Official Journal of the World Water Council
Water Policy

Water Policy Vol 26 No 4, 410 doi: 10.2166/wp.2024.246

The influence of water rights transfer policy on farmers' intention to conserve water

Zhaoxian Su[a] and Hao Fu[b,*]

[a] School of Public Administration, North China University of Water Resources and Electric Power, Zhengzhou 450046, China
[b] School of Business and Management, Yellow River Conservancy Technical Institute, Kaifeng 475004, China
*Corresponding author. E-mail: fuhao@yrcti.edu.cn

HF, 0009-0004-4584-0051

ABSTRACT

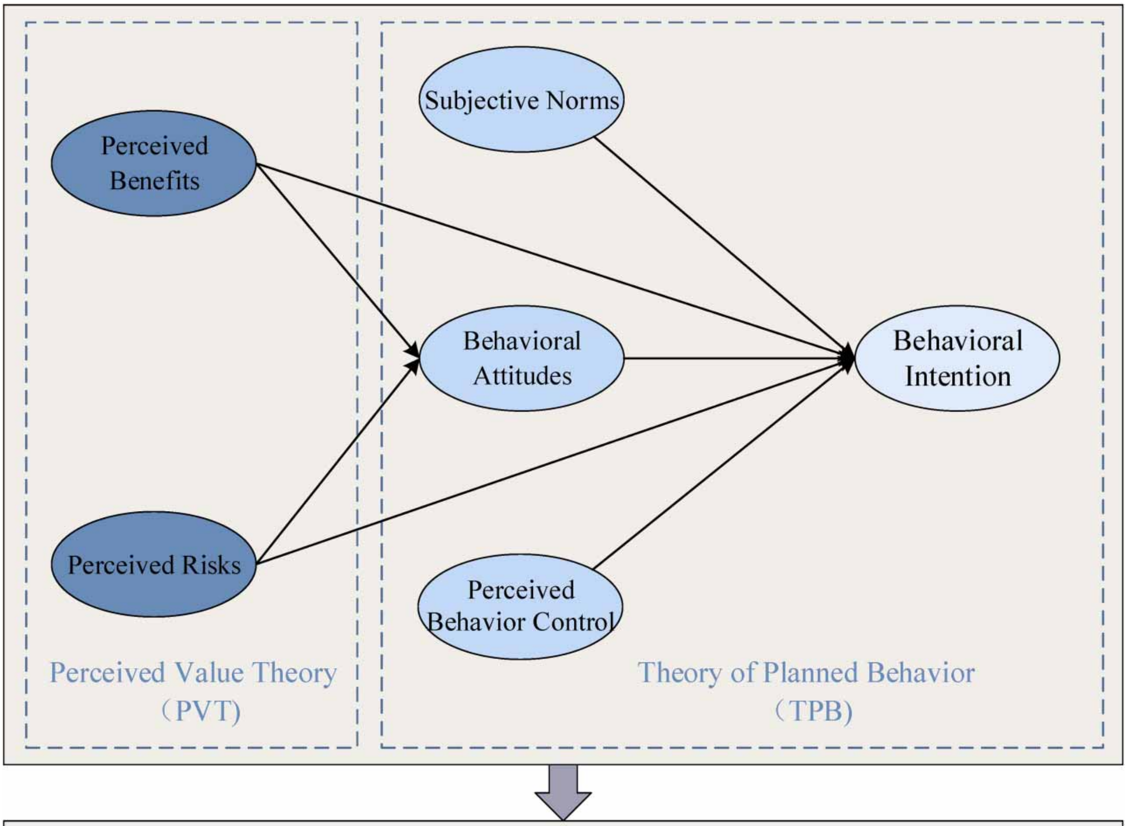
Exploring the factors influencing farmers' water conservation intentions under the water rights transfer policy is crucial for developing equitable water rights systems and safeguarding farmers' interests. Leveraging data from 608 respondents in the Yellow Irrigation District of Inner Mongolia, China, integrating the theory of planned behavior and the theory of perceived value, we present an analytical framework to investigate the factors affecting farmers' water conservation intentions through structural equation modeling. Our findings reveal the following: firstly, farmers' water conservation intentions are predominantly influenced by subjective norms, behavioral attitudes, perceived behavioral control, perceived benefits, and perceived risks; secondly, perceived behavioral control exerts the most significant impact on farmers' water conservation intention, whereas subjective norms have the weakest influence. This implies that farmers' water conservation intention is not closely related to subjective norms in the context of mandatory water-saving interventions; lastly, the paths leading to farmers' water conservation intention include 'perceived benefits/perceived risks → behavioral intention,' and an indirect path through 'perceived benefits/perceived risks → behavioral attitudes → behavioral intention'. Consequently, reducing the water-saving technology complexity, harnessing the influence of neighboring communities and water user associations, and enhancing farmers' compensation are effective strategies to bolster farmers' intention to engage in water conservation.

Key words: Farmers, Structural equation modeling, Water conservation intention, Water rights transfer

HIGHLIGHTS

- Through agricultural water conservation and the transfer of water rights, governments can re-allocate the scarce water resources to industries.
- The water rights transfer policy represents an institutional shift and involves a cognitive adjustment process for farmers on a psychological level.
- By integrating TPB and TPV, this paper unravels the logic behind the formation of farmers' intentions to save water.

GRAPHICAL ABSTRACT



1. Farmers' intentions to save water are predominantly influenced by subjective norms, behavioral attitudes, perceived behavioral control, perceived benefits, and perceived risks;
2. Perceived behavioral control exerts the most significant impact on farmers' intentions to conserve water, whereas subjective norms have the weakest influence;
3. The paths leading to farmers' intentions to save water include "perceived benefits/perceived risks → behavioral intention," and an indirect path through "perceived benefits/perceived risks → behavioral attitudes → behavioral intention".

