Relationships between farmers' environmental behaviors and water resource management: The case of Khuzestan Province, Iran.

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Aims: The present study concerns the environmental behaviors of farmers active in the Zohreh-Jarrahi, Maroun and Gotvand irrigation networks regarding water management in the farm.

Study design: cross-sectional study

Place and Duration of Study: This cross-sectional study was conducted in the afore-mentioned irrigation networks in the Khuzestan province between Janurary of 2008 and October of 2009.

Methodology: Using the simple random sampling technique, 278 farmers (26, 70 and 128 farmers from the Zohreh-Jarrahi, Maroun and Gotvand irrigation networks respectively) were chosen. This sample comprised of 258 males and 20 females, aged 16-87 years old. The theoretical framework of the present study was based on the key aspects of the health belief model (HBM), later completed by adding a few other effective variables. The data were then analyzed by the multivariable technique, using SPSS software.

Results: The findings of this study indicate that the key aspects of the health belief model significantly predict the farmers' water management behaviors. In other words, understanding the advantages and barriers associated with the preservation of water resources influences the farmers' water management behaviors through affecting their attitudes. Furthermore, existing attitudes towards water management practices in thereat, understanding the barriers associated with the preservation of water resources, and last but not least, perceived susceptibility against threats to water resources, all directly influence the farmers' water management behaviors. Access to information regarding advanced water management techniques in the farm is another variable included in the theoretical framework used for this study, playing a key role in predicting the farmers' management attitudes and behaviors.

Conclusion: The present study demonstrates a successful and clear application of the health belief model to water management in the farm using a few other significant variables, while enhancing the HBM for application to other issues related to the preservation of environmental resources. A few suggestions have been proposed at the end of the present study based on research findings.

Key Words: water management behavior, perception, health belief model, Irrigation network, Iran.

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1. INTRODUCTION

Water crisis is one of today's most formidable challenges across the world, particularly in arid and semi-arid regions like Iran. Many scientists are worried about the possibility of serious problems caused by using water resources in Iran without paying due attention to their limitations (Darvishi & Arkhi, 1998).

Situated in a high-pressure area (northern latitude of 30 degrees), Iran is mostly comprised of arid and semi-arid lands. In such regions, limited water resources constitute the most formidable obstacle to agricultural development. The mean annual precipitation rate in Iran is around 250mm, equivalent to one/third of the world average. Furthermore, about half of this precipitation occurs in around 25% of the country's area, following a highly irregular pattern of distribution. Most of this precipitation occurs out of the growing season. These factors are further exacerbated by long and consecutive periods of drought. In addition to precipitation, high evaporation (with an average rate of more than 2000mm) poses another challenge to Iran's already limited water resources. While comprising more than 1% of the world's total population, Iran has only 36% of its renewable freshwater resources. Studies have shown than in Iran, from around 88.5 billion cubic meters of freshwater resources, 93% is used for agriculture, 5% for drinking, and the rest for industry. Therefore, water resources are considered as the most crucial, and meanwhile, the most restrictive factor for agricultural development in Iran.

Since agricultural systems are essentially human systems, issues related to the farmers' perceptions, attitudes and behaviors can do much to explain the current crisis in water resources (Forouzani, 2003). This is because water management in the farm is influenced by a wide range of technical, economic, cultural and social factors. As manager of the operation unit, the farm operator should manage the available water resources using his knowledge and experience, based on the available resources to maximize productivity in proportion to available water resources (Akrami, 1996). Although in recent years farmers have become more aware of the destruction of environmental resources and its consequences, this raised awareness has not led to any change in their treatment of these resources. Other social, economic and psychological factors seem to be at work here, influencing the operators' decisions and their capacity to change their behavior (Bayard & Jolly, 2007).

Numerous studies have highlighted the role of social, economic and agricultural factors in shaping the farmers' water management practices in the farm. While emphasizing the influence of individual background and economic variables on the farm operators' attitudes and behaviors toward environmental resources, these studies also highlight the significance of perception to the process of change (Lichtenberg & Zimmerman, 1999 ; Bayard & Jolly, 2007; Gilg & Bar, 2006).

