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Research Article

AN INVESTIGATION INTO FACTORS AFFECTING THE ADOPTING OF DRIP IRRIGATION SYSTEM IN THE PLUM GARDENS BETWEEN 2002AND2012 (CASE STUDY)

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ABSTRACT
The drip irrigation has a specific position among irrigation methods as a result of providing the need of plants for water, minimizing water wasting, and saving water. Over the recent years, the government and the agricultural section have seriously paid attention to it. The present paper intends to study effective factors on adopting drip irrigation system in the plum gardens of Shahriar (located in Iran) between 2002 and 2012. With respect to the paradigm of the research, it is a quantitative research, and regarding control of variables, it is a descriptive-non experimental research. According to the results of the research, he farmers declare that the increase of efficiency, the improvement of crop quality, the need for fewer workers, the increase of performance, the increase of surface under cultivation, the explosion of rough lands, and the uniform irrigation of farms have encouraged them to adopt the drip irrigation system.

Keywords: *Drip Irrigation System, Plum Gardens, Crop Quality*

INTRODUCTION
Unfortunately, the use of water in the agriculture is not optimized. Usually, the surface irrigation system is used in Iran. In the surface irrigation, the water application efficiency is low and it maximally reaches 60 percent (Ebrahimi, 1997; Caswell and Zilberman, 1996). Some of the experts believe that increasing water efficiency is the first step to prevent water crisis. They declare that water use could be reduced up to 40-50 percent in the agriculture, up to 40-90 percent in the industry, and up to one-third in the cities (Hayati, Lari, 2000).

Innovation diffusion theory

Innovation diffusion theory (IDT) (Rogers, 1995) intends to represent information on the proper method for leading an innovative design from the invention stage to the application stage. IDT explains the innovative decision-making process that determines rate of applying inventions in practice. According to IDT, it is assumed that individuals could be categorized based on the rate of adopting innovation.The adaptors are categorized as the innovators, early adopters, early majority, late majority, and laggards. The categories are normally distributed (Rogers, 1995).

Table 1: The main characteristics of the innovation diffusion theory

The characteristics	Definition
Relative advantage	The perception that an innovation could cause improvements in the current condition (Moore and Benbasat, 1991)
Simple use	Understanding the difficulty or simplicity of adopting an innovation (Moore and Benbasat, 1991)
Notion	Understanding that applying an innovation creates a unified notion or status in a social system (Moore and Benbasat, 1991)
Observability	Observing others' using of a system in the organization (Moore and Benbasat, 1991)
Compatibility	The extent of compatibility of an innovation with the available values and previous needs and experiences of the potential users(Moore and Benbasat, 1991)
Results explaining ability	Tangibility of the results associated with innovation use, it includes visibility, and the ability to make relations(Moore and Benbasat, 1991)
Voluntary use	Perceiving the voluntary rate of the specific innovation(Moore and Benbasat, 1991)

The innovation diffusion theory also declares that there are four characteristics of relative advantage, compatibility, trialability, and observability to perform the innovation.

Agriculture is the main section of economic activities among the majority of the developing countries. A great part of the gross national product (GNP) and a high percent of employment in such countries belong to the agricultural section. The experience of the industrial countries indicates that efficiency in the agriculture is needed for economic self-sufficiency. Today, the excessive increase of natural resources consumption has caused a severe pressure on the environment. In much area, the present environment is more vulnerable than the previous decades. Though considerable improvements have occurred in the climatic quality and the condition of rivers in areas such as Europe and North America, a decline has occurred in environmental issues especially in vast areas of the developing countries. Despite the fact thatwater is one of the vital and non-renewable resources, agriculture has the most consumption of the available fresh water. In 2002, seventy percent of the fresh water consumed in the world belonged to the agriculture (Anonymous, 2003, Kijne, 2011), however, water distribution regarding time and space are not mostly in accordance with the needs of agriculture. Water is the most important factor that restricts agricultural development in the world, especially in the arid and semi-arid lands. Iran is considered as a land that confronts shortage of water. In Iran, the average annual rainfall approximately equals 250-300 mm and this is equal to one-third of the average annual rainfall on the earth. According to the announced statistics of the agriculture ministry of Iran, approximately 85 billion $m^3$of water is used to reach 65 million tons of the total agricultural production. Therefore, the water application efficiency of Iran approximately equals 0.7 kg per 100 kg water consumption. With regard to the limitation of water resources and the increase of population growth in Iran, it is necessary to study and improve water efficiency in agriculture (Sadat Mirayi and Farshi, 2003). The development of pressurized irrigation systems (sprinkler irrigation, drip irrigation) is one of the strategies that should be used by different relevant organizations (Namara& et al., 2007). In comparison with the traditional irrigation systems, the pressurized irrigation systems (PI) have higher water application efficiency; therefore, they have a specific position in the agricultural policy-planning especially in the lands that suffer from shortage of water (Valizadeh, 2003). Therefore, developing such systems among the farmers or the adopting of this technology by them is necessary (Karami and Rezaeimoghadam, 2002; Whittlesey, 2007). Moreover, the acceptance and development of many of the agricultural technologies by the target groups is one of the problems associated with the development of this technology (AmiriArdakani, and Zamani, 2010; Hea et al., 2007; Santos, 1996). Furthermore, the improvement of water application efficiency in agriculture, food safety, and sustainability of the food depends on the increase of water application efficiency, the improvement of managerial structure, and the optimization of water used, however, all of these depend on the fundamental changes in knowledge, attitude, skills,and behavioral changes among farmers (Kijine, 2001). Generally, a series of personal, psychological, social, economic, environmental, technical factors, and their consequences observed in the level of farms determine the reasons for selecting and accepting the irrigation technology and continuity of its use. Therefore, the farmers select a technology at the level of the farm based on their economic, social, and environmental conditions, their awareness of technologies, and supports of social entities and policymakers. Applying the technology has consequences such as the production increase based on the unit of surface, the increase of cultivation level, the change of dry lands into irrigated lands, saving water, minimizing labor cost, minimizing weed growth and diseases, and the easiness of consumption (Softranko et al., 2004).

