Application of the ‘theory of planned behavior’ to understand farmers’ intentions to accept water policy options using structural equation modeling

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ABSTRACT

The agricultural sector is the largest sector of water consumers, and farmers are important stakeholders involved in water conservation. This research has been conducted to determine how native farmers support different policy options to reduce agricultural water consumption. Structural equations modeling was used to construct structures derived from the ‘theory of planned behavior’. For each policy option, a separate model is proposed and the modeling data supports the view that attitudes, subjective norms, and perceived behavioral control have a positive and significant effect on the intention. Attitudes, and perceived behavioral control, have the strongest effect on intention. Significantly, intention also have a positive impact on farmers’ behavior. According to the results of the present research, the variance explained is over 85% for intentions and the variance explained for the farmers’ behavior on water policy options is above 45% which is a result that indicates the high ability of the ‘theory of planned behavior’ in predicting policies achievement on saving agricultural water resources. It is argued that the field of psychology, and in particular environmental psychology, can play an important role in understanding more of the drivers to reduce agricultural water consumption and contribute to the social research program for water policy.

Key words | agriculture water saving policy option, structural equation modeling, theory of planned behavior

HIGHLIGHTS

- A socio-psychological research on agricultural water resource saving policies.
- Applies the theory of planned behavior to agricultural water resource saving policies.
- Uses Structural Equation Modeling (SEM) to investigate causal relationships between variables affecting farmers’ adherence to agricultural water resource saving policies.

INTRODUCTION

One of the main reasons for food insecurity is the lack of water. Effective and integrated management of water resources has become a priority in many countries of the world. With the development of the agricultural, industrial, and service sectors, much pressure has been placed on limited water resources, while excessive use of groundwater leads to the depletion of aquifers and has significant negative consequences for natural habitats and ecosystems. According to recent research (Dalin et al. 2017), Iran has ranked second in the world over the past two decades in depletion of groundwater after India. In Iran, more than 90% of water use is related to the agricultural sector and
groundwater provides 62% of the water needs of irrigated lands, which have less than 30% irrigation efficiency. As a result, the agricultural sector is a vital objective for implementing water-saving policies and increasing productivity.

Developing modern irrigation techniques and technology can significantly help to control water consumption in the agricultural sector. With water-saving in the agriculture sector, water will be released for other uses. Such techniques may also increase the quality and quantity of agricultural products whilst saving water. Therefore, many national governments, by giving incentives to farmers to improve irrigation systems, are currently seeking to reduce water use in the agricultural sector, and following water-saving measures.

Over the past few decades, Iran has had many successes in dam construction and control of surface waters, and there are many investments of this sort. Environmentalists are sometimes critical that, due to exaggerated dam construction, approximately 4 billion cubic meters (4 × 10^9 m^3) of wetlands water rights have been allocated for other purposes. Over the past few decades, due to a self-sufficiency policy in food products, agricultural sector development policy, and increasing employment in this sector, there is a lot of pressure on water resources from the agricultural sector. According to UNSD (2012), using more than 40% of renewable water is considered to be severe water stress, while in Iran more than 80% of renewable water is used and so there is a 15 billion cubic meters negative balance in its plains. The total amount of renewable water in Iran has decreased from a long-term average of 110 × 10^9 m^3 to 89 × 10^9 m^3 (10-year average) (Babae & Alijani 2013).

Unfortunately, the development of water infrastructure in Iran has not been balanced and not much attention was paid to increasing transmission efficiency and field efficiency along with dam constructing. Therefore, the government has been trying to increase irrigation efficiency in recent years, and for this purpose, there are many incentives for farmers to implement modern and drip irrigation. The state subsidy grants vary from 250 USD to 1,000 USD per hectare. One of the problems is the small size of agricultural land holdings due to the law of inheritance. In the event of land accumulation and implementation of drip irrigation, the government pays 85% of the cost. The government also provides educational programs for villagers to modify the pattern of cultivation and production of economical and dehydrated products and creating other jobs. The government supports the cultivation of strategic products and guarantees their purchase. The government’s environmental policies are intended to save water resources, and the present research examined the feasibility of implementing any of these policies with the ‘theory of planned behavior’ (TPB).

