Effective Factors on Discontinuance of Sprinkler Irrigation Systems among Farmers in West Azerbaijan Province of Iran

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Abstract: The purpose of this study was to determine effective factors on discontinuance of sprinkler irrigation systems (SIS) among farmers in West Azerbaijan Province of Iran. A causal-comparative design was used and data was collected by means of questionnaire and interview with farmers who had used SIS and at least produced and harvested one agricultural crop in West Azerbaijan Province, as the target population. The sample was obtained through proportional stratified sampling (n=124). Instrument validity was established by a panel of experts and reliability analysis yielded an alpha value of 0.81. Study results showed that approximately 30% (n=36) of farmers discontinued use of SIS. The findings indicated that there was a statistically significant difference between adopters who continued SIS regarding some dependent variables including respondents' personal and farming characteristics and respondents' viewpoints about installing and keeping SIS). The result of discriminate analysis showed that "use of river as water source", "use of Gun system to farm irrigation", and "system design", were identified as the most discriminative factors (99.20% of population), affecting discontinuance of SIS.

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Iran has an average annual rainfall of 252 millimeters, and 90 percent of its area is considered as arid and semi-arid. In order to respond to increase in demand for water in this country, most politics are focusing on supply water management includes constructing dams, irrigation channels, and Make full use of groundwater that usually whole of this increasing demand with more extraction is provided by traditional methods from groundwater sources. On the other hand, the use of traditional irrigation methods with on-farm irrigation efficiencies ranged between 23 and 32% causes that the balance between amount of using groundwater sources (55 billion m^3) and extraction of groundwater (45 billion m^3) eliminates (U1-Hassan *et al.*, 2007). Thus, it is essential to pay more attention to demand for water management politics such as using modern irrigation systems. many authors have investigated Many effective factors on adopting SIS Kebede et al., 1993; Noruzi and Chizari, 2006; Skaggs, 2001; Caswell and Zilberman, 1985; Stevens, 2006; Xue et al., 2007; Tollefson et al., 2002; Barja1, 2002; Shrestha and Gopalakrishnan, 1993; Caswell, 1991) or have assessed different irrigation methods at specific places (Tecle and Yitayew, 1990; Karami, 2006). These studies show that farmers choose the best system based on their knowledge and information, economic and social conditions, and amount of society and government support that they expect to get these consequences such as good control of water application, rapid germination, saving labor and energy expenditures, applying nutrients through the irrigation system, and decreasing plant diseases on level of farm by using (Skaggs, 2001; Qassim, 2003). If these phases aren't done very well in this process, it will cause dissatisfaction and discontinuance using of SIS as an innovation.

Few studies have been conducted in discontinuance of an innovation, so that there is little information about this important aspect of behavior. Karami (2006) stated that discontinuance of an innovation is a decision to reject it after having adopted it. Rogers (1995) believed that this discontinuance may occur because of a better idea or dissatisfaction from innovation performance. Leuthold (1967) believed that in determining the extent of adoption of an innovation, the rate of discontinuance is as important as the rate of adoption. Researches among the USA and Canadian farmers indicated that innovators and early adopters, and laggards have the least and the most of extend of innovation discontinuance, respectively. Available data from theses researches showed that rate of discontinuance ranges from 14 to 40 percent of adopters (Bishop and Coughenour, 1964; Leuthold, 1967). Sofranko et al. (2004) used the term "de-adoption" to describe using discontinuance of previously adopted innovation and identifying non-

profitability as the main reason for innovation discontinuance in farmers of Illinois. Oladele (2005) research showed that lack of extension contacts are the main reason for innovation discontinuance in farmers of Nigeria. Kulecho and Weatherhead (2005) identified three reasons for micro-irrigation discontinuance among farmers in Kenya including: lack of maintenance, irrelevant cultural background and unreliable water supply. Kolawole et al (2003) identified three forms of immediate, gradual and rapid discontinuance in terms of innovation nature and farmer conditions in Ekiti state of Nigeria. Kulecho and Weatherhead (2005) found out in their research that inappropriate keeping, lack of social support, and unstable water sources were the main reasons for SIS discontinuance among farmers in Nigeria. Report of Ul-Hassan et al (2007) shows that rate of using SIS has a slow rate in Iran. So, only 2 percent (250 thousand hectares) of farm lands is under cultivation with these systems. In many cases, even after installing these systems, a number of adopters end up with disenchantment discontinuity and return to traditional methods. Now, this study attempts to reply this question: what reason is considered, in spite of expensive cost to install system, farmer X continues its use and farmer Y discontinues it after a while and returns to traditional irrigation system?