1. INTRODUCTION

With global population growth and economic development, the demand for natural water resources has surged. However, the availability of these resources to humans is diminishing due to pollution, groundwater depletion, and climate change. This worldwide issue presents challenges such as water resource scarcity, unequal spatial and temporal distribution of water resources, and environmental pollution (Wang *et al.*, 2018). Water scarcity is a fundamental national concern, exacerbated by population growth and climate change, which are poised to escalate water-related conflicts in China (Guo *et al.*, 2020). Agriculture in China is a major consumer of water resources, accounting for 63.0% in 2022, yet the effective utilization coefficient of agricultural irrigation water stands at a mere 0.572, leaving substantial room for water conservation in agriculture (Zhang *et al.*, 2021). As industrialization, especially heavy industry, has rapidly developed in this century, accompanied by the accelerated urbanization process and the improvement of people's living standards, the demand for domestic, industrial, and ecological water has continuously increased. The issue of industrial water use has become increasingly critical, and water scarcity has emerged as a significant constraint on industrial development in northern China. The Yellow River is a major surface water resource in northern China. Due to the substantial water resources, many industrial enterprises are obliged to obtain approval from the Yellow River basin authorities to increase their water intake for factory construction or expansion plans. Facing the challenge of inadequate water sources, many industrial and mining enterprises have struggled as their water usage applications have been delayed in approval. Consequently, a large number of energy-intensive and heavy chemical projects have faced difficulties in establishing themselves in resource-rich areas in northern China. In order to tackle the water challenges for industrial enterprises, the Chinese government has shifted its focus toward water conservation in agriculture. Since 2003, in the regions of Ningxia and Inner Mongolia where there is a severe imbalance between the supply and demand of water resources in the Yellow River basin, the government has been exploring the implementation of the water rights transfer (WRT) policy. The aim is to break through the constraints of the limited Yellow River water allocation quotas within the existing water rights system, leading to the emergence of the practice of 'water rights transfer' in the irrigated areas of the Yellow River basin (Sun *et al*., 2023).

WRT policy originated in the United States in the 20th century. In order to address the issue of drought and water scarcity in the Arkansas River Basin in the western United States, a project was implemented to reallocate agricultural water to the industrial and urban areas in that basin. During the same period, two countries, Australia in Oceania and Japan in Asia, also successively attempted the WRT policy to achieve regional water balance. As the implementation and effectiveness of the WRT policy became apparent, it was widely applied in countries such as Mexico in North America, Peru and Chile in South America, and Spain and Italy in Europe. In China, WRT is a system in which industrial enterprises invest in water-conserving infrastructure within irrigation areas, enhancing the lining of field channels to improve agricultural water efficiency. While the daily needs of residents, food security, and basic ecological water use are guaranteed, surplus agricultural water rights are converted into industrial water rights. This initiative aims to address the economic and social development challenges posed by 'water scarcity' (Wang *et al*., 2017; Ma *et al*., 2021). In the past two decades, as a development strategy combining top-level design and local practices, WRT policy has been widely promoted and implemented. Local governments have actively sought to expedite the establishment of industrial enterprises and achieve local industrialization through the approach of 'exchanging water for industry and using industry to support agriculture.' To facilitate the establishment of industrial enterprises by transferring more Yellow River water allocation quotas, local governments have expedited water-saving irrigation transformations in irrigation areas and promoted water-efficient agricultural development. Gradually, they have reduced agricultural water allocation quotas, ensuring the needs of industrial and urban water use.

Although the promotion of the WRT policy has led to rapid regional economic development, it has also intensified social conflicts in the irrigated areas. According to the WRT planning, the conversion of water resources from agricultural to industrial use requires the implementation of a 'supporting agriculture with industry' strategy. This means that WRT beneficiaries adopt a policy of economic compensation to offset additional investments or economic losses related to the transfer of agricultural water resources. In line with the actual situation of WRT, prices for industrial or domestic water use may be appropriately increased, and the accumulated funds can be invested in water-saving agriculture or compensating those involved in water resource transfer. However, in the actual operation process, the interests of farmers are not adequately protected. On the contrary, WRT has led to a shortage of water for agricultural irrigation, adversely affecting farmers' livelihoods. In theory, the WRT system relieves farmers from the financial burden of water-saving projects and channel lining transformations, offering benefits such as time and labor savings, crop yields increase, and irrigation cost reduction. These incentives are designed to motivate farmers to conserve water. However, in practice, the persistent reality is that farmers exhibit a low intention to save water (Jia *et al.*, 2016; Jenkins *et al.*, 2021). Some scholars attribute this reluctance to factors such as insufficient incentives for agricultural water conservation (Gholamrezai & Sepahvand, 2017), high social costs (Chang *et al.*, 2016), and farmers' negative perceptions of WRT (Wang & Zhao, 2023), which pose significant barriers to the development of China's WRT system.

Farmers' behavior intention (BI) in water conservation hinges on their perception of tangible benefits derived from it rather than simply an altruistic desire to preserve water resources (Feng *et al.*, 2023). Several factors influence this intention, including farmers' perceptions of agricultural water prices (Durán-Sánchez *et al.*, 2022), the level of water resource scarcity (Li, 2022), the efficacy of water-saving technologies (Huang *et al.*, 2017), the complexity of implementing such technologies (Zhou *et al.*, 2021), as well as the influence of neighboring farmers, water user associations, and irrigation district management sectors (Zhang *et al.*, 2019; Abadi & Kelboro, 2021). From an economic standpoint, the WRT policy represents an institutional shift, but it also involves a cognitive adjustment process for farmers on a psychological level. Prior research has often overlooked the impact of farmers' cognitive adjustments to policy changes on their adaptive behavioral evolution. Additionally, there is a paucity of quantitative analyses investigating the underlying reasons behind farmers' limited water-saving practices in the WRT context. Current research lacks extensive field survey data to substantiate the examination of factors influencing farmers' intentions to conserve water during WRT. Furthermore, it frequently neglects the influence of farmers' evolving understanding of water-saving practices and adaptive behavioral intentions.

What factors influence farmers' BI to conserve water during WRT? Why do farmers often exhibit a reluctance to engage in water-saving practices? How can we motivate farmers to enhance their commitment to water conservation within the WRT framework? These are pressing real-world challenges that demand solutions. This study seeks to address these critical questions by constructing an analytical framework for assessing the impact of WRT policies on farmers' water-conserving intentions. Leveraging research data from the Yellow River diversion irrigation area spanning 2020–2022, we integrate the theory of planned behavior (TPB) and the theory of perceived value (TPV). Through empirical analysis, our aim is to shed light on the factors influencing farmers' water-saving BI in the WRT context. Ultimately, our research aims to provide forward-thinking and targeted policy insights to bolster farmers' commitment to water conservation during WRT, safeguarding their interests. Compared to existing literature, this paper makes marginal contributions in two main areas: (1) it bridges the gap between the psychological factors drawn from behavioral science and psychology, offering insights into the impact of WRT policies on farmers' intentions to save water. (2) By integrating TPB and TPV, this paper provides a cognitive perspective, unraveling the logic behind the formation of farmers' intentions to save water. This involves more accurate calculations of the path coefficients between subjective norms, behavioral attitudes, perceived behavioral control, perceived benefits (PB), perceived risks (PR), and farmers' intention to engage in water-saving behaviors. This approach holds substantial practical and theoretical significance for devising effective strategies to enhance farmers' decision-making regarding water-saving behaviors under WRT policy.

