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The factors affecting on optimization of water use in greenhouses in Pakdasht city

Sedighe LayeghiMoghadam, Mehdi Rasouli, Mohammad Reza Soleimanpour
Department of Agricultural Extension and Education, Varamin-Pishva Branch, Islamic Azad University, Varamin, Iran

ABSTRACT

The main purpose of this study is aimed to determine the factors affecting on optimization of water use in greenhouses in Iran. The statistical population was 875 greenhouse owners working in Pakdasht. 269 people were selected through random sampling. A questionnaire was developed to collect the necessary data. Content and face validity of questionnaire were established by investigating the attitudes of some university professors and experts. Questionnaire reliability was estimated by calculating Cronbach's Alpha. According to the results, Cronbach's alpha for the respondents' questionnaires range 0.73 to 0.90 and so the reliability of questionnaire was confirmed. The results showed that 37.2% of the greenhouse owners with most frequently had work experience of 5 years or less. Based on the regression analysis, the variables of communication channels, technical and professional characteristics, and social participation can totally explain about 50 percent of changes of the dependent variable.
Keyword: greenhouses, water use, optimization, Pakdasht, Iran.

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INTRODUCTION

The tension on the water use by major user sectors (agriculture, industry and households) continues to increase. It is mostly aggravated by the scarcity of rainfall in recent years. Crop irrigation that consumes over 75% of available water is an important source of economy of this resource [1].

Water use by crops is of increasing concern as demands for water are growing while supplies are not. The overgrowing population and recent droughts are putting water resources under pressure and calling for new approaches for water planning and management if escalating conflicts are to be avoided and environmental degradation is to be reversed [2]. Irrigation is the major consumer of diverted water from surface and groundwater in the world. Therefore, it must be carried with high efficiency. One prerequisite for efficient irrigation is knowledge of consumptive use of major crops or their evapotranspiration. Such information is required to minimize percolation losses, runoff and thus environmental pollution [3]. The use of greenhouse in arid regions decreases crop water requirements by reducing evapotranspiration. The plastic cover utilized on these structures changes locally the radiation balance by entrapping long-wave radiation and creates a barrier to moisture losses [2].

Irrigated areas with traditional techniques are dominant. They are characterized by low efficiency, compounded by poor control of applied volume [1].

Adopted methodology is based on a regular monitoring of the water needs by using a probe with neutrons and alysimeter with pot; as well as restrictive water contributions at the stages of flowering and formation of fruits. The required principal objective is to appreciate the incidences of a hydrous constraint on the agricultural output of melon and to determine the fraction of the water needs to satisfy, likely to ensure a level of suitable production while sparing the mobilizable hydrous resources for this purpose [2].

During the studies data on water applied by the farmers was scarce as most farms did not have measuring devices. Due to pressure from the Government and local stakeholder organizations, farmers have installed water measuring instruments. Few studies have been undertaken on water requirement in greenhouse at Naivasha [4].

According to Bilderback, Dole and Sneed [5], a sufficient quantity of high quality water is extremely important for the production of nursery and greenhouse crops. Daily irrigation is required during most of the growing season for container crops that are predominantly grown in bark-based potting substrates, in the case of nurseries, and under protected cover that excludes precipitation, as in greenhouse production. This need for frequent irrigation requires careful planning and management, to ensure that operations have sufficient water to maintain adequate supplies for crop production.

The use of greenhouse in arid regions decreases crop water requirements by reducing evapotranspiration. The plastic cover utilized on these structures changes locally the radiation balance by entrapping long-wave radiation and creates a barrier to moisture losses. As a result ET is reduced by 60 to 85% compared to outside the greenhouse [6]. This leads to clear reduction in water demand when compared to field agriculture. Thus, greenhouse agriculture provides a way of increasing crop water use efficiency [2].

Baille [7] found that by applying a dense white paint to glass, a reduction of about 50% on solar radiation resulted. This drastic change in the greenhouse radiation load led to indirect modifications of other microclimatic variables such as air temperature and vapor pressure deficit, through the microclimate interactions. On the other hand, Orgaz *et al*. [3] conducted an experiment to determine K_c for horticultural crops under greenhouse (melon and watermelon). The K_c values were found to be similar to those under field conditions.

In another study Mears [8] stated that "While a greenhouse is generally regarded as necessary to provide a warm environment in cold climates, it has also been shown that with properly designed cooling system. It is possible to improve plant growing conditions under extensively hot conditions. Adaptation of modern technologies to arid conditions will undoubtedly lead to increased opportunities for production of high value plants and materials in areas where the environment is extremely harsh. Protected cultivation also has the potential benefit of substantially increasing plant productivity per unit water consumption which is important in many areas where water sources are severely limited".

