient sprinkler irrigation systems in medium and large farms and the use of equipment and methods that lead to savings in the labour force and increased efficiency. These findings confirm research by Albrecht and Ladewing (1999) and Dinar and Yaron (1990). Two variables of access to water and irrigation water quality had a significant and negative impact on adoption. It can be said that farmers who are faced with high water restrictions are more likely than other farmers to accept this method. On water quality we can say that one of the serious problems in the surveyed region towards adoption of the sprinkler irrigation system is the salinity of water, which, because of excessive exploitation of groundwater and digging of unauthorized wells, aggravates the seriousness of the situation. The results are consistent with Karami and Rezaei Moghdam (2002), and Wang (2008).

The results of the logistic regression show that 63.2% of the variability of the dependent variable (adoption) is explained and determined by the variable of labour force number, area under cultivation, technical knowledge, agriculture as the main job, and water quality.

By considering the dissatisfaction of the adopter using content analyses of open-ended questions, the results obtained show that failure to adequately train farmers in maintenance after system installation, their scientific and practical justifications, non-availability of efficient repairs, inappropriate design and implementation by companies for example system mismatch with farm size low quality of components and fittings, clogging of sprinklers due to salty water, non-compliance with environmental conditions for example installation of wheel move systems in windy areas difficulty using machines and large area occupied by the systems, parts shortages, transportation, lack of security and the possibility of stealing parts and fittings, and communal ownership of water resources had the greatest impact on the dissatisfaction of farmers. The results support the findings obtained by Amiri Ardakani and Zamani (2003), Azami *et al*. (2011), Dechmi *et al*. (2003), Karami and Rezaei Moghadam (2002), Jahannama (2001), Jalali and Karami (2006) and Lahannama (2002).

In this regard, in order to achieve the sustainability, development and expansion of the sprinkler irrigation system, the expectations and needs of its adopters should be considered.

In the following some recommendations are offered:

In order to solve farmers' problems, it is suggested that in addition to design and installation companies, other organizations should be established to provide services and training courses to farmers and their scientific justification after installation, and, for this, funding should be allocated.

Considering government grants in recent years to implement sprinkler irrigation systems and a greater tendency of large farm owners to do so, it is suggested that studies on the implementation of the system's compatibility with small farms be researched.

Given that inappropriate design and implementation is one of the dissatisfaction factors of adopters, the companies that install and run these systems should give more attention to engineering principles and make an arrangement to compensate farmers' losses in the case of inappropriate and/or poor design and implementation.

In order to control the salinity of water and excessive groundwater exploitation by farmers, it is necessary that the Department of Water Affairs installs volumetric flow meters as soon as possible.

Considering groundwater dropping in the surveyed area and high water consumption crops like alfalfa, barley and wheat it is recommended to change farming patterns and move toward crops with lower water consumption, such as canola.

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