The remainder of this paper is arranged as follows: Section 2 introduces a conceptual model that integrates TPB and TPV to explore farmers' BI regarding water conservation. Section 3 outlines our research methodology and provides a description of the data used in our study. In Section 4, we present and analyze the empirical results obtained through testing. Section 5 engages in a comprehensive discussion of these results. The final section summarizes our study and puts forth corresponding recommendations.

2. THE THEORETICAL FRAMEWORK AND RESEARCH HYPOTHESIS

2.1. Mechanisms for the formation of farmers' water-saving BI under the integration of dual theories

The impact of WRT policies on farmers' intention to conserve water is intricately influenced by a blend of psychological perceptual factors in a particular social context (Ajzen, 1991). TPB, proposed by Ajzen, possesses significant explanatory power concerning the mechanisms underlying individual behavioral pattern changes. TPB places emphasis on the assessment of objective factors by the individual undertaking the behavior, rather than merely integrating these objective factors into the analytical framework. This approach helps mitigate cognitive measurement biases stemming from differing individual perspectives on the same objective factors and allows for the seamless integration of subjective cognition, objective influences, and behavioral intentions (Ajzen, 2002). TPB has proven to be highly predictive when it comes to understanding individual intentions, and it has found widespread application in research related to farmers' intention to engage in water conservation. This includes areas such as technology adoption and cooperative behavior (Martínez-Espiñeira & García-Valiñas, 2013; Abadi & Kelboro, 2021; Shahangian *et al.*, 2021; Gibson *et al.*, 2023). It underscores that an individual's intention to conserve water is shaped by the combination of subjective norms (SN), perceived behavioral control (PBC), and behavioral attitudes (BA).

SN pertains to the external social influences that shape an individual farmer's constraints regarding water conservation. These influences encompass factors like the local community, water user associations, and initiatives promoted within the irrigation district. The intentions of farmers to conserve water can be significantly constrained by their own knowledge and judgment, with the pressure of SN exerting a substantial impact on their behavioral choices (Andow *et al.*, 2017; Valizadeh *et al.*, 2019). When farmers make decisions regarding water conservation, the guidance provided by government agencies and social organizations can have a positive influence on their intent to save water (Burnham & Ma, 2017). Additionally, they may take into consideration the level of support from sources beyond their immediate network of relatives, friends, and water user associations (Warner *et al.*, 2016). For instance, Chang *et al.* (2017) suggested that SN could partially explain farmers' water-saving behavior, and that individuals might be more inclined to endorse mandatory agricultural water-saving policies if they were aware of individuals or institutions that value water conservation in irrigated agriculture and were influenced by these entities. Therefore, we formulate the following hypothesis:

H1: SN exerts positive effects on farmers' water-saving BI significantly.

PBC represents individuals' assessment of their ability to perform some behavior before they actually undertake it, which includes the individuals' perception of their available resources, particularly concerning the incentives for water conservation in the context of WRT. PBC can directly affect behavior, and when it aligns with an individual's actual control over their behavior, it has the potential to directly shape behavior. This level of control is affected by both internal factors, like skills and knowledge, and external factors like technology, financial resources, time, and space (Pino *et al.*, 2017; Liao *et al.*, 2020). Farmers' participation in PBC for water-saving reflects their recognition of their own ability to engage in water-saving actions and invest time and effort in them. When farmers believe in their own capacity to respond to water-saving appeals, their PBC for water-saving tends to be strong. Research by Sarabia-Sánchez *et al.* (2014) has confirmed the significant and positive influence of PBC on self-reported water-saving behavior among respondents. Thus, we formulate the following hypothesis:

H2: PBC exerts a positive influence on farmers' intention to conserve water significantly.

BA is a relatively stable evaluative response of an individual to a certain behavior. As rational economic individuals, farmers' BA will promote the formation of their behavioral intention when WRT programs in the irrigation district meet their expected goal of maximizing profits; when WRT projects in the irrigation area deviate from their expected goal of maximizing profits, BA will hinder the formation of their behavioral intentions. The application and promotion of water-saving technology not only rely on the technology itself and government leadership but also on the behavioral response of farmers. Moreover, farmers' attitudes toward water-saving technology directly affect their choice of irrigation methods, irrigation water efficiency, and comprehensive benefits (Trumbo & O'Keefe, 2005). Xu *et al.* (2018) believed that farmers who lacked awareness of water-saving technologies would lead to fear and risk aversion, resulting in slow technology promotion and adoption. Therefore, hypothesis 3 is proposed:

H3: BA exerts a positive influence on farmers' water-saving BI significantly.

The traditional TPB underscores that human behavior is not purely voluntary but rather influenced by perceived control. Constructing a TPB model helps us comprehend how individuals modify their behavioral patterns after careful consideration. Although numerous studies have affirmed TPB's applicability and robust explanatory capability across various domains, some scholars argue that TPB simplifies behavioral motivation by integrating BA, SN, and PBC into a linear framework. They contend that solely analyzing latent variables within these three dimensions may not consistently predict the final behavior (Hassan *et al.*, 2016). Nevertheless, if it can be demonstrated that this new structure substantially enhances our understanding of intentions and behaviors, it becomes possible to introduce additional variables into the model (Yazdanpanah *et al.*, 2014). Consequently, a substantial body of literature applying the TPB model to examine individual intentions or behaviors has sought to incorporate supplementary factors into the theoretical framework to enhance predictive accuracy (Yuriev *et al.*, 2020). In 1988, Zeithaml proposed TPV, analyzing the perceptual process of micro-level decision-making behaviors. This theory established a research paradigm focusing on PB, PR, and perceived value (PV), providing theoretical support and an indicator framework for studying farmers' intention to engage in water-saving behaviors under WRT policy. Generally, PB encompasses dimensions such as economic and social benefits, while PR reflects the subject's perception of uncertainty regarding the outcomes of behavioral decisions. PV mirrors an individual's cognitive assessment of the value of objective entities and exhibits variability. PV can evaluate the trade-off between PB and PR, serving as an expression of the subject's ability to resist risks and acquire developmental capabilities. In other words, the subjective differences in PB and PR contribute to the formation of distinct perceived values and adaptive behaviors. Simultaneously, TPV suggests that the process of forming individual intentions should follow a logical sequence of 'cognitive hierarchy → cognitive balance → perceived value → behavioral intention' (Klöckner, 2013). An individual's intent is determined by their PV, which results from a subjective assessment of the trade-off between expected benefits and expected risks.