However, the question is how to increase the sensitivity of farmers to saving water and encourage them to pursue water-saving policies. Investigating factors affecting farmers’ intentions and behavior can allow policymakers to target specific policies. So far, despite extensive research on this topic, empirical research on the factors affecting farmers’ intentions and behaviors to adopt water policies has been very limited. Understanding farmers’ incentives to adapt to water-saving policies is especially important for governments, as it increases the success of government intervention in these policies and can reduce unnecessary costs. These risks are especially important when implementing these policies in times of water scarcity. In previous research on intervention for behavior change based on De Young (2000), there are two approaches:

1. The ‘antecedent approach’: This approach follows strategies that change behavior by affecting determinants of behavior, such as commitment and information provision, and attitudinal changes. For example, (Kurz et al. 2005) concluded that the provision of information on water conservation has led to a 23% reduction in household water consumption.

2. The ‘consequence approach’: This approach follows strategies that change the behavior of the individuals by informing the positive or negative consequences of the behavior, such as giving a reward for specific behavior.

Other researchers such as Steg & Vlek (2009), have proposed ‘information’ and ‘structural’ approaches instead of ‘antecedent’ and ‘consequence’ approaches. The ‘information’ approach has the purpose of changing attitudes, beliefs, motivations, and norms. The ‘structural’ approach has the purpose of changing the contextual factors, such as access to products and services, regulations, or financial incentives.

In the theory of planned behavior, both approaches are considered in the components influencing the intention
under the heading of attitude and behavioral control. A complete review of intervention literature goes beyond the scope of this paper. Our aim is to show how psychological research on determinants of behavior can be used to guide the development of effective interventions for implementing water policies. Our goal is to emphasize the fact that with the help of environmental psychology in the development of water policy, valuable information can be provided to inform evidence-based policy in the field of agricultural water-saving policies. Evidence-based policy (EBP) is a term often applied in multiple fields of public policy to refer to situations in which policy decisions are informed by rigorously established objective evidence.

Therefore, the present study embraced the TPB (Ajzen 1991), which is a well know framework in psychological literature, in order to assess the determinants of farmers’ behavioral intentions to implement any water resource saving policy. So, the present study could be considered as a novel approach to apply the TPB to water resources policy analysis.

**STUDY AREA**

Our study area is adjacent to Lake Urmia, one of the most valuable aquatic ecosystems and a UNESCO biosphere reserve (Figure 1). Lake Urmia has been facing significant declines in water volume and area. Due to the interactions between Lake Urmia and the studied area, the importance of investigating the challenges of water-saving for sustainable development becomes more significant. Integrated assessment was made of the study area water resource by adopting the System of Environmental and Economic Accounts for Water (SEEA-WATER) and calculating over thirty water resource, economic and social indicators in 2006 and 2016, which indicated the study area is highly stressed in terms of water quantity and quality. In addition, the area suffers severely from unsustainability and dis-equilibrium between water resources and consumption (Mahdavi et al. 2019).

Table 1 presents some of the important indicators related to water issues, especially agricultural water in the study area. The indicators show that the area suffers from dehydration and the implementation of water-saving policies is important.

**METHOD AND DATA SOURCES**

**Theoretical and applied foundations of the proposed model**

The TPB attributed to Ajzen (1991) represents a refinement of earlier models of rational decision-making, like the
Table 1 | Important indicators related to water issues in the study area (Mahdavi et al. 2019)

| Indicator | Relation | Value in 2016 |
|-----------|----------|--------------|
| Relative water stress index (RWSI) | Total consumption to natural renewable water resources | 1.37 |
| Water Use Intensity Index (WUII) | Total consumption to internal renewable water resources | 1.883 |
| Water utilization index in agriculture sector (WUI)a | Consumption in agriculture to total consumption | 94% |
| Economic Water Productivity Index in the agricultural sector (EWPId) | Agricultural gross revenue to agricultural consumption | 14 (Cent/m³) |
| Employment Percent in agriculture (Empd) | Employment in agriculture to total employment | 24% |
| Employee productivity Index in agricultural sector (EPI)a | Agricultural gross revenue to agricultural employment | 860 (Dollar/employee) |
| Per Capita Renewable Water Resources Index (PCRWI) | Natural renewable water resources to Population | 476 (m³/person) |

The theory of propositional control and the theory of reasoned action (Ajzen & Fishbein 1970). The TPB (Ajzen 1991) is a socio-psychological model that assumes that the intent of a person to perform a certain behavior is the strongest predictor of that behavior. According to this theory, there are three factors that influence the intent:

1. Attitude towards a policy option (ATT): indicating the farmer’s desired willingness about a policy option;
2. Subjective norm (SN): indicating the degree of social pressure of the influential persons on the farmer in following and accepting the policy option; and
3. Perceived behavioral control (PBC): indicating the level of comfort or difficulty of following the policy option.

