Indian J.Sci.Res. 5(1) : 9-15, 2014

ISSN : 0976-2876 (Print)
ISSN : 2250-0138 (Online)

FACTORS AFFECTING THE ADOPTION OF NEW IRRIGATION SYSTEMS BY IRANIAN FARMERS

GHOLAMREZAI SAEED[a], EBRAHIMI MOHAMMAD SADEGH[b1] AND ASLANI MARYAM[c]

[a]Department of Rural Development, Lorestan University, Iran
[b]Department of Rural Development, Isfahan University of Technology, Iran
[c]Department of Rural Development, Lorestan University, Iran

ABSTRACT

The main aim of this paper was to investigate factors affecting the adoption of new irrigation systems by farmers of Friedan County in Iran. This research was a applied research and in the terms of data collection was a survey research. The study population included all farmer owner in Friedan county (N=4000). Sample population was selected by use the Cochran formula (n=220). The main instrument used in this study was questionnaire. Validity of the questionnaire was confirmed by expert's viewpoint and doing the pretest. The reliability of the questionnaire was confirmed by examine the Alfa Cronbach that was equal 0.978 in all section and in the tendency of modern methods, economic tendency, farmers' awareness, social interaction and support needs of farmers was 0.835, 0.815, 0.819, 0.722 and 0.756 respectively. The results of research indicated five factors: economic, social, support, individual and environmental factors that explain 55% of variance of the use of presser irrigation systems by farmers.

KEYWORDS : Pressure irrigation, Effecting factors, Factor analysis, Friedan County

One of the greatest limits to agricultural productivity is insufficient irrigation. The agricultural sector has the most important place in the macroeconomics of Iran. Irrigation technology has the potential to dramatically increase water use efficiency in crop production in arid and semiarid regions of Iran (Kohpaie and Ebrahimi, 2003). Iran is located in arid and semi-arid regions with average annual precipitation of 250 mm. In these regions the main constraint for agricultural development is water shortage. Improved water use efficiency in agriculture is advocated to reduce water use among existing users and to increase the supply available for new users (Bagheri and Ghorbani, 2011). Each irrigation method has different characteristics that could make it the most suitable for a particular situation. When considering the different irrigation methods, it is important to remember that any method that is well designed, is properly installed and operated, and well maintained can give the desired results. Sprinkler irrigation is the most widely accepted method in Iranian fields. This system simulates the natural rainfall and is easy to operate. However, it is capital intensive and requires high amount of energy. In recent years government has been trying to extend Sprinkler systems, however because of technocratic view without holistic approach, its' adoption has encountered with several problems (Karaimi, 2006).

1.1. Conceptual framework

Due to the diversity of social, economic and natural factors influencing the adoption of irrigation technologies, making such a decision is not a simple process. Karami, 2006 believed that selection of appropriate irrigation methods is a very complex task. There is no general agreement on how to go about selecting an irrigation method. Extension agents and farmers are constantly confronted with the problem of choosing a particular irrigation method among possible alternatives. There is an increasing awareness that choosing irrigation methods, solely on the basis of economic viability, may not result in selection of the best alternative. A selection process that considers as many of the relevant criteria as possible is better than reliance on a single criterion. Cornish, 1998 described the factors with the greatest influence on the modern irrigation systems as follows: availability of water, type of exploitation (individual or communal schemes), farming system, role of government and private-sector agencies, marketing and finance. Several studies have shown that different factors can affect the attitude of people toward participation in new activities. All the reviewed literature indicated that economic factors are the most effective elements for attracting farmers to use of new irrigation systems (Everitt and Dunn, 1991, Oka, 2000). Apart from this, several studies indicate that individual