As primary users of water-conserving irrigation technology, farmers routinely weigh the benefits and risks associated with their behavior. To delve deeper into their self-interested motivations, this study expands the theoretical model of WRT policies impacting on farmers' water conservation by introducing PB and PR. The PV of water saving is determined through the summation and evaluation of PB and PR. PB represents whether farmers can discern the tangible advantages brought about by water infrastructure construction and the adoption of water-conserving technologies in the WRT process (Castillo *et al.*, 2021). PR is the subjective assessment of potential risks when individuals undertake specific behaviors, including the risk aversion stemming from policies that affect farmers (Rodriguez-Sanchez & Sarabia-Sanchez, 2020). Consequently, higher levels of perceived risk are associated with diminished intentions among farmers to engage in water-saving behavior. Moreover, scholars have posited that the PV level can influence the positivity of farmers' intentions regarding water conservation, with higher PV levels leading to more favorable intentions for water-saving practices (Oberkircher & Hornidge, 2011). Consequently, this paper augments the original analytical framework with two pathways: ‘PB →BA’ and ‘PR → BA.’ Consequently, we propose the following hypotheses:

H4a: PB positively influences farmers’ attitudes toward water-saving behavior.
H4b: PR negatively impacts farmers’ attitudes toward water-saving behavior.
H5a: PB positively affects farmers’ BI to conserve water.
H5b: PR negatively affects farmers’ BI to conserve water.

2.2. Theoretical model

Both TPB and TPV are extensions of the Theory of Rational Behavior, and they share some theoretical similarities. In this paper, we integrate these two theories to harness their combined explanatory power. The integrated model depicting the mechanism behind the formation of farmers’ intention to conserve water is illustrated in Figure 1. Now that elements such as SN, SN, PBC, PB, and PR are latent variables that cannot be directly observed, this paper draws on existing research designs and the actual conditions of the surveyed region. The items related to SN are based on the study by Valizadeh *et al.* (2023), the items related to SN were adapted from the research by Wang *et al.* (2023), PBC items were referenced from the study by Bagheri & Teymouri (2022), PB items were adapted from the research by Kumar *et al.* (2022), and PR items were based on the study by Hu *et al.* (2022). The items covering water conservation BI were drawn from the research by Rahimi *et al.* (2016). Subsequently, based on interviews and pilot testing with some farmers in the surveyed irrigation area, and considering farmers’ comprehension abilities and the implementation status of WRT policies in the irrigation area, we modified the items. In the end, 6 latent variables and 18 observed variables were determined (see Table 1). A Likert seven-

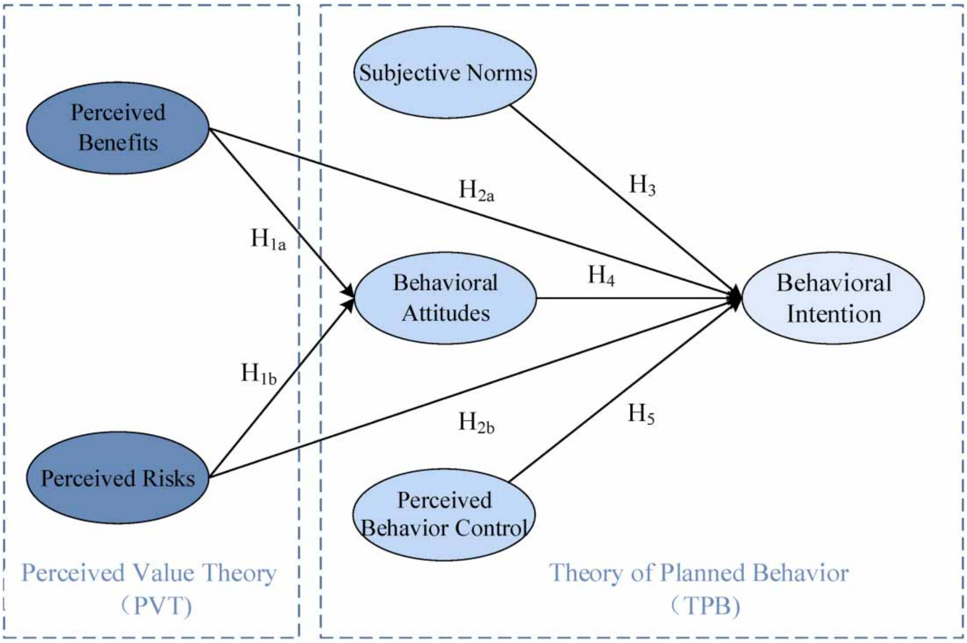


Fig. 1 | Hypothetical model of farmers’ water-conserving intention in the WRT context.

Table 1 | Scale construction and descriptive statistical analysis.

Latent variables	Items	Number	Mean value	Standard deviation
SN	The government actively publicizes and advocates WRT in irrigation districts.	SN1	5.10	1.798
	Farmers' water user associations publicize WRT in irrigation districts.	SN2	5.23	1.705
	Neighboring farmers or family farms are involved in WRT in irrigation districts.	SN3	5.19	1.748
PBC	I can operate the water-saving irrigation system.	PBC1	4.73	1.913
	I can acquire the knowledge of water-saving irrigation techniques.	PBC2	4.76	1.877
	I have enough time to learn water-saving irrigation techniques.	PBC3	4.70	1.857
BA	I think water-saving irrigation technology has a better prospect of being used.	BA1	4.43	1.882
	I believe that WRT will improve irrigation technology in irrigation districts.	BA2	4.39	1.877
	I think WRT can increase grain production in irrigation districts.	BA3	4.42	1.892
PB	I think WRT can help improve water-use efficiency in irrigation districts.	PB1	5.32	1.520
	WRT helps save water, time, and labor in irrigation districts.	PB2	5.32	1.489
	The water rights transfer helps reduce land salinization in irrigation districts.	PB3	5.23	1.479
PR	The water rights transfer will lead to higher agricultural water prices in irrigation districts.	PR1	2.53	1.471
	The water rights transfer may result in some farmland not being effectively irrigated in irrigation districts.	PR2	2.52	1.461
	The water rights transfer may lead to an increase in highly polluting businesses in the neighborhood.	PR3	2.91	1.435
BI	I intend to accept the promotion and application of water-saving technology.	BI1	5.82	1.261
	I intend to be trained to master water conservation techniques.	BI2	5.73	1.357
	I intend to avoid wasting water in production and planting as much as possible.	BI3	5.80	1.275

point scale was employed (ranging from 'strongly disagree' to 'strongly agree,' with values assigned from one to seven), representing the respondents' varying attitudes toward the questionnaire items.