Each of these structures arises from a set of beliefs related to the pros and cons of the intended behavior (behavioral beliefs), the support of influential individuals or government organizations (normative beliefs), and the understanding of the ease or difficulty of following and pursuing that policy option (control beliefs) (Pino et al. 2017). The intention is a predictor of behavior that indicates a farmer’s readiness to adopt a policy option. This theory has been used in many studies to evaluate the cognitive factors influencing water conservation behavior and to evaluate behavioral interventions aimed at promoting sustainable environmental behaviors (Abrahamse et al. 2005). In our study, we used this theory to examine the possibility of implementing water policies, which are mainly to reduce agricultural water consumption. The TPB’s ability to predict compliance with water policy options is due to the fact that, according to this theory, behavior is not only influenced by external factors such as the cost of actions and access to information, but also by conditions and decision-making motivations (Cary 2008; Dolnicar & Hurlimann 2010). Income from water policy options implementation and education, as well as the receptiveness to information on the implementation of water policy options (Trumbo & O’Keefe 2005) and concerns about future water scarcity (Clark & Finley 2007), may have a positive impact on farmers’ intentions.

With regard to the intrinsic motivation forces of individuals, previous research (Lam 1999) has shown that TPB variables effectively predict people’s intentions to implement water policies. Lam (1999) used the latent variable of people’s perceived moral obligation to examine the behavior of water consumption reduction, but this latent variable did not have a significant effect on behavior. Recent research has attempted to determine the impact of the variable of moral commitment of individuals according to their degree of concern for their environment (so-called ‘tendency to environmental values’). However, the effect of this variable on the intention to save water is contradictory. Salvaggio et al. (2014) found that people’s attitudes toward environmental values had a positive impact on water saving policies. Also Clark & Finley (2007) found that environmental concerns were poorly significant to predict people’s intent to save water. On the contrary, Chang (2015) found that this variable has no significant effect on water-saving behaviors.

Chang et al. (2016) found that farmers’ desirable attitudes toward limiting water use could predict the adoption of water-saving policies by them. Also, Tohidyan Far &
Rezaei Moghaddam (2015) showed that attitude toward water resources management, subjective norm, and perceived behavioral control affects farmers’ intentions to participate in water-saving projects. Regarding the adoption of water-saving measures, Lynne et al. (1995) established that farmers’ attitudes toward water-saving measures, subjective norms, and perceived behavioral control are significant predictors for farmers’ investment in such measures. These findings were partially confirmed by Yazdanpanah et al. (2014), which focused on a wide range of farmers’ measures to save and protect water. They found that behavioral control perceived by Iranian farmers directly penetrated the acceptance of these behaviors, while attitudes and subjective norms indirectly affect this behavior. The TPB has been used for a wide range of protection behaviors such as environmental conservation, soil conservation, water conservation (Clark & Finley 2007; Dolnicar & Hurlimann 2010), saving water, payment of water bills, reuse of wastewater (Nancarrow et al. 2008), and changing the behavior of people in household water consumption (Cary 2008). However, the current understanding of the impact of the TPB variables on farmers’ intentions to adopt water policy options is very limited, and this research is intended to assess the feasibility of successfully implementing water policy options.

The proposed model and hypotheses

According to the framework of TPB theory (Figure 2), four null hypotheses (\(H_0A\), \(H_0B\), \(H_0C\) and \(H_0D\)) are pursued in the field of water policy options. \(H_0A\) = There is a positive relationship between a person’s attitude towards water policy options and the intention to implement water policy options. \(H_0B\) = There is a positive relationship between the positive perceptions of influential and important individuals and organizations regarding water policy options and the farmer’s intention to pursue water policy options. \(H_0C\) = There is a positive relationship between perceptions of the ability to conform to water policy options and the intention to conform to water policy options. \(H_0D\) = There is a positive relationship between the intention to pursue water policy options and actual compliance (behavior). All of these beliefs were assessed on a 5-point scale (1 = ‘very low’, 5 = ‘very high’).

The policy options

Since the location, type of resources, and water quality affect the acceptance of the policy option type, in this research, four regions are considered as Table 2. The policy options reviewed are:

1. Crop level reduction policy
2. Crop pattern change policy
3. Policy of increasing irrigation efficiency
4. The policy of increasing non-agricultural incomes

Structural equations for all four policy options were modeled in Smart PLS software and their results discussed.