Research Hypotheses

The present paper intends to determine factors that affect the adopting of drip irrigation system technology by the gardeners of Shahriar(located in Iran). In order to achieve the purpose, the following hypotheses have been investigated:

- The gardeners of plum gardens of Shahriar have a significant and positive attitude toward the adopting of drip irrigation.
- There is a significant and positive relation between economic factors and the adopting of drip irrigation system.

- There is a significant and positive relation between farming factors and adopting of drip irrigation system.
- There is a significant and positive relation between social factors and the adopting of drip irrigation system.

The studies on the adopting of irrigation methods indicate that diverse factors affect the acceptance of such technologies and these technologies cause different effects in different situations. According to the studies done by Caswell and Zilberman (1995) in the field of selecting irrigation technologies in California, the farmers who use the groundwater resources are more likely to accept drip and sprinkler irrigation technologies. According to this study, the type of crop also makes the farmers accept modern irrigation technologies. Caswell and Zilberman (1996) have also studied the effects of depth of well and land quality on selecting irrigation technology. Based on the findings of this research study, the adopting of drip and sprinkler irrigation technologies lead to the increase of crop yield. The use of the new irrigation technologies is probably more in lands whose quality is relatively low and water price is high. However, the surface irrigation technology is probably used in areas with heavy soil, cheap water, and plat lands. They have estimated the irrigation efficiency in traditional irrigation technologies of the west of US equal to 60 percent, this value equals 85% and 95% for sprinklerirrigation and drip irrigation respectively.

Dinar and Yaron (1992) studied the acceptance and non-acceptance of irrigation technologies. They found a significant relation between variables such as water price, crop price, and subsidy for purchasing irrigation equipment, and acceptance of irrigation technologies. The results of the other research in the field of effects of individual, structural, and environmental variables on the acceptance of irrigation technology (Albrecht and Ladwig, 1985) indicated that the size of farm was the most important factor that influenced the acceptance of irrigation technologies; however, environmental factors affected the perception and acceptance of irrigation technologies.

METHODOLOGY

The present paper intends to assess factors that affect the adopting of new irrigation method. To do so, the survey method is used. Regarding the method of receiving information, the present paper is in the realm of field study which is done based on the cross-sectional method in 2013. The present paper is a correlation based paper; however, it follows the ex-post-facto research method. It is because of the fact that the research is done in a natural situation, and the researcher studies the relation between variables without aiming to change the variables (Sarmad et al., 2008). In fact, the changes of the independent variable affect the dependent variable. Regarding purpose of the research, it is an applied research.

Statistical Population

The statistical population of the present paper encompasses the producers of garden products of Shahriar (located in Iran). With regard to the available statistics, 9500 operating units are active in the gardening of Shahriar. In next stage, the sample size is determined based on pre-test study and also Cochran's method.

Sampling Method

Since the statistical population is broad, it will be difficult to select the sample. Therefore, the random sampling method is used to distribute the questionnaires.

RESULTS AND DISCUSSION

Inferential statistics

- The gardeners of plum gardens of Shahriar (located in Iran) have a significant and positive attitude toward the adoptingof drip irrigation system.

Results of the correlation test indicate a significant and positive relation between the acceptance (adopting) and the gardeners' attitude. The gardeners' attitude is made up of the following seven issues. Since the level of significance is 5% and it is less than 0.05, there is a positive and significant relation between two variables of attitude and accepting the drip irrigation system. Consequently, the null hypothesis is rejected and the researcher's hypothesis is confirmed.