3. MATERIALS AND METHODS

3.1. Methods

Since SN, PBC, BA, PB, PR, and BI are all latent variables that cannot be directly observed and exhibit multidimensional common effects, they require measurement through certain epiphenomenal indicators. Given the limited observational dimensions of the Logistic and Probit models, we have opted for structural equation modeling (SEM) for our empirical study. SEM excels at handling the interplay among multiple latent variables for factor analysis and path analysis while effectively mitigating issues related to collinearity in regression (Sarstedt & Cheah, 2019). In essence, SEM encompasses factor analytic evaluation models and path analytic structural models, each designed to elucidate the structural relationships of explicit and latent variables, respectively. The specific models and equations are detailed as follows:

$$X = \Lambda_X \xi + \delta \tag{1}$$

$$Y = \Lambda_Y \eta + \varepsilon \tag{2}$$

$$\eta = \beta\eta + \Gamma\xi + \varsigma \tag{3}$$

Equations (1) and (2) represent the measurement models. X and Y are measurable exogenous and endogenous variables, and ξ and η are latent exogenous and endogenous variables, respectively. The symbol Λ_X expresses the relationship between measurable exogenous variables and latent exogenous variables, while Λ_Y symbolizes the relationship between observable endogenous variables and latent endogenous variables. δ and ε are error terms in the measurement model.

Equation (3) represents the structural model. η is the endogenous latent dependent variable, and ξ is the exogenous latent independent variable. β and λ are structural model coefficients, where the former indicates the relationship between endogenous latent variables, and the latter indicates the relationship between exogenous latent variables and endogenous latent variables. ς is the error term in the structural model.

3.2. Data sources

The Inner Mongolia Autonomous Region (IMAR) serves as the birthplace of China's WRT model, and the current potential for water-saving in regional agricultural irrigation districts is substantial (Guan *et al.*, 2021). Consequently, several locations within IMAR were selected for investigation, including the South Bank Irrigation District in Erdos City, Luanjingtan Irrigation Area in Alashan League, Dengkou Pumping Irrigation Area, and National Unity Irrigation Area in Baotou, Hetao Irrigation District in Bayannur, as well as Xindi Irrigation Area and Bayintaohai Irrigation Area in Wuhai. To prepare for the formal survey conducted from 2020 to 2022, we conducted 35 copies of pre-surveys, involving interviews with experts and scholars in related fields. The final questionnaire version was refined through repeated revisions of questions and expressions. Given that a majority of the interviewees were aged over 50, each questionnaire was administered through interviews with farmers face to face either in their households or in the field. Team members conducted these interviews and completed the questionnaires on-site to ensure data quality. In total, 700 questionnaires were administered during this research. After we excluded questionnaires with missing information or inconsistent responses, 608 valid questionnaires were obtained, resulting in a validity rate of 86.86% (as indicated in Table 2).

3.3. Sample descriptions

Table 2 offers an overview of the basic information for the 608 valid samples. Regarding the gender distribution of householders in the irrigation area, males constitute the majority at 81.58% of the total samples. The age distribution of householders skews toward the middle-aged demographic, with farming operators aged 30–60 comprising 69.41% of the total samples. In terms of education level, householders with high school and higher education make up 48.58% of the total samples. In relation to net income per unit area, the range of RMB 2,000–4,000 represents the largest portion at 74.34%. Overall, the householders in the irrigation area exhibit characteristics of being predominantly male, middle-aged, and oriented toward quality.

4. RESULTS

4.1. Reliability and validity test

The reliability testing consisted of both internal consistency reliability and combined reliability assessments. Internal consistency reliability was evaluated by using Cronbach's alpha coefficient, with values falling into the low, moderate, and high reliability categories when ≤ 0.35, between 0.35 and 0.7, and ≥ 0.7, respectively. Meanwhile, combined reliability was measured using Composite Reliability (CR), typically requiring a value exceeding 0.7. We conducted the reliability analysis for PB, PR, SN, BA, PBC, and BI using SPSS 23.0 software.

Table 2 | Basic characteristics of samples.

Basic characteristics	Valuation	Sample numbers	Proportion
Householders' gender	Male	496	81.58
	Female	112	18.42
Householders' age	Under 30 years old	53	8.72
	Aged 30 and 45	55	9.04
	Aged between 46 and 60	421	69.40
	Over 60	78	12.82
Householders' education background	Primary school	214	25.20
	Junior middle school	281	26.22
	High school and higher education	113	48.58
Number of family labor (persons)	≤2	316	51.97
	3	78	12.66
	≥4	214	35.20
Net income per unit area (Yuan)	≤2,000	107	17.60
	2,000–4,000	452	74.34
	≥4,000	49	8.05
Income source	Farming	413	67.92
	Non-farming	195	32.07

As indicated in Table 3, the Cronbach's alpha coefficients for the latent variables – PB, PR, SN, BA, PBC, and BI – were 0.849, 0.858, 0.9, 0.905, 0.903, and 0.864, respectively. All of these values surpass 0.8, demonstrating strong internal consistency reliability and successfully passing the combined reliability test. The CR value of each measurable variable is between 0.8521 and 0.9078, all of which surpass 0.7, passing the combined reliability test; the value of average variance extraction (AVE) is over 0.5, the KMO values are 0.5, and the sig values are all <0.05, passing the Bartlett's spherical test, which makes it suitable for factor analysis; the AVE value of each latent variable surpasses 0.5, which indicates that the measurable variables explain the latent variables relatively well, passing the validity test.

4.2. Model fit testing

In this study, we conducted further model fit tests and found that the absolute fit indices, incremental fit indices, and parsimonious fit indices met the standards (as revealed in Figure 2 and Table 4). In summary, the model passed the overall fit test, indicating that the theoretical model integrated and constructed in this paper aligns well with the actual willingness of farmers to engage in water-saving behaviors.