The main purpose of this study was to examine the effective factors on discontinuance of SIS among farmers in West Azerbaijan Province of Iran. The specific objectives were:

1. To determine personal and farming characteristics of farmers;
2. To determine viewpoints of farmers about Usefulness and;
3. To compare the selected independent variables between two groups of farmers, those who continued use of SIS and those who discontinued use of SIS;
4. To identify the major components of independent variables for discriminating farmers who continued

2. Materials and methods

A casual-comparative study was conducted to achieve research objectives. Farmers, who used SIS and at least produced one agricultural crop in the West Azerbaijan Province of Iran, were the target population of this study. Sample size was determined a Krejcie and Morgan (1970). Therefore, a sample of (n=124).West Azerbaijan Province is located in northwest of Iran, and produces many agricultural crops such as wheat, alfalfa, sugar beat, corn, and barely. This province is located between 36^{o} and 39^{o}E and 44^{o} and 47^{o}N. It has an area covering 37590 square kilometers and has a population of 2873459, out of which, 1148505 live in rural areas. Its annual rainfall average is 300-400 mm.

A questionnaire was to collect data. The instrument was divided into three sections. Section one was designed to gather data about farmers' personal and farming characteristics such as age, experience in farming, education level, farm acreage. Section two was designed to gather data about farmers' viewpoints regarding system design (11 items), and system's economic consequents (12 items). Third focused on farmers' viewpoints regarding the amount of social (7 items), organization (7 items), after sales-services (7 items) and extension-education (6 items) supports For using SIS. six-point Likert-type Scales ranged from 0=not at all, 1=very low, 2=low, 3=medium, 4=high, and 5=very high), were developed to measure variables in section 2 and section 3.. It should be noted that, although discontinues of SIS depends on local climate and soil characteristics in a complex way, local climate and soil characteristics may not vary much from field to field within a location. Therefore, these variables were not investigated in this research.

Face validity was established by a panel of experts consisting of faculty members at Tarbiat Modares University, Department of Agricultural Education and Extension, and Irrigation Sciences. The reliability for each of the section within the study were: system design=0.91; system's economic consequences=0.85; social supports for installing and using system=0.79; organizational supports for installing and using system=0.89; after sales-services=0.87; and extension and education supports for installing and using system=0.92

Data was collected through interview with farmers on their farms from June to August 2009. The data was coded and analyzed using the Statistical Package for the Social Science (SPSS 14). Descriptive statistics (frequencies, means, standard deviations, range, minimum, and maximum) were used to describe data. Independent sample t-test, Mann-Whitney test, Chi-Square test, and Stepwise Logistic Regression were employed to analyze the relationships and differences among variables.

3. Results and discussion

Finding for each objective will be presented in this section in the order outlined in the purpose and objective section, and will be discussed as follows.

Personal and farming characteristics of farmers:

Data analysis showed that all farmers who used SIS for irrigating were male. The mean age of farmers was 48 years old and the majority of them (50.6%) Were between 46 - 56 years old (Table 1). While 4.8% of farmers (n=6) were illiterate, 44.40% (n=55) had a primary school education. About

25.80% of farmers (n=32) had guidance level education and 25% (n=31) had high school or post secondary education. Respondents had, on average, 30 years of experience in agriculture and majority of them (36.3%) had an experience between 30 - 40 years. A majority of respondents (68.5%) farmed from 2 to 12 hectares of farm land. In other words, farmers owned 13 hectares of agricultural land that 7 hectares of which was irrigated by using of SIS. With regard to SIS type used by farmers, about 41.1% of the respondents (n=20) used Solid-Set, and approximately 11% (n=14) of them used Continuous Move. Regarding water resources,, about 16.1% of the farmers (n=20) used rivers and approximately 62% (n=77) of them used exclusive water well.

Farmers' viewpoints on system design, its economic consequences, and supports for installing and using it: viewpoints on installing and using SIS was investigated as described in the methodology section. For the purpose of characterization, the scores were labeled as: "weak", "mediate", "good", and "excellent". Based on means and standard deviations of the view point score, the four categories were determined by scores that within two standard deviations to the left of the mean on a normal curve, and two standard deviations to the right of the mean (Sadighi and Mohammadzadeh, 2002).

A = weak: A<Mean-SD
B = mediate: Mean-SD<B<Mean
C = good: Mean<C<Mean + SD
D = excellent: Mean + SD<D