Bayard and Jolly (2007) have used the health belief model to assess people's environmental behaviors. This model emphasizes the four psychological aspects influencing people's decision to involve in a certain kind of behavior (Redding et al., 2000; Bayard & Jolly, 2007).

The present study is an attempt to assess the farmers' water management practices in the farm as one aspect of their environmental behaviors using the four key aspects of the health belief model. In other words, this study sets out to investigate the determinants of the farmers' water management practices in Zoheh-Jarrahi, Maroun and Gatvant irrigation networks in Khuzestan, Iran.

The Study of Theoretical Framework

Numerous studies have investigated the various variables predicting the farmers' behaviors toward environmental resources. The health belief model (HBM) concerns itself with the psychological aspects of people's behaviors when faced with different behavioral situations based on their attitudes towards, and perceptions of these situations. This model was proposed by social psychologists in the 1950's to be used in public health and disease

prevention programs. According to this model, people behave based on their individual perceptions, and on the premise that they are potentially vulnerable to various new situations which could have serious consequences as well. Based on this perception, adopting preventive measures can serve as effective protections against such challenges. The advantages associated with protection against new threats outweigh the costs associated with subsequent measures to mitigate already existing problems and challenges (Redding et al., 2000). The four key components of the health belief model directly influence the likelihood of adopting preventive measures in public health through creating an adequate understanding of the dangers associated with various types of problems and their consequences. Numerous studies have been conducted to investigate people's attitudes and behaviors based on the HBM's various aspects (Lichtenberg & Zimmerman, 1999 ; Bayard & Jolly, 2007). Furthermore, many studies have been conducted to examine people's behaviors toward environmental resources, highlighting the role of access to information regarding optimal methods of environmental protection in promoting the influence of the HBM's various components in predicting people's attitudes and behaviors toward environmental resources (Blank et al., 2007; Jalan & Samantan, 2008 & Moshtaq et al., 2006). Pahl et al., (2005) and Hensher et al., (2005), for instance, have studied the significant relationship between access to information on the one hand, and perceived vulnerability and the perceived advantages associated with adopting preventive measures on the other. Therefore, the following model (fig. 1) was tested to assess the farmers' water management attitudes and behaviors.