Table 2 | The characteristics of the four regions, in terms of water resources and the number of villages

| Region Number | Village Count | Surface water and Groundwater status |
|---------------|---------------|--------------------------------------|
| 1             | 10            | Surface water until mid-summer and groundwater limited to just springs |
| 2             | 6             | Surface water until the late spring and groundwater are decreasing |
| 3             | 7             | Surface water very limited and groundwater slightly salty and saline |
| 4             | 7             | Surface water very limited and groundwater limited to just springs |

Figure 2 | The conceptual framework.
Questionnaire

The data gathering tool used was a researcher-made questionnaire designed using a literature review (Table 3). To assess the validity of the questionnaire, the content validity ratio, and content validity index were calculated using 10 expert opinions. To measure the content validity rate, experts evaluated questionnaire queries one by one on a three-point scale (1. The question is necessary; 2. The question is useful but not essential; 3. The question is not necessary) and a content validity ratio was then calculated.

To evaluate the content validity index, 10 experts were asked to specify ‘relevancy’, ‘clarity’, ‘simplicity’ and ‘expressivity’ of questionnaire queries on a 4-point ordinal scale (e.g. for ‘relevancy’: 1- not relevant/2- relatively relevant/3-relevant/4- completely relevant) and finally, the content validity index was calculated. In this research, after collecting expert comments, all of the questions have a content validity ratio above 0.75 and a content validity index above 0.79.

Cronbach’s alpha coefficient (Cr-aco) was used to examine the reliability of the set of questions related to each variable. The mean coefficient was higher than 0.7 for

Table 3 | Sample questionnaire for policy option 'reduce cultivated area'

| Intention                                      |
|------------------------------------------------|
| Q1. How much do you intend to reduce your cultivated area?  |
| Q2. Are you going to reduce your cultivated area in the future?  |
| Q3. How much do you intend to encourage other farmers to reduce the cultivation area?  |
| Choose your answer: 1- Very little 2- Little 3- Medium 4- Much 5- Very much |

| Attitude                                       |
|------------------------------------------------|
| Q1. Should farmers be thinking about maximizing production efficiency rather than thinking about reducing their cultivation?  |
| Q2. Do you think agricultural production more important than protecting groundwater resources?  |
| Q3. In addition to drought conditions, is it important to reduce the area under cultivation in all conditions?  |
| Q4. Do you believe that under the current conditions, the reduction of the area under cultivation for the conservation of water resources is unnecessary?  |
| Q5. Do you believe that reducing the crop area is beneficial for the conservation of water resources?  |
| Q6. Do you believe that reducing the crop area in order to protect water resources is wise?  |
| Q7. Do you believe that reducing the cultivated areas to protect water resources is your preference?  |
| Choose your answer: 1- Very little 2- Little 3- Medium 4- Much 5- Very much |

| Social norms                                    |
|------------------------------------------------|
| Q1. Most people who are important to me think that reducing the area under cultivation is considered desirable.  |
| Q2. If I reduce my cultivated area in order to save and protect the water resources, those people who are important to me will support my actions.  |
| Choose your answer: 1- Very little 2- Little 3- Medium 4- Much 5- Very much |

| Perceived behavioral control                   |
|------------------------------------------------|
| Q1. For me, reducing the cropping areas to protect water resources is easy.  |
| Q2. If I want to, I can easily reduce the cultivation area to protect water resources.  |
| Q3. How much freedom do you have to reduce your cultivation area?  |
| Q4. Reducing the cultivated area in order to preserve water resources is an option at my disposal.  |
| Q5. How difficult is it for you to get involved in reducing the cropping areas to protect water resources?  |
| Q6. I do not have the time and skills needed to reduce the amount of cultivation to preserve water resources.  |
| Q7. For me, the application of tools to reduce the cultivation area to preserve water resources is costly.  |
| Q8. Is it possible for you to reduce the cultivation area in order to preserve water resources according to your farm conditions?  |
| Q9. It is impossible for me to carry out measures to reduce the cultivation area in order to maintain water resources.  |
| Choose your answer: 1- Very little 2- Little 3- Medium 4- Much 5- Very much |

| Behavior                                       |
|------------------------------------------------|
| Q1. How much have you reduced your agricultural area?  |
| Q2. How much have you reduced your horticultural area?  |
| Choose your answer: 1- Very little 2- Little 3- Medium 4- Many 5- Too much |
questions about the variables of attitude toward the behavior (Cr-aco = 0.71), subjective norm (Cr-aco = 0.70), perceived behavioral control (Cr-aco = 0.73), and behavioral intent (Cr-aco = 0.72).

Sample

The study area has 30 villages with a population of 4,000 farmers and only 20% (800) of these farmers own agricultural land larger than one hectare and only half of them have a reliable water source, making it possible for them to implement water resources policies. There are about 400 of these farmers, who are the statistical community of the study area and a questionnaire was completed by a statistical sample of 66 farmers (16.5% of the statistical population). The minimum sample size required can be looked up from the guidelines suggested by Marcoulides & Saunders (2006), depending on the maximum number of arrows pointing at a latent variable as specified in the structural equation model.