Based on a research by Thompson *et al*. [9], 80% of cropping within greenhouses in Almeria is in soil, and drip irrigation is used in all greenhouses. The replacement of furrow irrigation with drip irrigation, during the 1980s, appreciably improved overall irrigation efficiency. However, given that current irrigation management is mostly based on experience, considerable scope remains for improved irrigation management practices at the farm-level. Information that contributes to improved irrigation management practices will assist in maintaining both the supply and quality of aquifer water, which are essential for the sustainability of this industry in its present form.

According to the reasons noted above, this research aimed to determine the factors affecting on optimization of water use in greenhouses in Iran. This study was conducted in Pakdasht where is a city of Tehran province.

MATERIALS AND METHODS

The methodological approach of this study employed an analytical method (correlational study).The study population consists of greenhouse owners in Pakdasht (N=875).Target population have been selected by random sampling method (n=269).On the basis of review of the literature, a questionnaire was developed to collect the necessary data. The questionnaire covered six areas: 1) Attitude towards optimization of water use were measured by 13 question;2) Technical and professional characteristics which were measured by 7 question; 3)Communication channels which were measured by 11 question; 4) Social participation which were measured by 8 question; 5) Optimizing water use which were measured by 10 question; 6)Training factors which were measured by 5 question. These questions were measured on a five-point Likert scale which ranged from 1(very low) to 5(very high).

Content and face validity of instrument were established by investigating the attitudes of some university professors and experts. A pilot study was conducted with 30 greenhouse owners. Questionnaire reliability was estimated by calculating Cronbach's Alpha. According to the result of table 1, reliability for the overall instrument was confirmed. The compiled data were saved at a data bank designed for this purpose. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS/18).In descriptive level, through statistical measures such as frequency, percentage, average, variance and standard deviation and in inferential level, Pierson and Spearman correlation coefficient and regression analysis have been used.

Table 1- Cronbach's alpha values for different parts of the questionnaire

parts of the questionnaire	Cronbach's alpha
Attitude towards optimization of water use	0.86
Technical and professional characteristics	0.83
Communication channels	0.73
Social participation	0.88
Optimizing water use	0.90
Training factors	0.74

RESULTS

Based on the results of this research, 81% of studied people were male and the average age of them was 37 years and more than half of them were under 40 years old. Most of the greenhouse owners had bachelor (22.7%) and 22.3% of them had a master's degree. The majority of respondents (58%) had a positive attitude towards water use optimization.

The results of table 2 shows that about 37.2% of the greenhouse owners with most frequently had work experience of 5 years or less. While only 16.7% of them had experienced over 15 years. Meanwhile, the average experience of surveyed people was 13.16 (Table 2).

Table 2- Distribution of greenhouse owners based on the work experience

Work experience	Frequency	Percent	Cumulative Percent
5 years or less	94	34.9	34.9
6 – 10 years	30	11.2	46.1
11 – 15 years	100	37.2	83.3
15 years or more	45	16.7	100
Total	269	100	—

Mean: 13.16 Mode: 12 SD: 5.63 Minimum: 1 Maximum: 18

In order to, to measure social participation of greenhouse owner 6 different questions were used. The results of table 3 shows that according to 30.5% of the surveyed people, with the highest frequency, social participation was described high, and only 7.8% of respondents believed that their social participation is very low.

Table 3- Distribution of greenhouse owners based on the social participation

Social participation	Frequency	Percent	Cumulative Percent
Very low	21	7.8	7.8
Low	58	21.6	29.4
Moderate	48	17.8	47.2
High	82	30.5	77.7
Very high	60	22.3	100
Total	269	100	—

Mean: 17.78 Mode: High SD: 5.89 Minimum: 8 Maximum: 28

Scale: (1-6= very low, 7-12= low, 13-18= moderate, 19-24= high, 25-30= very high)

In this study, 10 different questions were used to assess the amount of optimizing water use. The results of table 4 indicates that according to 31.2% of the surveyed people, with the highest frequency, optimizing water use was described high, and only 7.4% of respondents believed that the optimizing water use is very low.

Table 4- The amount of optimizing water use

Optimizing water use	Frequency	Percent	Cumulative Percent
Very low	20	7.4	7.4
Low	28	10.4	17.8
Moderate	71	26.4	44.2
High	84	31.2	75.4
Very high	66	24.5	100
Total	269	100	—

Mean: 30.50 Mode: High SD: 7.21 Minimum: 13 Maximum: 47

Scale: (1-10= very low, 11-20= low, 21-30= moderate, 31-40= high, 41-50= very high)

In order to compare the optimization of water use between different greenhouses which are being grouped according to various variables, the t-test was done for comparing two groups and ANOVA was used for comparing more than two groups. The results of t-test show that there is no significant difference between the optimization of water use of male and female greenhouse owners (Table 5).