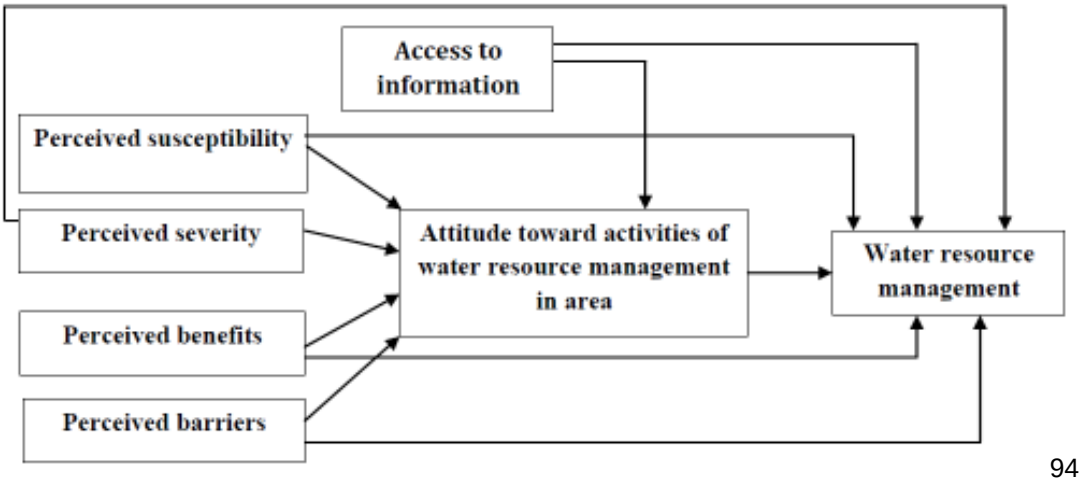


Fig. 1. The study theoretical framework

2. METHODOLOGY

This is a cross-sectional survey. The Statistical population consists of 1125 farm operators in the Zohreh-Jarrahi, Maroun and Gotvand irrigation networks in Khuzestan province, Iran. Based on the table compiled by Krejcie and Morgan (1970), a sample of 278 people was drawn using the simple random sampling technique. The Zohreh-Jarrahi, Maroun and Gotvand irrigation networks were represented by 70, 26 and 182 farm operators respectively, in proportion to the area of cultivated land and the number of farm operators in each district. A questionnaire was used for data collection. The questionnaire was designed after reviewing the relevant literature. According to the theoretical framework of the questionnaire, individual characteristics and hidden variables (5-15 questions), water management behaviors (15 statements), attitudes toward water management activities in the region (12 statements) access to information (7 statements), perceived susceptibility (5 statements), perceived severity of destruction (12 statements), perceived benefits (13

statements), and finally perceived barriers (6 statements) were measured. The participants' views on the variables of the research model were collected using the likert scale, ranging from "totally agree" (5) to "totally disagree" (1). The conceptual definitions of the research variables are presented in table 1.

Table1. The conceptual definitions of the research variables

Variable	Conceptual Definition	Reference
Perceived Susceptibility to threats against water resources (**PSWR**)	Concerns people's feelings of being influenced by a particular problem	Bayard & jolly, 2007
Perceived Severity of water resources destruction (**PSWD**)	Concerns people's awareness regarding the magnitude of a particular problem	Redding et al., 2000
Perceived Benefits of improving or preserving water resources (**PBWR**)	Concerns the social and economic advantages associated with the improvement and/or preservation of water resources	Bayard & jolly, 2007
Perceived Barriers associated with the preservation of water resources (**PBPW**)	Concerns psychological and economic background factors preventing the development of positive behaviors	Lichtenberg & Zimmerman, 1999
Attitudes toward water management initiatives undertaken by qualified organizations in the region (**ATIOR**)	Concerns the farmers' positive or negative attitude toward water management initiatives in the farm undertaken by qualified organizations in the region	Spash et al., 2006
Water management behaviors (**WMB**)	Concerns the extent to which standard water management practices are adopted in the farm	Beedell & Rehman, 2000
Access to information (**ATI**)	Concerns the extent of access to organizations providing information and educational programs on the best current water management practices in the farm, the mass media and peers (other farm operators)	Zhang & brown, 2005

To check validity and reliability, the pre-test questionnaire was filled in by a sample of 30farmers from outside of the main sample selection, in the shape of a pilot study. Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. Ideas were collected to determine Cronbach's Alpha coefficient for determining the reliability of the questionnaire and theoretical framework variables (Kalantari, 2006). Cronbach's Alpha coefficient for the Variable Water management behavior (WMB) equals 0.72 and other information is expressed in Table 2. Necessary changes over the questionnaire were done and data was analyzed by SPSS software.

Table 2. Validity and reliability of the research indicators

Variables / Indicator	Number of item	reliability
PSWR	5	0.61
PSWD	12	0.79
PBWR	13	0.70
PBPW	6	0.85
ATIOR	12	0.63
WMB	15	0.72
ATI	7	0.68

3. RESULTS

3.1 DEMOGRAPHICAL CHARACTERISTICS OF SAMPLE FARMERS

During the study, some of the farmers' individual and occupational characteristics such as age, literacy, the number of household members and the extent of lands under cultivation were also measured. According to the findings of the present study, the mean age and literacy of the farmers were 40.9 and 7.3 years respectively. The difference between the maximum and minimum age and literacy years was found to be 71 and 16 years respectively. The average number of the farmers' household members was estimated to be around 5.7 household members. Furthermore, the average extent of their land was 12.8 hectares. The largest and the smallest pieces of land covered areas of 120 and 0.5 hectares respectively.

3.2 The Comparison of the study's variables in the Three Irrigation Networks

Given the nominal size of the network variable, the technique of one-way analysis of variance was used to mark out differences of opinion among the farm operators within each irrigation network regarding the ranked variables of the study including perceived susceptibility, perceived severity of destruction, perceived benefits and barriers, access to information, and finally water management attitudes and behaviors. Given the unequal size of the study groups, the LSD comparative test was used to mark out existing differences among them. The test results for each variable will be explained later on.