[1]**Corresponding author**

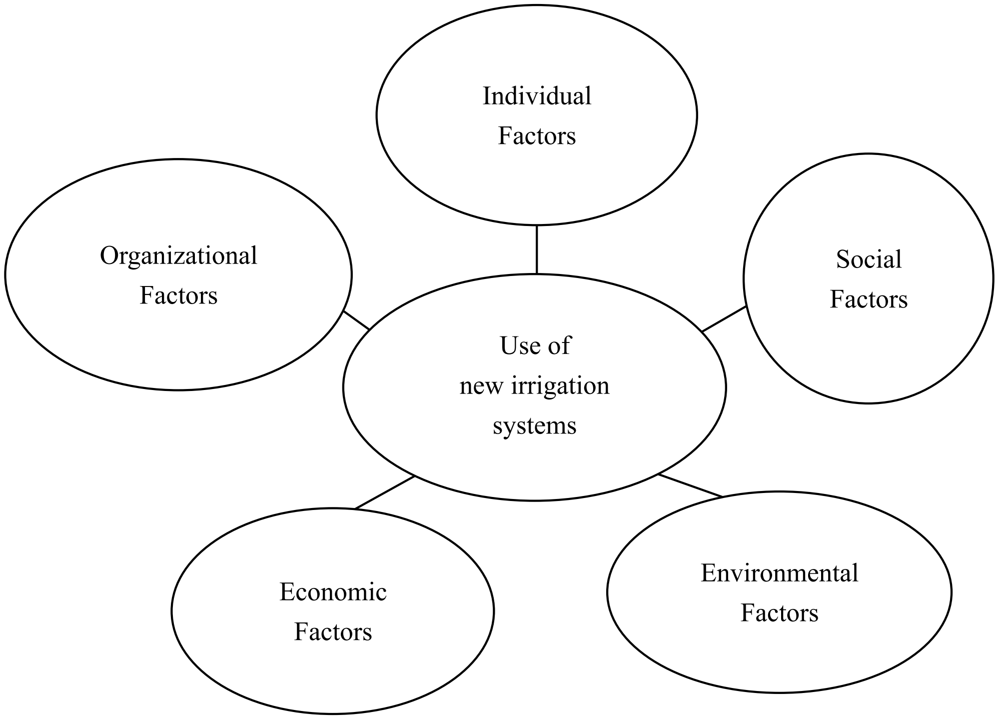

Figure 1: Conceptual framework for factors affecting the adoption of new irrigation systems

characteristics, organizational support (Vermillion and Sagardoy, 1999., Wituk et al., 2000), and social factors play an important role on attracting people to use of new irrigation systems (Musch and Schmidt-Kallert,2000). Schuck and et al., 2005) believed that while change s in irrigation technology can allow producers to continue production on lower levels of water applications, changes in return flows stemming from changes in irrigation technology can have profound impacts on both down stream flows and water quality. As a result, while more technically efficient irrigation systems can potentially help individual farms survive droughts, the regional effects may or may not be helpful. Therefore in this study, economic, social, climatic, individual and organizational factors have been considered as components of the conceptual framework (Figure 1). According to this framework, these factors have direct and indirect impact on attracting farmers to join pressure-irrigation systems. This study is an attempt to empirically test this conceptual framework among farmers of Faridan County.

MATERIALS AND METHODS

This study is applied research, carried out by the survey method. The statistical population consisted of 4000 farmers in Faridan, in the Isfahan province in Iran. From that population, 220 people were selected randomly using multi-stage sampling from two groups of farmers: those who are the member of pressure-irrigation systems. The questionnaire-by-interview method was used for data collection. To examine the reliability of the questionnaire, a pilot test was conducted on 25 tea farmers in Faridan county, and the Cronbachs Alpha coefficients for the different variables on Likert type scales were calculated. The results of the Alpha coefficients (shown in Table 1) indicated that the selected scales were appropriate.

In this study, descriptive statistics, correlation coefficients, mean contrasts and path analysis were used for data analysis. Mean contrasts t-tests and Mann Whitney U-tests were used.

To determine the appropriateness of data and measure the homogeneity of variables attracting farmers to new irrigation systems, the Kaiser-Meyer-Olkin (KMO)

Table 1 : Reliability Analysis(Alpha)

Scale Name	No. of items	Alpha Value
Organizational characteristic	6	0.756
Attitude to pressure-irrigation systems	8	0.835
Economic characteristic	7	0.815
Environmental characteristic	9	0.722
Social characteristic	10	0.819

Table 2 : KMO measure and bartlett's test to assess appropriateness of the data for factor analysis

KMO	Bartlett's test of sphericity	
	Approx. chi -square	Sig.
0.730	2875.44	0.000

and Bartlett's test measures were applied. These statistics show the extent to which the indicators of a construct belong to each other. The KMO and Bartlett's test results obtained for these variables show that the data are appropriate for factor analysis (table 2).