4.3. Hypothesis testing

Based on the previously established model of the formation mechanism of farmers' intention to engage in water-saving behaviors, hypothesis testing was conducted for each latent variable. Additionally, the theoretical model constructed in this paper, combining TPB and TPV, proved to be effective in predicting and explaining farmers' intention toward water-saving behaviors and their formation process. The structural path coefficients reflect the significance of the influence between latent variables. At the current stage, all latent variables have passed the significance test at the 5% level. Therefore, hypotheses H1–H5 have all been validated (see Table 5).

(1) The influence of SN on farmers' water-saving intention. The standardized path coefficient of SN on farmers' intention to conserve water is 0.151, and it is positively significant at the 1% level, which indicates that

Table 3 | Results of reliability and validity analysis.

Latent variables	Measurable variable codes	Cronbach's alpha	KMO	Bartlett test	Standardized factor loadings	CR	AVE
SN	SN1	0.900	0.715	1,189.845 (0.000)	0.966	0.9024	0.7562
	SN2				0.804		
	SN3				0.830		
PBC	PBC1	0.903	0.698	1,253.380 (0.000)	0.988	0.9066	0.7655
	PBC2				0.810		
	PBC3				0.815		
BA	BA1	0.905	0.716	1,247.074 (0.000)	0.971	0.9078	0.7675
	BA2				0.823		
	BA3				0.826		
PB	PB1	0.849	0.711	803.612 (0.000)	0.905	0.8521	0.6592
	PB2				0.749		
	PB3				0.773		
PR	PR1	0.858	0.709	866.292	0.924	0.8618	0.6771
	PR2				0.746		
	PR3				0.788		
BI	BI1	0.864	0.706	914.279 (0.000)	0.941	0.8692	0.6909
	BI2				0.770		
	BI3				0.771		

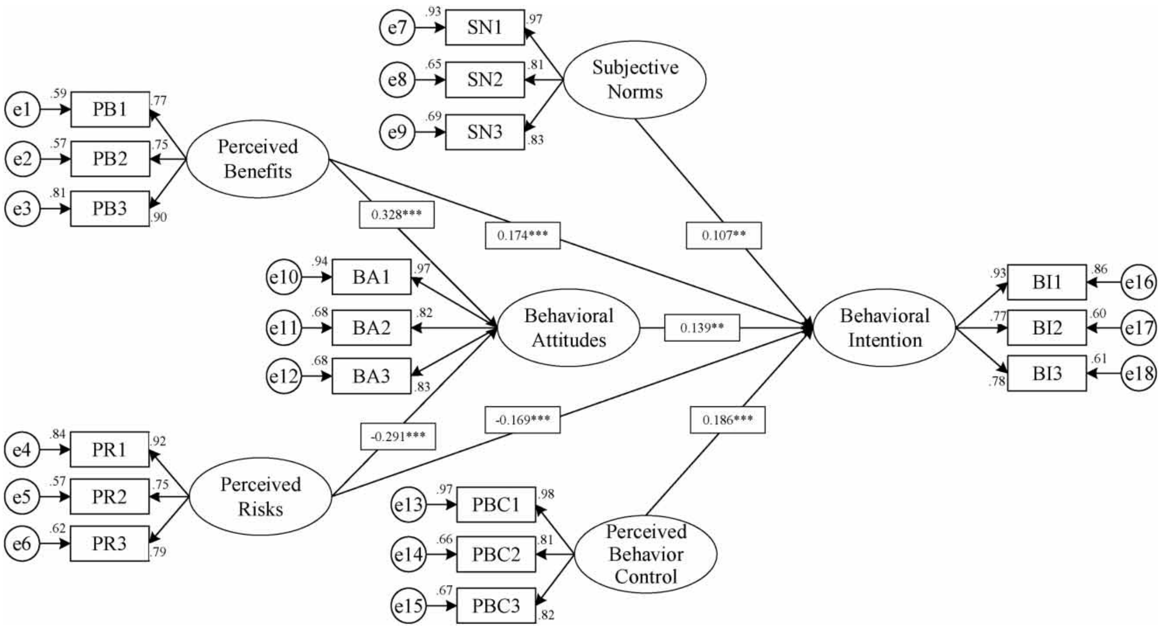


Fig. 2 | Results of the hypothetical model of farmers' water-saving intention in the WRT context.

Table 4 | Fitting discriminations for SEM.

	Absolute fitting index				Value-added fitting index			Simple fitting index	
Types of indices	**CMIN/DF**	**GFI**	**RMR**	**RMSEA**	**NFI**	**CFI**	**IFI**	**PGFI**	**PNFI**
Evaluation criteria	<3	>0.90	<0.08	<0.08	>0.90	>0.90	>0.90	>0.50	>0.50
Fitting results	1.997	0.959	0.069	0.041	0.967	0.983	0.983	0.684	0.771
Fitting assessment	Fit				Fit			Fit	

Table 5 | Hypothesis testing results.

Hypotheses	Paths	Standardized estimates	S.E.	C.R.	*P*	Conclusion
H_1	SN → BI	0.107	0.030	3.024	0.002	Hypothesis holds
H_2	PBC → BI	0.186	0.030	3.824	***	Hypothesis holds
H_3	BA → BI	0.139	0.031	2.229	0.026	Hypothesis holds
H_{4a}	PB → BA	0.328	0.068	8.922	***	Hypothesis holds
H_{4b}	PR → BA	−0.291	0.067	−6.107	***	Hypothesis holds
H_{5a}	PB → BI	0.174	0.051	3.479	***	Hypothesis holds
H_{5b}	PR → BI	−0.169	0.047	−3.599	***	Hypothesis holds

Note: *** signifies significance on levels 1%.

farmers' intention to engage in water-saving behaviors is positively affected by the perceptions of other relevant social actors, confirming hypothesis H1 in this study. The significant path coefficient for SN suggests that the stronger the perception of norms related to agricultural water conservation, the more liable farmers are to promote the implementation of water-saving behaviors. In current rural areas, collective actions may influence farmers' intention to conserve water through external rewards or pressure that constrains individual behavior, which encourages farmers to align their actions with those around them, thereby impacting their willingness to save water.

(2) The influence of PBC on farmers' water-saving intention. The standardized coefficient for the influence of PBC on farmers' water-saving intention is 0.185, and it is significantly positive at the 1% level. This reveals that, holding other variables constant, when surveyed farmers perceive lower levels of difficulty in participating in water-saving processes, their intention to engage in water-saving behaviors is higher, which validates hypothesis H2 in this study. When individual farmers have confidence that taking actions will lead to expected outcomes, they are more inclined to adopt water-saving measures. Conversely, if they lack this confidence, they are less liable to engage in water-saving actions.