The results of the one-way analysis of variance test for each study variable are presented in table 3. As can be seen in this table, there is a significant difference among the farm operators in the three irrigation networks under study in terms of the average rate of information access ($F=9.52$ & $P<0.01$). Given the significance shown by the one-way analysis of variance, the LSD test was used to compare the three groups. The results of this test indicate that there is no significant difference between the farm operators in the Zohreh-Jarrahi irrigation network and the other two groups in terms of access to information. Meanwhile, a significant difference in this regard was found between the farm operators in the Maroun irrigation network and those operating in the Gotvand irrigation network (16.69 compared to 19.39).

The results shown in table 3 indicate no significant difference among the three groups in terms of their attitudes toward water management activities in the region ($F=2.72$ & $P=0.067$). Given the range of this variable (13-65), it can be concluded that the farm operators in the three groups under study have a more or less moderate attitude toward water management activities in the region.

The results of the one-way analysis of variance presented in table 3 indicated a significant difference among the three groups in terms of the average perceived susceptibility (F=16.54 & P<0.01). The LSD test results indicated a significant difference between the average degree of perceived susceptibility to threats against water resources among the farm operators in the Zohreh-Jarrahi irrigation network in comparison to their peers in the Maroun (23.03 compared to 21.53) and Gotvand (23.03 compared to 21.1) irrigation networks.

In addition, based on the results presented in table 3, the Maroun and Gotvand network irrigations show a significant difference in terms of the average degree of perceived susceptibility (21.53 compared to 21.1). Furthermore, there is a significant difference in terms of the average degree of perceived susceptibility to threats against water resources between the Maroun farm operators (21.53 compared to 23.03) and Gotvand farm operators (21.1 compared to 23.03) on the one hand, and those operating in the Zohreh-Jarrahi irrigation network on the other. In fact, as indicated by the range of this variable (5-25), the farmers operating in the Zohreh-Jarrahi irrigation network feel more vulnerable to threats against water resources.

As can be seen in table 3, there is a significant difference among the three groups of farm operators in terms of the perceived severity of water resources destruction (F=5.56 & P<0.01). As indicated by the follow-up LSD test, there is a significant difference between the Gotvand and Zohreh-Jarrahi groups in terms of perceived destruction of water resources (54.3 compared to 56.9). Furthermore, there is a significance difference between the Gotvand farm operators and their peers in the Maroun group in terms of perceived severity of water resources destruction (54.3 compared to 56.6). As indicated by table 3, there is a significant difference among the three groups in terms of perceived advantages associated with the preservation of water resources (F=10.06 & P<0.01). The LSD results indicate a significant difference between the Gotvand farm operators and their peers in the Zohreh-Jarrahi group in terms of perceived benefits associated with the preservation of water resources (50.32 compared to 53.08). Furthermore, according to the same results, there is a significant difference between the Gotvand farm operators and their peers in the Maroun group in terms of perceived benefits associated with the preservation of water resources (50.32 compared to 53.78). Therefore, given the range of this variable (14-70), it can be concluded that the farm operators in the Zohreh-Jarrahi and Maroun irrigation networks have a deeper understanding of the benefits associated with the preservation of water resources.

Results obtained from analysis of variance presented in table 3 indicate a significant difference among the three groups of farm operators in terms of perceived barriers associated with the preservation of water resources (F=5.15 & P<0.01). Based on the LSD test results, there is a significant difference between the farm operators in the Maroun network irrigation and their peers in the Zohreh-Jarrahi irrigation network in terms of perceived barriers associated with the preservation of water resources (17.96 compared to 20.61). The same significant difference can be observed between the farm operators working in the Maroun irrigation network and their peers in the Gotvand network (17.96 compared to 19.67).

As indicated by results obtained from variance analysis in table 3, there is a significant difference among the three groups in terms of water management behaviors (F=9.04 & P<0.01). the LSD test Results indicate a significant difference between the farm operators in the Gotvand irrigation network and their peers in the Zohreh-Jarrahi irrigation network in terms of water management activities (55.19 compared to 45.93). The same significant difference can also be observed between the former and their peers in the Maroun irrigation network (55.19 compared to 48.75). As indicate by the range of this variable (0-92), the farm operators in the Gotvand irrigation network show more appropriate behaviors in terms of water management compared to their peers in the other two groups.