Factor analysis is a statistical method that is based on the correlation analysis of multi-variables. The purpose is to reduce multiple variables to a lesser number of underlying factors that are measured by the variables. Factors are formed by grouping the variables that have a correlation with each other. Factor analysis is effective when the sample size is more than 300. There are mainly four stages in factor analysis (Emin et al., 2007).

a. Initial solution: Variables are selected and an inter correlation matrix is generated for including all of the variables. An inter-correlation matrix is a k k (where k equals the number of variables) array of the correlation coefficients of the variables with each other. When the degree of correlation between the variables is weak, it is not feasible for these variables to have a common factor, and a correlation between these variables is not studied. KaiserMeyerOlkin (KMO) and Bartlett's tests of sphericity (BTS) are then applied to the studied variables in order to validate if the remaining variables are factorable. The KMO value should be greater than 0.5 for a satisfactory factor analysis. BTS, on the other hand, should show that the correlation matrix is not an identity matrix by giving a significance value smaller than 0.001.

b. Extracting the factors: An appropriate number of components (factors) are extracted from the correlation matrix based on the initial solution. In the initial solution, each variable is standardized to have a mean of 0.0 and a standard deviation of 71.0. Thus, the eigenvalue of the factor should be greater than or equal to 1.0, if it is to be extracted.

c. Rotating the factors: Sometimes one or more variables may load about the same on more than one factor, making the interpretation of the factors ambiguous. Thus, factors are rotated in order to clarify the relationship between the variables and the factors. While various methods can be used for factor rotation, the Varimax method is the most commonly used one.

d. Naming the factors: Results are then derived by analyzing the factor load of each variable. Appropriate names are given to each factor by considering the factor loads (Emin et al., 2007).

RESULTS

Survey respondents indicated that the tea gardens in Iran have structural problems that could be solved by the establishment of pressure-irrigation systems. Table 3 presents some of the respondents' key characteristics.

Table 3: Descriptive Statistics of Some Characteristics of Farmers

Variables	Mean	SD
Age	56.1	13.2
Agricultural work experience	33.1	16.6
Amount of land under pressure irrigation	3.8	2.9
Implementation of new irrigation systems	3.7	2.1

According to Table 4, more than 70% of the respondents were middle-aged, farmers have 33.1 Agricultural work experience and these have the average 4 ha land with irrigated land in new method.

Correlation analysis was used to analyze the relationship between the variables. Table 4 demonstrates significant correlation between use of new irrigation systems with age, agricultural work experience and number of labor.

Table 4 : Correlation between Variables

Variables	Correlation coefficient	Sig
Age	-0.159 *	0.018
Agricultural work experience	-0.172 *	0.010
The number of labor	0.260 **	0.000 *

*Significant at 0.05 level **Significant at 0.01 level

In the present study, 26 components were significantly loaded into five factors. These factors explained 54.73 per cent of total variance of components on attracting farmers in use of new irrigation systems.

However, the Kaiser criterion was utilized to arrive at a specific number of factors to extract. Based on this criterion, only factors with eigenvalues greater than one were retained. Accordingly, five factors with eigenvalues over one were extracted. The eigenvalues and percentage of variance explained by each factor are shown in Table 5.

Table 5 : Number of extracted factors, eigenvalues and variance explained by each factor

Factors	Eigenvalue	% of variance	Cumulative % of variance
1	5.062	18.078	18.078
2	3.624	12.944	31.022
3	2.899	10.352	41.374
4	2.126	7.593	48.967
5	1.613	5.762	54.729

Eigenvalues drive the variances explained by each factor. Sum of squares of factor's loadings (eigenvalue) indicates the relative importance of each factor in accounting for the variance associated with the set of variables being analyzed. According to Table (5) eigenvalues for factor 1 through 5 are 5.062, 3.624, 2.899, 2.126 and 1.613, respectively.

The percentage of trace (variance explained by each of the five factors) is also shown in Table 6. The traces for factor 1 through 5 are 18.078, 12.944, 10.352, 7.593 and 5.762, respectively. The total percentage of the trace indicates how well a particular factor solution accounts for what all the variables together represent. This index for the present solution shows that 54.73 per cent of the total variance is represented by the variables contained in the factor matrix.