Table 5- The results of t-test according to independent variables

Variable	Frequency	Mean	SD	t	sig.
gender	male: 218	2.68	0.347	0.453	0.123
	female: 51	2.18	0.324		

** Significant in 0.01 level; * Significant in 0.05 level

The ANOVA results show that there is no significant difference between the amounts of optimizing water use in different kind of greenhouses. So, the kind of greenhouse has no effect on the optimization of water use (table 6).

Table 6- The results of ANOVA according to independent variables

Variable	Frequency	Mean	SD	F	sig.
greenhouse	mechanized: 167	35.32	5.32	0.341	0.786
	semi- mechanized: 85	28.54	6.56		
	traditional: 17	29.18	6.87		

** Significant in 0.01 level; * Significant in 0.05 level

In this research to consider the relationship between independent and dependent variables Pierson and Spearman coefficients were used. The data of table 7 shows that the variable of using communication channels, education level of greenhouse owners, technical and professional characteristics, and social participation have positive and significant relation with optimization of water use in greenhouses. On the other hand, the variables of attitude, training factors, age and income of greenhouse owners had no significant relationship with dependent variable. Other results of correlation analysis are shown in the table 7.

Table 7- Relationship between optimization of water use and independent variables

Variables	Measure	Correlation Coefficient	r	Sig.
Attitude towards optimization of water use	Scale	Pearson	0.004	0.953
Using communication channels	Scale	Pearson	0.632**	0.000
Education	Ordinal	Spearman	0.582**	0.002
Training factors	Scale	Pearson	0.040	0.513
Age	Scale	Pearson	0.097	0.120
Technical and professional characteristics	Scale	Pearson	0.270**	0.001
Social participation	Scale	Pearson	0.269**	0.000
Income	Scale	Pearson	0.673	0.167

** Significant in 0.01 level; * Significant in 0.05 level

According to the results of regression analysis, in first step *communication channels* was entered in the equation that the multiple regression coefficient (R) was 0.589 and determining coefficient was 0.346. It means that 34.6 percent of changes of optimization of water use are explained by this variable. In the next step, the variable of *technical and professional characteristics* was entered in the equation. This variable increased the multiple regression coefficient of (R) to 0.620 and determining coefficient to 0.384 percent. Actually, this variable can explain 3.8 percent of changes of dependent variable. In the third step, the variable of *social participation* was entered in the equation that showed 0.705 of correlation coefficient and 0.497 of determining coefficient. This variable can explain 11.3 percent of changes in dependent variable (tables 8,9).

Table 8- Determining coefficients of effective variables in optimization of water use

step	R	R^2	R^2Ad
1	0.589	0.346	0.324
2	0.620	0.384	0.342
3	0.705	0.497	0.405

Table 9- Effect rate of variables in between optimization of water use

variables	B	*Beta*	t	Sig.
Constant coefficient	1.344	—	9.428**	0.000
Using communication channels (X_1)	0.410	0.325	4.231**	0.001
Technical and professional characteristics (X_2)	0.421	0.254	3.543**	0.005
Social participation (X_3)	0.479	0.221	3.273**	0.000

** Significant in 0.01 level; * Significant in 0.05 level

The results of the regression analysis shows that after entrance of all independent variables which had significant correlation with dependent variable, only the variables of *communication channels*, *technical and professional characteristics*, and *social participation* remained. These three variables can totally explain 49.7 percent of changes of the dependent variable. Of course, other changes are related to other elements which have not been studied in this research. So, According to the results, the linear equations of regression would be as follow:

$Y=1.344+0.410X_1+0.421X_2+0.479X_3$ *and*

$Y=0.325X_1+0.254X_2+0.221X_3$

DISCUSSION AND CONCLUSION

The importance of water for agricultural production differs from one place to another based on factors such as availability, quality and convenience. During this century, problems of water supply have been gradually increasing everywhere due to water pollution, drought, and water level depression in underground water. Although water supply problems are generally more apparent in dry climates, most places in the world are starting to experience water supply problems. Although there are many water conservation methods being applied in agriculture, there is a strong desire for more efficient methods. The ultimate goal of this study was to identify factors affecting on optimization of water use in greenhouses.

The results showed that there is no significant difference between the optimization of water use of male and female greenhouse owners and there is no significant difference between the amounts of optimizing water use in different kind of greenhouses.

The other consequences of this study were positive and significant correlation of communication channels, education, technical and professional characteristics, and social participation with optimization of water use in greenhouses. In fact, the more educated people and the greenhouse owners with more technical characteristics, and social participation used water more optimized. Also, the results of multiple regression showed that communication channels has more important effect in dependent variable of optimization of water use.

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