Farmers' view points about system design ranged from 19 to 42 (M=34.63 and SD=5.92). Table 3 shows that a majority of farmers had "mediate (n=22 & f=17.70%) and good (n=78 & f=62.90%)" viewpoints about system design in their farms. Farmers' view points about system economic consequents ranged from 13 to 58 (M=43.70 and SD=11.32). Table 3 shows that a majority of farmers had "mediate (n=33 & f=26.60%) and good (n=62 & f=50%)" viewpoints on the system economic consequents. Farmers' view points about social supports installing and using it ranged from 12 to 32 (M=19.40 and SD=4.98). Table 3 indicates that a majority of farmers had "mediate (n=34 & f=27.40%) and good (n=11 & f=9%)" viewpoints about social supports for installing and using SIS. Farmers' view points about organization supports for installing and keeping SIS ranged from 3 to 21 (M=17.07 and SD=3.13). Table 3 indicates that a majority of farmers had "mediate (n=34 & f=27.40%) and good (n=67 & f=54%)" viewpoints about organization supports for installing and keeping SIS. Farmers' view points about after-sales services of SIS keeping ranged from 4 to 21 (M=11.67 and SD=3.62). Table 3 indicates that a majority of farmers had "mediate (n=43 & f=34.70%) and good (n=42 & f=34%)" viewpoints about after-sales services. Farmers' view points about extension-education supports for SIS ranged from 2 to 25 (M=15.11 and SD=6.54). Table 3 indicates that a majority of farmers had "mediate (n=47 & f=37.90%) and good (n=16 & f=13%)" viewpoints on extension-education supports for installing and keeping SIS.

Table 1: Respondents' personality and farming characteristics (n=124)

Variables	Items	f	%
Age	24-34	14	11.30
	35-45	28	22.60
	46-56	64	51.60
	57-67	18	14.50
Land under cultivation (Hectare)	2-12	85	68.50
	13-23	20	16.10
	24-34	13	10.60
	35-45	6	4.80
Size of land under cultivation using of SIS (Hectare)	2-4	18	14.50
	5-7	46	37.10
	8-10	33	26.60
	11-13	25	20.20
	14-16	2	1.60
Type of irrigation system	Gun	43	34.70
	Solid-Set	51	41.10
	Continuous Move	14	11.30
	Semi-Portable	16	12.90
Experience in farming (Year)	8-18	24	19.40
	19-29	43	34.70
	30-40	45	36.20
	41-51	12	9.70
water resource	River	20	16.10
	Spring	17	13.70
	Participatory water well	10	8.10
	Exclusive water well	77	62.10
Education level	Illiterate	6	4.80
	Primary school	55	44.40
	Guidance	32	25.80
	High school	28	22.60
	Post secondary	3	2.40

Table 2: Farmers' view point about supports for installing and keeping SIS (n=124)

Variables	Items	f	%
system Design	Weak	18	14.50
	Mediate	22	17.70
	Good	78	62.90
	Excellent	6	4.90
Social supports for installing and keeping SIS	Weak	24	19.40
	Mediate	34	27.30
	Good	55	44.40
	Excellent	11	8.90
after-sales services	Weak	19	15.30
	Mediate	43	34.70
	Good	42	33.90
	Excellent	20	16.10
System economic Consequents	Weak	17	13.70
	Mediate	33	26.60
	Good	62	50
	Excellent	12	9.70
Organization supports for installing and keeping SIS	Weak	13	10.50
	Mediate	34	27.40
	Good	67	54
	Excellent	10	8.10
Extension-education supports for installing and keeping SIS	Weak	24	19.40
	Mediate	47	37.90
	Good	16	12.90
	Excellent	37	29.80

Comparison of selected independent variables in two groups of farmers, those who continued use of SIS and those who discontinued use of SIS:

- Comparison of personal and farming *characteristics of farmers who continued use of the system* and those who did not.

An independent-samples t-test was conducted to evaluate the differences between these two groups of farmers. As shown in table 4, there was a statistically significant difference between two groups in terms of their age. The findings indicated that farmers who are still using the system are older that those who discontinued. This finding contradicts the results of various published literature (Rogers, 1995; Bishop and Coughenour, 1964; Leuthold, 1967).An independent-sample t-test was conducted to evaluate the differences between two groups. As shown in table 4, there was a statistically significant difference between two groups of farmers in terms of land under cultivation and irrigated farm Using SIS. The findings indicated that farmers who still use SIS had larger farms and larger irrigated farms using SIS, than those who discontinued. This supports Karami (2006) study. His study showed that using sprinkler irrigation was an inappropriate decision for farmers who had not good economic condition and they should not have used it.

- *Comparison of the viewpoints of two groups of farmers on system design, system economic consequences, and supports for using SIS.*

Mann-Whitney tests were conducted to evaluate the differences between two groups as shown in table 3; there were statistically significant differences in the viewpoints of two groups on system design and economic consequences of the system. The findings indicate that design of system and system economic consequents in continued users were better and more than discontinued users. This finding is consistent with the results of prior research (Sofranko et al., 2004; Kolawole et al., 2003).

As shown in table 3, there was a statistically significant difference in the viewpoints of two groups on Extension-education supports for installing SIS. The finding indicated that farmers, who are continuing the use of SIS, received stronger extension and educational supports. This finding supports the findings in Oladela (2005) study. The results implied that extension agents should continue extension-education supports after adoption of innovation, because in many systems Farmers often receive negative messages about adopted innovation.