Table 3. The Comparison of the study's variables in the Three Irrigation Networks by One - Way Anova of Variance

variables	Score Domain of variables	Group (Irrigation Networks)			F	Sig.	LSD Test		
		Zohreh-Jarrahi (ZJ)	Maroun (M)	Gotand (G)			ZJ-M	ZJ-G	M-G
		Mean							
ATI	0-35	17.6	16.7	16.4	9.52	0.000	0.356	0.069	0.000
ATIOR	12-60	38.0	39.8	40.8	2.73	0.067	0.226	0.031	0.210
PSWD	12-60	57	56.7	54.2	5.56	0.04	0.824	0.030	0.004
PSWR	5-25	23.0	21.5	20.1	16.54	0.000	0.019	0.000	0.000
PBWR	13-65	53.1	53.8	50.3	10.06	0.000	0.597	0.025	0.000
PBPW	6-30	20.6	17.9	19.7	5.15	0.006	0.008	0.302	0.006
WMB	5-75	45.9	48.7	55.2	9.04	0.000	0.372	0.001	0.001

3.3 The Correlation between the Study's Independent variables and the Dependent Variables of attitudes toward Water Management Activities in the Region and Water Management behaviors

Based on the results presented in table 4, there is a significant positive correlation among attitudes toward water management activities in the region, access to information and perceived benefits. The correlation between attitudes and access to information is significant at 0.01 (R=0.197), while the correlation between attitudes and perceived benefits is significant at 0.05 (R=0.154). There is a significant negative correlation between the farm operators' attitudes and their perception of the barriers associated with the preservation of water resources (P<0.01 & R=-0.219). Furthermore, there is a significant positive correlation between perceived susceptibility to threats against water resources and water management activities (P<.01 & R=0.197). The correlation between access to information and perceived obstacles on the one hand, and water management behaviors on the other, is significant at 0.01 (0.369 and 0.291 respectively).

The analysis of correlation coefficients among the variables also reveals a significant positive correlation between the farm operators' attitudes and perceived benefits associated with the preservation of water resources (0.122) on the one hand, and water management behaviors (0.05). The significance of this correlation between the farm operators' attitudes and perceived benefits associated with the preservation of water resources on the one hand, and the dependent variable (water management behaviors) indicates that improved levels of the farm operators' access to information regarding optimum water management behaviors can raise their awareness of the relevant initiatives undertaken by various organizations, thus directing their attitudes toward more appropriate water management behaviors.

It can be argued that the farmers' poor performance in terms of water management activities despite their adequate understanding of their own susceptibility to threats against water resources is caused by other additional factors such as the perceived difficulty associated with water management in the farm or poor access to tools and instruments necessary to achieve this end, severely limiting their ability to engage in such activities.

Table 4. Correlation coefficients between research model variables

	ATI	ATIOR	PSWD	PSWR	PBWR	PBPW	WMB
ATI	1						
ATIOR	0.197**	1					
PSWD	-0.223**	0.116	1				
PSWR	-0.081	0.036	0.317**				
PBWR	-0.031	0.154*	0.199**	0.481**	1		
PBPW	0.107	-0.219**	-0.030	0.073	-0.039	1	
WMB	0.369**	0.122*	0.197**	0.104	0.122*	0.291**	1