Since the extant research has indeed ascertained that farmers are generally unwilling to spend their time completing surveys and sharing data and/or information on themselves and their activities, in this research, sample selection from the statistical community was made purposefully and carefully until saturation state was reached, and the composition of the interview and the questionnaire used was as follows:

During the prayers of the Maghreb, when most farmers come to the mosque in order to perform a prayer, a free collective interview was held, and their suggestions and solutions for saving water were heard. In this interview, two or three farmers in each village were chosen purposefully and a questionnaire was completed by them.

RESULTS AND DISCUSSION

Structural equation modeling (SEM)

Structural equation modeling (SEM) is a second-generation multivariate data analysis method that is often used by researchers because it can test theoretically supported linear and additive causal models. With SEM, researchers can visually examine the relationships that exist among variables of interest in order to prioritize resources. The fact that unobservable, hard-to-measure latent variables can be used in SEM makes it ideal for tackling research problems such as the implementation of water-saving policies.

There are several distinct approaches to SEM: the first approach is the widely applied covariance-based SEM (CB-SEM), using software packages such as AMOS, EQS, LISREL, and MPLUS. The second approach is partial least squares (PLS), which focuses on the analysis of variance and can be carried out using PLS-Graph, VisualPLS, SmartPLS, and WarpPLS. It can also be employed using the PLS module in the ‘r’ statistical software package. The third approach is a component-based SEM known as generalized structured component analysis (GSCA); it is implemented through VisualGSCA or a web-based application called GeSCA. Another way to perform SEM is called nonlinear universal structural relational modeling (NEUSREL), using NEUSREL’s causal analytics software (Wong 2013).

PLS is a soft modeling approach to SEM with no assumptions about data distribution (Vinzi et al. 2010). Thus, PLS-SEM becomes a good alternative to CB-SEM when the following situations are encountered (Wong 2013):
1. Sample size is small.
2. Applications have a weak theoretical basis.
3. Predictive accuracy is paramount.
4. Correct model specification cannot be ensured.

This paper focuses on SmartPLS because it is freely available to the research community across the globe. Attitude, subjective norm, perceived behavioral control, intention, and behavior were modeled as latent reflective variables. The crop level reduction policy conceptual model is presented in Figure 3, the crop pattern change policy conceptual model is presented in Figure 4, the policy of increasing irrigation efficiency conceptual model is presented in Figure 5, and the policy of increasing non-agricultural incomes conceptual model is presented in Figure 6.

Checking reliability and validity

To find a reliability value, the square of each of the outer loadings was verified, and all were higher than 0.70
Figure 3 | Graphical representation of the conceptual crop level reduction policy model (a) path coefficients and $R^2$ (b) T-values.

Figure 4 | Graphical representation of the conceptual crop pattern change policy model (a) path coefficients and $R^2$ (b) T-values.

Figure 5 | Graphical representation of the conceptual policy of increasing irrigation efficiency model (a) path coefficients and $R^2$ (b) T-values.
Traditionally, ‘Cronbach’s alpha coefficient’ is used to measure internal consistency as a measure of scale reliability in social science research and in various research fields where questionnaires are involved, but this coefficient is used conservatively in PLS-SEM. Previous literature has suggested the use of ‘composite reliability’ as a replacement (Hair et al. 2014). In this research, ‘composite reliability’ values are larger than 0.6, so high levels of internal consistency reliability have been demonstrated among all five reflective latent variables. To check convergent validity, each latent variable’s average variance extracted (AVE) was evaluated. It was found that all of the AVE values are greater than the acceptable threshold of 0.5, so convergent validity is confirmed. Fornell & Larcker (1981) suggest that the square root of AVE in each latent variable can be used to establish discriminant validity if this value is larger than other correlation values among the latent variables. To do this, Table 4 was created in which the square root of AVE is manually calculated and written in bold on the diagonal of Table 4. The correlations between the latent variables are copied from the ‘latent variable correlation’ section of the default report and appear in the lower left part of Table 4.

Checking structural path significance

SmartPLS can generate T-statistics for significance testing of both the inner and outer model, using a procedure called bootstrapping. By using a two-tailed t-test with a significance level of 5%, if T-statistics values are larger than 1.96, the path coefficients are significant. In our models, the results of the T-statistics values for the subjective norm to intention in Figures 3(b)–6(b), perceived behavioral control to intention in Figure 3(b), and Behavior to BH1 in Figure 6(b), mean that the path coefficients are not significant in the above cases.