Table 3: Comparison of independent variables in two groups of farmers

Variables	Continued users (n=88)	discontinued users (n=36)	t-test	P-value
	Mean	Mean		
Age	49.27	45	2.35*	0.020
Experience in farming	28.39	26.83	0.93	0.353
Size of land under cultivation	14.55	8.83	3.88***	0.000
irrigated farm using SIS	8.04	6.27	2.89**	0.004

Note: $P \leq 0.001^{***}$, $p \leq 0.01^{**}$, $p \leq 0.05^{*}$

As shown in table 4, there was a statistically significant difference in the viewpoints of two groups on social supports for SIS. The finding indicated that social supports for using SIS in farmers who are still using SIS was stronger compared to the supports received by those who discontinued SIS. This confirms also pointed by Kulecho and Weatherhead (2005).

Table 4: Comparison of independent variables in two groups of farmers

Variables	Mean Rank	Mean Rank	Z	U	p-value
Education level	60.06	68.46	-1.25	1369.50	0.209
system design	75.14	41.94	-4.69***	736	0.000
System economic consequents	72.84	37.22	-5.02***	674	0.000
After-sales services	59.93	55	-0.70	1458	0.484
Organization supports or using SIS	63.05	61.15	-0.97	1460	0.783
Extension-education supports or using SIS	61.18	51.06	-2.27*	1172	0.023
Social supports for using SIS	67.76	49.64	-2.56*	1121	0.010

Note: $P \leq 0.001^{***}$, $p \leq 0.01^{**}$, $p \leq 0.05^{*}$

The major components of independent variables for two groups of farmers

A forward stepwise logistic regression analysis technique was employed to identify the major components of independent variables for discriminating continued users from discontinued users of SIS. The statistically significant dependent variables in (an independent) t-test (table 3), Mann-Whitney test (table 4), and Chi-square test (table 4) were used as independent variables in logistic regression analysis. The findings indicated that the logistic regression stopped on the third step, and variables such as "use of river as water source" (Dummy variable), "use of Gun system for irrigation" (Dummy variable), and "system design " were found as the most important discriminative components of discontinuance of SIS. Table 5 shows the detail analysis of the logistic regression test. These factors made a valuable distinction among 99.20% of population. The variability of Chi-square shows high magnitude and effect of discriminative variables (variable components) on discontinuance of SIS (table 5).

For predicating framer's decision on continuance or discontinuance of SIS, the legit of f(x) function was calculated (Table 6). Based on statistically significant variables in the logistic regression analysis, and constant values, the logistic regression equation could be derived as follows:

$F(x) = 6.774 + 0.503 (X_1) + 0.109 (X_2) – 0.089 (X_3)$

The magnetite of f(x) could be predicted by determining the value of each major variable in this equation. The positive values of beta in this equation indicate that Increase in the value of these two variables (use of river as water source and use of Gun system for irrigation), raises the possibility of discontinuance.

Table 5- Discriminative dependent variables affecting discontinued user of SIS

Step	Variable	Correct Class%	Chi-square	df	p-value
1	Use of river as water source (X_1)	87.10	60.106***	1	0.000
2	Use of Gun system for irrigation (X_2)	96.80	121.847***	2	0.000
3	Appropriate and engineering design of system (X_3)	99.20	136.889***	3	0.000

Note: $P \leq 0.001^{***}$, $p \leq 0.01^{**}$, $p \leq 0.05^{*}$

Table 6: Variables in Logistic Regression Analysis

Variable	Beta	SE	df	P-value	EXP(B)
Use of river as water source (X_1)	0.503	0.870	1	0.007	0.001
Use of Gun system for irrigation (X_2)	0.109	0.022	1	0.007	1.085
System design (X_3)	-0.089	0.31	1	0.002	1.118
Constant	6.774	0.035	1	0.007	1.221

Note: -2 Log likelihood= 12.516; Cox & Snell R Square= 0.668; Nagelkerke R Square= 0.995

4. Conclusions

Continuance of innovation is another side of adoption of innovation that has been investigated in many studies. This study aimed at determining the factors influencing farmer's decision to continue or discontinue SIS. The result of this study showed that economic factors such as size of cultivated land, appropriate engineering design, system economic consequents, extension-education supports for SIS, social supports for use of SIS, type of system had an impact on continuing or discontinuing SIS. A model

was developed to predict who will continue SIS. Three variables including "use of river as a water source", "use of Gun system for irrigation" and "system design "were included in the model. The results of this study could help Government and donor agencies to predict who will continue SIS, and in which farms this system could be more effective. This prediction will result in more cost recovery and infrequent failure

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