** Significant in 0.05, **Significant in 0.01*

3.4 The Path Analysis Test

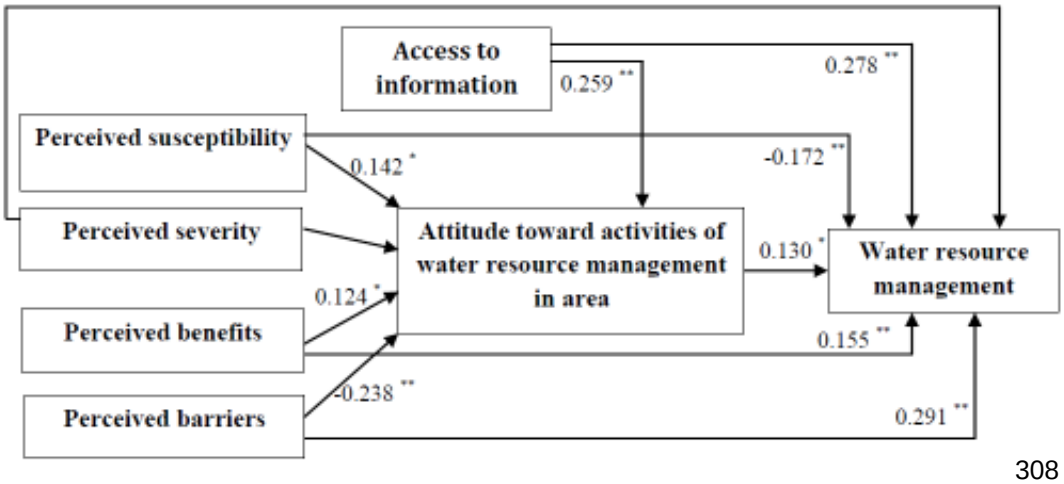
Path analysis is a multivariable technique used to assess the direct and indirect influences of the independent variable(s) on the dependent variable, thus analyzing the relations among different variables based on existing realities (Kalantari 2006). The path analysis test results for each of the variables are presented below.

Perceived barriers and access to information (at 0.01), and perceived susceptibility and perceived benefits (0.05) were found to have a direct and significant influence on the farm operators' toward water management initiatives undertaken by various qualified organizations in the region. Access to information was shown to have the most significant influence on the attitudes variable (P<0.01 & Y=0.259). The variable of perceived barriers was found to have the second most direct negative influence on the attitudes variable (P<0.01 & Y=-0.238). The variables of perceived susceptibility and perceived benefits were among other variables shown to have an influence on the farm operators' attitudes toward water management activities in the region. The route coefficients of these variables with the attitudes variable are significant at 0.05 (fig. 2). These variables can predict changes in attitudes toward water management activities in the region (as the dependent variable) (14%). The results were in quick agreement with the findings of Lichtenberg & Zimmerman, 1999, Mushtaq et al., 2006, Bayard & Jolly, 2007, Kideghesho et al., 2007, Atari et al., 2009 and Greiner e t al., 2009.

Results obtained by calculating the route coefficients between the independent variables of perceived susceptibility, perceived barriers, perceived benefits, access to information and the farm operators' attitudes on the one hand, and the water management behaviors variable indicate that perceived barriers toward the preservation of water resources has the most significant direct influence on water management behaviors (P<0.01 & Y=0.278). Access to information is another variable which shows a significant correlation (ar 0.05) with water management behaviors (P<0.01 & Y=0.291). Perceived susceptibility is yet another variable showing a direct and significant correlation with the farmers' water management behaviors (P<0.01 & Y=-0.172). The variables associated with the perceived benefits of the preservation of water resources and attitudes toward water management activities in the region are significant in 0.01 and 0.05 respectively. The route coefficient of these variables is 0.155 and 0.130 respectively. A positive and causal relation among the variables related to information access and the perceived benefits and barriers associated with preserving water resources in the farm confirms pervious findings of Tucker & Napier, 2002; Tucker & Napier, 2001, Kaiser & Scheuthle, 2003, Bekele & Drake, 2003, Zhang & Brown, 2005, Bayard & Jolly, 2007, Blanke et al., 2007, Ashraf et al., 2007 and Bjornland et al., 2008. The significant causal relationship between the variables related to attitudes toward water management activities in the region on the one hand, and water management behaviors in the farm with findings of Skagge, 2001, Pahl et al., 2005, Gilg & Bar, 2006, Azizi Khalkheili & Zamani, 2008 and Garcia-Vila et al., 2008 and the significant negative correlation between perceived susceptibility to threats against water resources clearly support by the findings present in

studies Hensher et al., 2005, Gilg & Barr, 2006 and Spash et al., 2006. The variables associated with perceived susceptibility, perceived benefits, perceived barriers, access to information and attitudes can predict changes in the dependent variable (water management practices in the farm) (26%).