Cross-validated redundancy measures

Stone-Geisser’s (Q2) values (cross-validated redundancy measures) are obtained by the blindfolding procedure in SmartPLS (Table 5). Q2 values of 0.02, 0.15, and 0.35 indicate an exogenous construct has a small, medium, and large predictive relevance for an endogenous latent variable, respectively.

Cross-validated communality measures

If cross-validated communality is positive, the measurement model has a good quality. In this research all cross-validated communality for the five variables are positive.

Determining model fit

In the research literature, determining the appropriate model is one of the most important steps in the SEM (Barrett 2007; Hooper et al. 2008). In recent years, appropriate indicators have been under intense scrutiny, and some authors have even suggested that some of them should not be used (Barrett 2007). Some researchers find it appropriate to report a number of fit indices models because different indices reflect a different aspect of model fit. The rejection...
of a model shows that there are significant paths between variables that are not presented in the model.

Standardized root mean square residual (SRMR) is defined as the difference between the observed correlation and the model implied correlation matrix. Thus, it allows assessment of the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of model fit criterion. A value of less than 0.10 or 0.08 is considered a good fit. Hair et al. (2014) introduced SRMR as a goodness of fit measure for PLS-SEM that can be used to avoid model misspecification. One of the first fit measures proposed in the SEM literature is the normed fit index (NFI) by Bentler & Bonett (1983). It computes the Chi2 value of the proposed model and compares it against a meaningful benchmark. Since the Chi2 value of the proposed model in itself does not provide sufficient information to judge model fit, the NFI uses the Chi2 value from the null model, as a yardstick. The NFI is then defined as 1 minus the Chi2 value of the proposed model divided by the Chi2 value of the null model. Consequently, the NFI results in values between 0 and 1. The closer NFI is to 1, the better fit. NFI values above 0.9 usually represent an acceptable fit. In the ‘policy of increasing irrigation efficiency’ model, the NFI values are closer to 1, indicating a better fit compared to the other models.

Table 4 | Fornell-larcker criterion analysis for checking discriminant validity

| Latent variable correlations | Perceived behavioral control | Behavior | Attitude toward the behavior | Intention | Subjective norm |
|-----------------------------|-----------------------------|---------|-----------------------------|-----------|-----------------|
| **Crop level reduction policy model** | | | | | |
| Perceived behavioral control | 0.894 | 0.813 | 0.893 | 0.892 | 0.845 |
| Behavior | 0.813 | 0.961 | 0.798 | 0.750 | 0.787 |
| Attitude toward the behavior | 0.893 | 0.798 | 0.922 | 0.907 | 0.867 |
| Intention | 0.892 | 0.750 | 0.907 | 0.919 | 0.842 |
| Subjective norm | 0.845 | 0.787 | 0.867 | 0.842 | 0.919 |
| **Crop pattern change policy model** | | | | | |
| Perceived behavioral control | 0.963 | 0.786 | 0.953 | 0.950 | 0.933 |
| Behavior | 0.786 | 0.943 | 0.792 | 0.822 | 0.650 |
| Attitude toward the behavior | 0.953 | 0.792 | 0.961 | 0.954 | 0.928 |
| Intention | 0.950 | 0.822 | 0.954 | 0.939 | 0.890 |
| Subjective norm | 0.933 | 0.650 | 0.928 | 0.890 | 0.928 |
| **Policy of increasing irrigation efficiency model** | | | | | |
| Perceived behavioral control | 0.991 | 0.820 | 0.839 | 0.859 | 0.818 |
| Behavior | 0.820 | 0.914 | 0.859 | 0.845 | 0.789 |
| Attitude toward the behavior | 0.839 | 0.859 | 0.931 | 0.911 | 0.875 |
| Intention | 0.859 | 0.845 | 0.911 | 0.908 | 0.901 |
| Subjective norm | 0.818 | 0.789 | 0.875 | 0.901 | 0.973 |
| **Policy of increasing non-agricultural incomes model** | | | | | |
| Perceived behavioral control | 0.991 | 0.586 | 0.667 | 0.561 | –0.086 |
| Behavior | 0.586 | 0.821 | 0.677 | 0.600 | –0.142 |
| Attitude toward the behavior | 0.667 | 0.677 | 0.876 | 0.866 | –0.204 |
| Intention | 0.561 | 0.600 | 0.866 | 0.875 | –0.238 |
| Subjective norm | –0.086 | –0.142 | –0.204 | –0.238 | 0.875 |

Table 5 | Cross-validated redundancy measures

| Latent variable correlations | Perceived behavioral control | Behavior | Attitude toward the behavior | Intention | Subjective norm |
|----------------------------|-----------------------------|---------|-----------------------------|-----------|-----------------|
| Crop level reduction policy model | | | | | |
| Perceived behavioral control | 0.948 | 0.519 | 0.584 | 0.402 |
| Behavior | 0.519 | 0.684 | 0.65 | |
non-agricultural incomes mode' model, the research data support the model weakly, and it would have been better if the data collected for this mode had been revised, which was accepted because the normed fit index is close to the acceptable threshold (Table 6).