- Drip irrigation leads to saving water
- Drip irrigation minimizes soil erosion
- Drip irrigation minimizes weed growth
- Drip irrigation reduces annual costs
- Drip irrigation minimizes labor costs
- Drip irrigation increases crops
- The future advantages of drip irrigation system is more than its current costs

Table 2: The correlation test between attitude and adopting drip irrigation

the correlation test between attitude and adopting drip irrigation	Pearson correlation	Significance
	0.71	0.000

- There is a significant and positive relation between economic factors and the adopting of drip irrigation system.

Results of the correlation test indicate that the level of significance is 5% and it is less than 0.05.Therefore, there is a positive and significant relation between two variables of economic factors and the adoptingof drip irrigation system. Consequently, the null hypothesis is rejected and the researcher's hypothesis is confirmed.

Table 3: The correlation test between attitude and adopting drip irrigation

the correlation test between economic factors and the adopting of drip irrigation	Pearson correlation	Significance
	0.083	0.000

- There is a significant and positive relation between farming factors and adopting drip irrigation system.

Results of the correlation test indicate that the level of significance is 5% and it is less than 0.05. Therefore, there is a positive and significant relation between two variables of farming factors and adopting drip irrigation system. Consequently, the null hypothesis is rejected and the researcher's hypothesis is confirmed.

Table 4: The correlation test between farming factors and adopting drip irrigation system

the correlation test between farming factors and adopting drip irrigation system	Pearson correlation	Significance
	0.074	0.020

- There is a significant and positive relation between social factors and adopting drip irrigation system.

Results of the correlation test indicate that the level of significance is 5% and it is less than 0.05. Therefore, there is a positive and significant relation between two variables of social factors and adopting drip irrigation system. Consequently, the null hypothesis is rejected and the researcher's hypothesis is confirmed.

Table 5: The correlation test between social factors and adopting drip irrigation system

the correlation test between social factors and adopting drip irrigation system	Pearson correlation	Significance
	0.091	0.000

There are some problems to implement the drip irrigation system among the gardeners. The problems are mentioned in table 6, and they have been mentioned from the most important ones to the least important ones.

Table 6: Descriptive statistics

Descriptive Statistics

	N	Mean	Std. Deviation
Initial cost for providing the system	369	3.7073	1.01402
Absence of comprehensive training classes	369	3.6938	1.00865
Lack of required equipment	369	3.6883	.98240
high cost of particles	369	3.6883	1.02570
Improper time for holding training classes	369	3.6829	.99442
Lack of experienced work force	369	3.6667	1.02416
Lack of accordance between the system and climatic condition	369	3.6206	1.03588
Lack of insurance for irrigation systems	369	3.5989	1.03818
Useless administrative rules	369	3.5935	1.02287
companies' improper confronting with problems	369	3.5718	1.06366
Lack of security and risk of particles being stolen	369	3.5691	1.00066
Lack of shop centers for selling the particles in the city	369	3.5339	1.06044
Lack of awareness of issues	369	3.4905	1.06605
Small size of garden area	369	3.4878	1.10605
Short time for returning the received loans	369	3.4011	1.04601
Lack of security in the region	369	3.3957	1.04807
Valid N (listwise)	369		

The most important problems for implementing the drip irrigation system refers to lack of supporting services, the initial cost for providing the system, lack of comprehensive training classes, lack of the required equipment, and the high cost of the equipment.

An investigation into the most influential factors regarding the adopting of the drip irrigation system by the gardeners

In order to determine the effect of the aforementioned variables on the adopting of drip irrigation system by the gardeners (the statistical sample), the multiple regression analysis based on the stepwise method is used. The stepwise method is a method in which the strongest variables enter the regression in turns, and this process continues up to the stage that the error of significance test reaches 5 percent. In this research, after entering the variables that have a significant correlation with the dependent variable (adopting the drip irrigation system), the equation has had a progress up to three steps. The results indicate that in the first step, the variable of the effect of farmers' economic factors on adopting the drip irrigation enters the equation. The value of multiple correlation coefficients (R) equals 0.380 and the coefficient of determination (R^2) equals 0.232. In other words, 23.2 percent of the dependent variable changes (adopting) is determined by this variable. In the second step, the variable of "farming factors" enters the equation. Its multiple correlation coefficient equals 0.589, and its coefficient of determination equals 0.369. In other words, 13.7 percent of the dependent variable changes are determined by this variable. In the third step, the variable of "social factors" enters the equation. This variable increases the multiple correlation coefficient up to 0.754 and the coefficient of determination up to 0.451, therefore, 8.2 percent of the dependent variable changes is determined by this variable. According to the results, these three variables could determine 45.1 percent of changes related to the dependent variable (adopting drip irrigation systems) by the gardeners and the rest 54.9 percent is related to other factors that are not recognized in this research.