Table 6 : Variables loaded in the first factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Economic factor	Cultivation	0.937
	Average annual income from agriculture	0.930
	Funds received	0.875
	Average farm assets	0.638
	Average non -farm assets	0.633

The varimax rotated factor analysis is shown in Tables 6-10. In determining factors, factor loadings greater than 0.50 were considered as to be significant. As anticipated, the first factor accounts for 18.078 per cent of variance and 5 variables were loaded significantly. These variables were presented in Table 7. A relevant name for this on loading's pattern is the “economic factor”. Eigenvalue of this factor is 5.062, which is placed at the first priority among the attracting farmers to use of new irrigation systems in Iran.

The second factor associated mostly with the variables related to social factor. Thus this factor can be named as the “social factor”. The eigenvalue for this factor

Table 7 : Variables loaded in the second factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Social factor	Farmers attitudes towards modern methods	0.674
	Farmers attitude towards irrigations	0.828
	Farmers' awareness of issues relating to irrigation	0.802
	Social interactions farmers in agriculture	0.703

Table 8 : Variables loaded in the third factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Organizational - support factor	Attending classes - promoting	0.702
	Visit the Agricultural Extension Offices	0.614
	TV programs of agricultural extension	0.533
	Radio programs of agricultural extension	0.540
	Book and other package of agricultural extension program	0.664

Table 9 : Variables loaded in the fourth factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Individual factor	Age	0.737
	Agricultural work experience	0.796
	The number of labor	0.565
	The number of family	0.612

was 3.624 which explain 12.944 per cent of the total variance (Table 7).

The name assigned to the third factor is the "organizational-support factor". This factor with an eigenvalue of 2.899 explains 10.352 per cent of the total variance of the attracting farmers to use of new irrigation systems in Iran (Table 8).

Table 10 : Variables loaded in the fifth factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Environmental factor	The number of dried wells	0.864
	the number of dried fountain	0.814

The fourth factor contains 4 variables relating to the "individual factor". These variables explain 7.593 per cent of total variance (Table 9).

The fifth factor associated with the variables related to geographical challenges. Thus this factor can be named the "Environmental factor". The eigenvalue for this factor is 1.613 which explains 5.762 per cent of the total variance (Table 10).