Strength of the theoretical model to testing the research hypotheses

This research proposed a model that contained three independent variables and two dependent variables. The PLS algorithm was able to calculate an estimate $R^2$ for the dependent variable. The strength of the theoretical model was established by factor $R^2$. The $R^2$ was calculated using the PLS algorithm with 300 iterations. Falk & Miller (1992) suggest that the explained variance ($R^2$) should be greater than 0.1. All of the $R^2$s for the four models achieved high explained variance scores. All were above the 0.1 recommended levels. The $R^2$ statistics and path coefficients are shown in Figures 3(a)–6(a).

First hypothesis: there is a positive relationship between attitude towards water policy options and the intention to comply with water policy options.

Based on the results in Figures 3–6 and given T-values for variables, the null hypothesis is rejected and hypothesis 1 is confirmed. It is concluded from this discussion that there is a significant direct relationship between attitude towards water policy options and the intention to comply with water policy options.

Second hypothesis: there is a positive relationship between the positive perceptions of important others to water policy options and the intention to comply with water policy options.

Based on the results in Figures 3–6 and given T-values for variables, the null hypothesis is rejected and hypothesis 2 is confirmed. It is concluded from this discussion that there is a significant direct relationship between the positive perceptions of important others to water policy options and the intention to comply with water policy options.

Third hypothesis: there should be a positive relationship between perceptions about the ability to comply with water policy options and the intention to comply.

Based on the results in Figures 3–6 and given T-values for variables, the null hypothesis is rejected and hypothesis 3 is confirmed. It is concluded from this discussion that there is a significant direct relationship between perceptions about the ability to comply with water policy options and the intention to comply.

Fourth hypothesis: there should be a positive relationship between intention to comply with water policy options and actual compliance.

Based on the results in Figures 3–6 and given T-values for variables, the null hypothesis is rejected and hypothesis 4 is confirmed. It is concluded from this discussion that there is a significant direct relationship between intention to comply with water policy options and actual compliance.

Descriptive statistics of intention to comply with water policy options by region

As described above, the study area was divided into four areas according to the status of water resources. In this section, we want to compare the number of farmers’ intentions regarding the four water policy options in the four regions (Figure 7).

Region ’1’ farmers, because of access to surface water by mid-summer, have a lower intention of implementing agricultural water-saving policies than any other group. Farmers in this area have maintained their cultivations and sometimes developed their gardens, and usually changed their cropping patterns and turned to early crop cultivation (roses, beans). Region ’1’ is elevated upstream and wells are rarely drilled. Region ‘2’ has the largest number of wells that can facilitate the implementation of drip irrigation projects (irrigation efficiency improvement policy), but the small size of the land is an obstacle to this policy. Farmers in region ‘3’ can use surface water for a short time in the event of heavy rains and floods. Due to the underground water salinity in region 3, they supply

| Fit criterion | Crop level reduction policy mode | Crop pattern change policy model | Policy of increasing irrigation efficiency mode | Policy of increasing non-agricultural incomes mode |
|---------------|---------------------------------|---------------------------------|-----------------------------------------------|-----------------------------------------------|
| SRMR          | 0.039                           | 0.037                           | 0.055                                         | 0.1                                           |
| NFI           | 0.90                            | 0.91                            | 0.92                                          | 0.85                                          |
their water demand by purchasing water from the neighboring area (region 2). Therefore, region 3 has the highest water stress, and in order to adapt to this stress, farmers in region 3 intend to agree on any type of agricultural water-saving policy. They have severely reduced their land cultivation. They also cultivated crops that are resistant to saline water and water stress (Alfalfa, Pistachio, and Elaeagnus Angustifolia). By lining of channels, they have increased the irrigation efficiency and now wish they also had non-agricultural incomes. Region 4 is mountainous and has a hard aquifer, and there are no wells in this area and the water resources are spring and qanats.

Because of the necessity for high initial capital to generate non-agricultural incomes, these incomes are limited and are usually agriculture-related such as livestock or processed crops, and a limited income from carpet weaving. Since implementation of crop level reduction policy and crop pattern change policy leads to a significant and modest reduction in agricultural incomes, it is noted that regions with very limited water resources are willing to comply with these policies. On the other hand, the implementation of increasing irrigation efficiency and increasing non-agricultural incomes policies requires high government investment. Therefore, considering the financial facilities of the state and the intention of the farmers, the policymaker can choose the appropriate option for each region.