Table 7: the multiple-regression in order to study the effect of independent variables on the dependent variable

Sig	Adjusted coefficient R^2_{Ad}	Coefficient of determination R^2	Correlation coefficient R	Independent variable	Step
0/000	0/198	0/232	0/380	Economic factors	1
0/000	0/311	0/369	0/589	Farming factors	2
0/000	0/421	0/451	0/754	Social factors	3

the amount of effect of independent variables on the dependent variable

Sig	t	Beta standard coefficient	Beta non-standard coefficient	Independent variables
0/000	5/563	-	15/532	fixed coefficient -
0/000	2/253	0/466	2/32	(X_1)economic factors -
0/000	3/235	0/542	0/342	(X_2)farming factors -
0/001	1/365	0/425	1/52	(X_3)social factors -

According to the above explanations, the linear equation obtained from the regression is presented as follows:

$Y= 15.523+ 2.32X_1+.342X_2+ 1.52X_3$

The above equation indicates the significance of the regression equation. However, the regression equation does not indicate the relative significance of independent variables in t and f tests, it also does not predict the changes of the dependent variable. In order to determine the relative significance of independent variables in predicting the dependent variable, the value of Beta should be considered. This statistics indicates the effect of each independent variable on the dependent variable without considering the effect of other independent variables. Therefore, the variable of "farming factors" is the most effective independent variable on the dependent variable. The value of beta in this case equals 0.542. In other words, a unit of change in the standard deviation of the variable "farming factors "causes 0.542 units of change in the standard deviation of the dependent variable. The beta values of other variables are determined based on their significance of effectiveness on the dependent variable. Beta value equals 0.466 for the economic factors, and 0.425 for the social factors. Therefore, the improvement of these three variables could cause the farmers' satisfaction from agricultural products insurance. The gardeners are in contact with many people. In order to recognize the most influential characters in encouraging the gardeners to adopt the drip irrigation, a research has been done; the results of the research are represented in the following table.

Table 8: The descriptive statistics of farmers' methods of acquiring information

	N	Mean	Std. Deviation
Local leaders	369	3.7751	.95600
Other successful farmers	369	3.6829	.99442
Private experts	369	3.1680	1.28281
Promoters	369	2.3523	1.05578
Producing companies	369	2.2358	.98974
Administrative companies	369	1.9485	.87542
Valid N (listwise)	369		

Results of comparing means via independent T- test

In order to test research hypotheses, T-test has been used and its results are represented as follows:
According to the results of the T-test, there is a significant difference between being familiar with drip irrigation methods and participation of the rural youth in agricultural activities regarding their marital status. The significant difference equals one percent of error and 99 percent of confidence level. Therefore, the null hypothesis is rejected based on the research assumption about the difference equal to 5 percent of error.

Table 9: Comparing performance and familiarity with drip irrigation methods

The dependent variable	The independent variable	Standard deviation	Level of significance
Performance	Local leaders	3/19	.020
	The other successful farmers	3/18	.003
	Private experts	3/450	.000
	Producing companies	3/420	.000
	Administrative companies	2/345	.000

*** Significance at level of five percent*

Conclusion

Today, agriculture confronts many crises such as shortage of water, contamination of water resources, transferring agricultural water to other places, and low efficiency of water application in agriculture. In the arid and semi-arid countries, the protection of sustainability of irrigation systems needs applying more accurate plans and principles (Jin, 2005). Today, managing water resources is applied in two sections. The first section is supply management, and the second section is water demand management.The limitation of water resources and the pressure on water supplies have led to paying attention to the efficient and optimized management of water resources in the demand section. The demand management includes operations such as transferring water through canals, using groundwater for irrigation, and using a combination of both of the canal water and groundwater. With regard to the increasing need of Iran for the food as a result of population growth, and shortage of water, it is concluded that adopting pressurized irrigation systems help people for saving water, increasing surfaces under cultivation, and preventing soil erosion.

The sprinkler irrigation increases efficiency up to 70 percent and drip irrigation increases efficiency up to 95 percent, while in the surface irrigation method, the water application efficiency does not exceed 50 percent, and sometimes it is less than 35 percent (Keshavarz and Sadezadeh, 2000). Therefore, it is necessary to recognize factors that lead to taking advantage of this technology. The present paper has tried to recognize such factors. However, the low quality of connections and particles, improper design and implementation of the system by companies, useless administrative rules, lack of shop centers of the particles ad connections, and finally lack of insurance are the problems for implementing drip irrigation systems for the gardeners. These results are in accordance with the results of research studies done by Ardakani and Zamani (2003), Jahannama (2001), Lahanama (2002), and Dechmi (2003).

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