In sum, it can be argued that although the variables associated with the farmers' attitudes toward water management activities, perceived susceptibility, perceived benefits and barriers associated with the preservation of water resources have a direct and significant influence on water management behaviors in the farm, the variable associated with access to information is a strongly predictor of the latter.



** Significant in 0.05, **Significant in 0.01*

Fig 2. Path diagram of variables affecting Water Resource Management Behaviors

4. CONCLUSION

The findings of the present study suggest that compared to other variables, access to information regarding best water management practices in the farm and an adequate understanding of the barriers associated with the preservation of water resources show the most strong positive correlation with the farmers' attitudes toward water management initiatives undertaken by qualified organizations in the region. This is also the case with water management behaviors in the farm as well. Furthermore, the role of proper access to information in predicting the effectiveness of the other variables on the farmers' attitudes and behaviors highlights the role played by regional authorities. So, the recommended:

1- The regional authorities must take the necessary steps to properly educate farm operators on issues such as the current status of water resources, the negative consequences caused by their destruction to the farmers, standard water consumption practices, appropriate alternative methods, current irrigation practices, and last but not least, environmentally healthy practices through the development of rigorous educational and training programs. However, the role of the mass media including radio and television programs in offering excellent models of water management is not to be underestimated.

2- Furthermore, the regional authorities should change the farmers' attitude toward water management initiatives undertaken by qualified organizations in the region, thus positively changing their behaviors in terms of proper management of water resources and adopting the best water consumption practices through improving their access to facilities and equipment´s necessary for the preservation of water resources and providing them with bank loans and other forms of financial assistance.

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APPENDIX

Statements for Measuring the Hidden Variables of the research model

Access to Information:

I attend classes in which standard water management practices are taught.

I read journals dedicated to agricultural extension.

I can use training programs provided through radio and television concerning the best water management practices in the farm.

I obtain some information regarding water management practices from my colleagues and friends.

Perceived Susceptibility:

Drought and water shortage have damaged my land

My agricultural activities have been limited due to the occurrence of drought.

Water shortage has made me worried over the loss of my livelihood.
Polutions caused by pesticides and other chemical agents have posed a serious risk to the health of my household.

Perceived Severity of Destruction:
Water shortage has damaged large pieces of arable land in recent years.
Salinity and overcultivation have degraded the quality of most arable lands.
Concerns have been raised over the possibility of a decrease in precipitation and its consequences.
A large part of the country is faced with drought.
Groundwater levels have dramatically fallen.

Perceived Benefits:
Sprinkler irrigation reduces costs in terms of both water use and manpower.
Leaving the remains of plants in the farm cuts down manure and water consumption.
The application of sprinkler irrigation technique helps in preserving the water supply in case of water shortage.
Optimum water use reduces the outbreak of plant diseases.

Perceived Barriers:
I do not implement water preservation techniques because the physical features of my land do not allow for such techniques to be implemented.
I do not participate in water problem solution programs because I am not particularly informed about such programs.
I do not use sprinkler or drip irrigation techniques in my farm because such techniques are beyond my financial ability.
I do not grow drought-resistant crops because the low price of such crops reduces my income from the farm.

Attitudes:
The development of irrigation networks has contributed to a more appropriate distribution of irrigation water.
The promotion of sprinkler and drip irrigation techniques is effective carried out in the region.
Farmers do not enjoy proper access to financial assistance in order to acquire sprinkler and drip irrigation facilities and equipment´s.
New patterns for cultivating drought-resistance crops in the region in case of water shortage have been effectively promoted.
Holding numerous meetings has not done much to raise awareness regarding water shortage and drought crises.

Behavior:
I replace rain fed agriculture for irrigated agriculture during dry seasons.
I reduce the needed irrigation water during the next cultivation through reducing the frequency of plowing.
I use biological agents to check the growth of pests in the farm.
I irrigate my farm during the night or early morning in order to minimize water wastage.
I implement sprinkler and drip irrigation techniques.
I try to reduce water use through narrowing the furrows in the farm.