Regarding the high ability of intention to predict behavior, in Table 7, based on the average intentions score, prioritizations of policies to follow in the four regions and in the whole area are given.

### CONCLUSIONS

Uncontrolled and inefficient use of water in the study area, especially in the agricultural sector, has increased concern and reduced water security. Therefore, the attention of researchers and policymakers to the implementation of water-saving policies has been drawn. In this study, the well-known behavioral theory of Ajzen (1991) was used to identify the motivational factors that could encourage farmers to follow water-saving policies. Despite the widespread use of this theory in the literature on environmental behaviors, it has rarely been used to measure farmers’ compliance with water-saving policies.

While past research has often focused on water conservation intentions this research moved toward measuring
both water conservation intentions and measuring water conservation behavior. This paper drew on a social–psychological model to determine how the native farmers in a fertile region in the northwest of Iran support different agricultural policy options. Results suggest that the TPB framework is an effective tool for the feasibility of water-saving policy options. In a meta-analysis of the TPB, Armitage & Conner (2001) found that the TPB accounted for 39% of the variance in intention. In this study, the explained variance in the intention of the TPB was higher than this finding. Differences in the results of these studies may refer to the premise that water-saving behavior, as is true for many other behaviors, changes according to individuals’ demographic characteristics such as age and gender, and cultural and socio-economic differences. Consistent with previous research from Chang et al. (2016) and Azizi Khalkheli & Zamani (2010), this study established that farmers’ favorable attitudes toward water-saving policy options predict their intention to adopt them.

Therefore, one of the important duties to attract farmers’ participation in water-saving policy is creating a positive attitude towards participation. To do this, solving the existing problems, providing appropriate training and publicity programs, especially by the media and service centers in agriculture, increasing farmers’ knowledge, and more focus on water company staff training connected to farmers can be effective. In line with Tohidyan far & Rezaei Moghaddam (2015), the subjective norm has a very significant effect on farmers’ intent to adopt water-saving policy options. Unlike Nancarrow et al. (2008) in Australia regarding recycled drinking water, and like Lynne et al. (1995), regarding soil conservation, they found that PBC is a significant predictor of intention.

Similar to research from Yazdanpanah et al. (2014), this study also found that perceived behavioral control had a major impact on the intentions of farmers to comply with water-saving policy options, because farmers’ income is limited and usually the implementation of these policies has needed high initial investment and a sufficient supply of water with adequate quality and volume. In most of the work carried out by the TPB model in Iran, the perceived behavioral control of Iranian farmers has had a great impact on farmers’ intentions.

It is concluded that farmers are more likely to comply with water-saving policy options when the government has provided financial incentives. Farmers will also follow policy options that will not reduce their income. In general, the economic interests of farmers are dominant in following water policy options. Many farmers think that drip irrigation reduces crop yields. They also generally have concerns about marketing low-water crops and have no experience growing such crops. Therefore, education and awareness by government agencies such as the agricultural organization can be effective.

Consistent with previous research (Clark & Finley 2007; Vermeir & Verbeke 2008; Yazdanpanah et al. 2014) the results of this study are entirely consistent with the theory of TPB because it shows that farmers’ intention to adopt water policy options has a positive relationship with farmers’ attitudes toward the water policy option (ATT), subjective normative (SN) and perceived behavioral control (PBC) and there is a positive relationship between intention to comply with policy option and actual compliance (behavior).

SN showed little effect on and low predictive relevance to intention in any of the four water policy option models. This shows that if farmers’ attitudes to agricultural water policy are positive and that there are no barriers to doing that, they will pursue the policy without affecting social norms.

PBC had a strong influence on intentions due to the individual perception of the difficulty of implementing policy options due to financial constraints, especially in the two policy options ‘Irrigation Productivity Increase Policy’ and ‘Non-Agricultural Income Increase Policy’. Therefore, for the implementation of these two policies, the government must provide more financial support for farmers.

ATT showed a large effect and high predictive relevance on intention in all four water policy option models. Therefore, it is recommended to design intervention programs based on promoting attitudes in order to encourage them to implement water policy.

According to the findings of this research, the explained variance over 85% for intentions and above 45% for the behavior of water policy options, suggests the high ability of the theory of planned behavior in predicting policies for saving agricultural water.

CONFLICTS OF INTEREST

The author declares no conflict of interest.
DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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