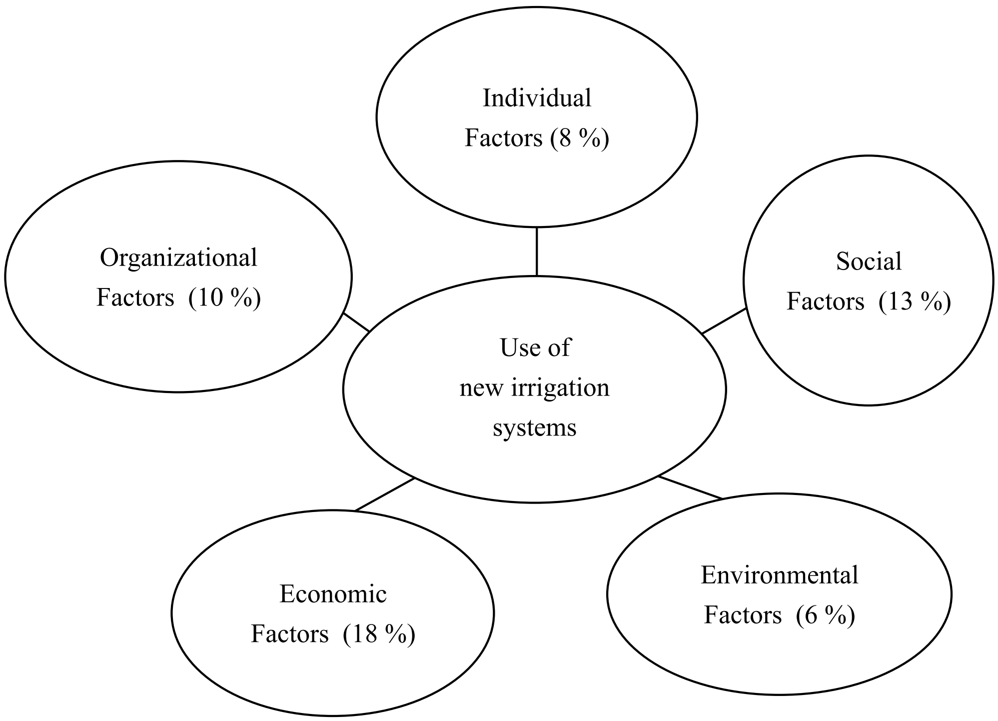

Figure 2: Factors affecting the adoption of new irrigation systems in Iran

CONCLUSIONS

The finding of the present study showed that more than more than 70% of the respondents were middle-aged, farmers have 33.1 Agricultural work experience and these have the average 4 ha land with irrigated land in new method. There was also a significant correlation between variables such as: age, agricultural work experience and number of labor with the use of farmers of new irrigation systems. In the present study, 26 components were significantly loaded into five factors. These factors explained 54.73 per cent of total variance of components on attracting farmers in use of new irrigation systems. These factors include the economic, social, organizational-support, individual and environmental factors (Figure 2). The first factor accounts for 18.078 per cent of variance and 5 variables were loaded significantly. A relevant name for this on loading's pattern is the "economic factor". In this factor loaded variables such as: cultivation, average annual income from agriculture, funds received, average farm assets and average non-farm assets.

The factor with the second-highest effect on attitude to farmers in use of new irrigation systems was the social factor. The social factor has estimated 12.944 per cent of variance and 4 variables were loaded significantly. In this factor loaded variables such as: farmer's attitudes towards modern methods, farmers attitude towards irrigations, farmers' awareness of issues relating to irrigation and social interactions farmers in agriculture. The third factor was organization-al-support factor. This factor has estimated 10.352 per cent of variance and 5 variables were loaded significantly. In this factor loaded variables such as: attending classes promoting, visit the agricultural extension offices, TV programs of agricultural extension, radio programs of agricultural extension and book and other package of agricultural extension program. The fourth factor contains 4 variables relating to the "individual factor". This variable explains 7.593 per cent of total variance and was included to: age, agricultural work experience, number of labor and number of family. The fifth factor associated with the variables related to geographical challenges. Thus this factor can be named the "Environmental factor". The factor which explains 5.762 per cent of the total variance and was included to: number of dried wells and number of dried fountain in the rural areas. Therefore these variables that loaded in these factors were the key important verbenas and factor to use new irrigation systems with farmers in Faridan county in Iran.

REFERENCES

Bagheri A and Ghorbani A., 2011. Adoption and non-adoption of sprinkler irrigation technology in Ardabil Province of Iran. African Journal of Agricultural Research, **6(5)**: 1085-1089.

Cornish GA (1998). "Pressurized irrigation technologies for smallholders in developing countries a review."The Journal of Irrigation and Drainage Systems **12**: 18-20.

Emin, M. O., Emel, L. O., Ercan, E. and Gamze, V., 2007. Industry financial ratios-application of factor analysis in Turkish construction industry. Building and Environment, **42**:385-392.

Everitt B. S. and Dunn G., 1991. Applied Multivariate Data Analysis. London: Edward Arnold.

Karami A., 2006. Appropriateness of farmer's adoption of irrigation methods: The application of the AHP model. Agricultural Systems. **87**: 101-119.

Koohpahi M. and Ebrahimi M.S., 2003. An investigation of the density of size distribution of Iranian tea gardens. The Iranian journal of rural development studies. **5**:1-8.

Musch A. and Schmidt-Kallert E., 2000. "Farmers' user groups in irrigated farming Betsiboka project in Madagascar," Journal of Agricultural and Rural Development, **1**: 41-43.

Oka T., 2000. "The Free-Rider Problem and Organization Messes in Self-Help Groups: Justification, Accusation and Exposure Stories in Qualitative Research." Presented at the 29th Annual Conference of Association for Research on Nonprofit Organization and Voluntary Action in New Orleans, USA, 16-18 November, 2000.

Oka T. and Borkman T., 2000. "The history, concepts and theories of self-help groups: from an international perspective."The Japanese Journal of Occupational Therapy, **34(7)**:718-722.

Schuck E. and et al., 2005. Adoption of More Technically Efficient Irrigation Systems as a Drought Response. Water Resources Development, **21(4)**: 651-662.

Vermillion D. and Sagardoy J. 1999. "Transfer of irrigation management services. "Irrigation and Drainage Paper 58. Food and Agricultural Organization of the United Nations. Rome.

Wituk A. et al., 2000. "Factors Contributing to the Survival of Self-Help Groups." Self-Help Network of Kansas, Wichita State University.