(3) The influence of BA on farmers' intention to conserve water. The standardized path coefficient for the influence of BA on farmers' intention to conserve water is 0.104, and it is positively significant at the 5% level, validating hypothesis H3 in this study. This suggests that farmers' perception of the actual benefits brought about by WRT has a significant positive impact on their intention to engage in water-saving behaviors. In the promotion of WRT policies in irrigation areas, farmers are not required to bear the costs of water-saving equipment and channel lining transformation. This policy brings benefits such as labor and time savings, increased yields and income, and reduced irrigation water costs. These positive effects on income positively influence farmers' intention to save water.

(4) The impact of PV on farmers' BA and BI to conserve water. The standardized coefficients for the influence of PB and PR on farmers' BA are 0.328 and −0.291, respectively, and both are highly significant at the 1% level, validating hypotheses H4a and H4b. These results indicate that a high-benefit, low-risk behavioral environment positively impacts farmers' BA toward water-saving. Additionally, the standardized path coefficient for the influence of PB on farmers' willingness to conserve water is 0.174, and it is highly significant at the 1% level, confirming hypothesis H5a, which means that there is a positive correlation between farmers' water-saving intention and their PB. The standardized path coefficient for the influence of PR on intention to conserve water is −0.169, and it passes the significance test at the 1% level, validating hypothesis H5b, indicating a negative correlation between farmers' intention to conserve water and their PR. PB and PR not only jointly influence the intention to conserve water but also independently affect farmers' attitudes toward water-saving behaviors.

4.4. Mediation analysis

The bootstrap method was used to test for chain mediation effects in this study. The specific steps involve repeated random sampling with a confidence level set at 95%. If the confidence interval does not include 0, the mediation effect is considered significant; otherwise, it is not significant. As shown in Table 6, both paths have confidence intervals that do not include 0, which means that the mediation effects are significant, and the null hypothesis is accepted. For the path BI ← BA ← PB, the effect size is 0.037, with a 95% confidence interval of 0.003–0.079. The *p*-value passes the significance level test, confirming that BA mediates the relationship between PB and BI. For the path BI ← BA ← PR, the effect size is −0.028, with a 90% confidence interval of −0.062 to −0.003. The *p*-value also passes the significance level test, indicating that BA mediates the relationship between PR and BA. In summary, both PB and PR have indirect significant effects on the farmers' water-saving intention, with the influence of PB being greater than that of PR. This could be because 'economically rational' farmers are more likely to enhance their intention to engage in water-saving behaviors when they can perceive the actual benefits brought about by relevant policies in WRT, such as the formulation of benefit compensation standards and improvements in water infrastructure. Therefore, PB has a greater impact on farmers' intention to conserve water compared to PR.

5. DISCUSSION

In recent years, despite the Chinese government's efforts to promote WRT in irrigation areas and to formulate and improve relevant policies to advance water-saving agriculture, there are still many obstacles to the widespread adoption of agricultural water-conserving technologies. Field research has revealed that while WRT can effectively improve irrigation water conditions and efficiency, farmers have a relatively low intention to engage in water-saving behaviors. They often fail to perceive the decrease in irrigation water costs, have misconceptions about agricultural water prices, question the benefit compensation standards, and face weak influence from

Table 6 | Results of the mediation effect testing.

Paths	**Effect size**	**Lower limit**	**Upper limit**	***p*-value**
BI ← BA ← PB	0.037	0.003	0.079	*
BI ← BA ← PR	−0.028	−0.062	−0.003	*

Note: *signifies significance on levels 10%.

farmers' water-use associations. Understanding the factors influencing farmers' water-saving behaviors in the context of WRT can assist the government and policymakers in improving these behaviors and preventing the wastage of water resources. This study integrates TPB and TPV to investigate the influencing factors of WRT policies on farmers' water-saving behaviors. It analyzes the data and tests the research hypotheses. The innovation of the current study is noteworthy in two aspects that have received relatively less attention in previous research. First, it combines psychological factors from the fields of behavioral science and psychology to analyze the impact of WRT policies on farmers' BI to save water. Second, it integrates TPB and TPV to deconstruct the logic behind the formation of farmers' BI to save water from a cognitive perspective. This involves more accurate calculations of the path coefficients between SN, BA, PBC, PB, PR, and farmers' intention to engage in water-saving behaviors. This approach holds substantial practical and theoretical significance for devising effective strategies to enhance farmers' decision-making regarding water-saving behaviors under WRT policy.

Based on the questionnaire survey and SEM analysis, it has been found that SN, PBC, and BA have a positive correlation with farmers' intention to engage in water-saving behaviors. This study indicates that farmers' water-saving intention is influenced by multiple factors, including both internal and external factors. Firstly, PBC has the most significant impact on farmers' intention to save water. This finding aligns with the research by Mahdavi (2021). As the population grows and the urbanization accelerates in China, the demand for urban life and industrial water use is increasing sharply and water scarcity and the resulting water competition and conflicts are becoming more prominent. Implementing WRT policies is beneficial for the efficient use of water resources. If farmers can understand the relevant policies related to WRT, their intention to save water becomes more positive. Secondly, BA is a secondary factor in the formation of farmers' intention to save water. This finding is in agreement with the research by Rezaei *et al.* (2019), which suggests that one of the primary prerequisites for motivating farmers to implement water-saving behaviors is to have a positive attitude toward these behaviors. When farmers perceive a behavior as reasonable and valuable and believe that it will lead to positive outcomes, they are more likely to form favorable judgments about that behavior, thereby generating an intention to engage in it. Lastly, SN has the weakest impact on farmers' intention to save water, which is in line with the viewpoint in the study by Chang *et al.* (2016). Although it is theoretically believed that the collective consciousness in the Chinese cultural context has a significant influence on rural residents' water-saving awareness, studies like Chang *et al.* (2017) also suggest that the relationship between SN and attitudes toward mandatory agricultural water-saving policies is not strong. Implementation of mandatory water-saving policies, such as WRT, may harm the interests of some farmers, which could reduce public understanding and support for these policies. Sheeran & Orbell (1999) argue that the weak relationship between SN and BI is mainly due to the fact that the concept of SN does not adequately reveal the social influence on individual behavior. Therefore, there may be a need to redefine SN.

Furthermore, PB and PR influence farmers' water-saving intentions in both direct and indirect ways. On the one hand, they directly affect farmers' water-saving intention through the path 'PB/PR → BI'. On the other hand, they indirectly influence farmers' water-saving intention through the path 'PB /PR → BA → BI'. PB is a crucial factor influencing farmers' water-saving intention, which is consistent with the findings of Qiao *et al.* (2017). Farmers are more willing to conserve water when they can perceive the actual benefits brought by related policies in WRT, such as the establishment of compensation standards and improvements in water infrastructure. PR hinders the formation of farmers' willingness to save water, which is consistent with the research by Sabbagh & Gutierrez (2022). Given the current WRT policies involve certain risks and uncertainties, farmers tend to overestimate the potential risks and difficulties when facing new initiatives and they are less inclined to be the 'early adopters' when uncertainties are involved.

This study also attempts to discuss an important issue: why, in the current WRT context, farmers are aware of the importance of agricultural water conservation and the benefits it brings, yet their intention to save water still remains low. The reasons for this can be outlined as follows: (1) Continuous increases in water prices offset the reduced irrigation costs from water-saving by farmers. In recent years, local governments have attempted to encourage farmers to adopt water-saving technologies by raising agricultural water prices. However, in some cases, the rate of increase in water prices has exceeded the cost savings achieved by farmers through water-saving practices, which creates a psychological gap for farmers. Their intention to save water is influenced more by their own perceptions and PB, especially when farmers realize that the application of water-saving technologies does not significantly reduce irrigation costs, despite rising water prices, which leads them to reevaluate the benefits of adopting water-saving technologies. (2) Current compensation policies have not effectively incentivized farmers' awareness of water-conserving behaviors. In the WRT process, local governments, water-demanding enterprises, and water rights trading platforms can directly benefit. However, farmers, as direct sellers of water rights, often receive indirect economic benefits rather than direct income. (3) There are some difficulties in accurately measuring individual farmers' actual water use with water metering and monitoring equipment. In a situation where irrigation cost expenditures are continuously rising, if water metering facilities cannot accurately monitor the individual water consumption of farmers, then farmers have an economic incentive to use more water to their advantage. This behavior aligns with the rational choices of economic actors and can lead to the wasteful use of water resources.

The research findings of this paper provide a distinctive model for other countries to implement WRT policy with Chinese characteristics. The evolution of China's WRT policy, like other water resource allocation policies, has progressed from pilot projects to gradual widespread application, from informality to institutionalization and legalization, and from controversy to acceptance. It has undergone a continuous process of improvement and deepening. In the implementation and promotion of WRT policy in China, the current trend is to reallocate agricultural water use from water-deficient regions to non-agricultural sectors with higher economic benefits. The substantial water-saving potential in the agricultural sector serves as a possibility for the implementation of the WRT policy, with the water supply–demand imbalance in non-agricultural sectors being a primary driving force. However, due to China's use of irrigation districts as the basic unit for agricultural production and water resource utilization (reflecting the traditional agricultural structure and the unique characteristics of a small-scale farming economy), water rights become public property within irrigation districts and cannot be allocated to individuals. Simultaneously, the limited per capita resource allocation constrains the potential benefits through market mechanisms, preventing farmers from directly benefiting from water conservation. This leads to a low desire among farmers to participate in water-saving efforts. Therefore, in countries with imperfect water rights systems implementing the WRT policy, more attention and emphasis should be placed on protecting rural development and the interests of farmers.

6. CONCLUSIONS AND RECOMMENDATIONS

Uncovering the impact mechanism of WRT policies on farmers' intention to save water is crucial for water rights system development and safeguarding farmers' interests. In accordance with survey data from seven Yellow River irrigation areas in Inner Mongolia from 2020 to 2022, this study, in conjunction with TPB and TPV, employed SEM to investigate the mechanisms behind farmers' intention to save water and the influencing factors. The main findings are as follows: Firstly, WRT policies in irrigation areas can significantly affect farmers' intention to save water. This impact is primarily influenced by such factors as SN, BA, PBC, PB, and PR, among which, PBC has the most significant influence on farmers' water-saving intention. Secondly, the impact of intrinsic cognition outweighs external influences, with SN having the weakest effect on farmers' intention to save water, which suggests that under compulsory water-saving interventions, farmers' water-saving intention is not closely tied to SN. Finally, regarding the factors influencing farmers' water-saving intention, both direct and indirect effects are observed through the pathways of 'PB/PR → BI' and 'PB/PR → BA → BI'.

Given the current challenges posed by increasing agricultural water prices, which may reduce farmers' income and have a limited impact on promoting water-saving behavior, the following recommendations are derived from the findings of the study. (1) The operation of water-saving technologies for farmers should be simplified. Local governments should regularly organize water-saving training programs to reduce the learning costs and threshold constraints associated with using water-saving technologies. Through publicity and demonstration effects, farmers can develop a more reasonable understanding of the benefits of these technologies. (2) The compensation mechanisms within the water rights system are to be enhanced to benefit farmers. Irrigation management authorities should consider decentralizing water usage rights to individual farmers, enabling them to directly benefit economically from water-saving practices, which can significantly boost farmers' intention to adopt water-saving behaviors. (3) The influence of local communities and water user associations should be harnessed in shaping subjective norms. Targeted training for farmers under suitable conditions can be initiated to leverage the power of demonstration effects, which can encourage neighboring farmers to adopt water-saving technologies and engage in learning and application willingly and actively (Table 6).

This study has brought innovation in terms of perspective and methodology. However, there are potential limitations to consider. The study did not account for regional differences in the effectiveness of WRT models, nor did it investigate whether different planting scales and structures have varying impacts on farmers' intention to save water. Future research could employ multi-group SEM methods to further validate differences among various irrigation regions and farmer groups.

ACKNOWLEDGMENTS

This study was financially supported by Henan Provincial Department of Education Humanities and Social Sciences Research Project (2024-ZZJH-151) and Philosophy and Social Science planning project of Henan Province (2022BJJ068).We gratefully acknowledge the anonymous reviewers for their insightful comments on and suggestions for this paper.

DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

CONFLICT OF INTEREST

The authors declare there is no conflict.

REFERENCES

Abadi, B. & Kelboro, G. (2021). Farmers' contributions to achieving water sustainability: A meta-analytic path analysis of predicting water conservation behavior. *Sustainability 14*(1), 279. https://doi.org/10.3390/su14010279.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes 50*(2), 179–211. http://dx.doi.org/10.1016/0749-5978(91)90020-T.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology 32*(4), 665–683. http://dx.doi.org/10.1111/j.1559-1816.2002.tb00236.x.

Andow, D. A., Resende Filho, M. A., Carneiro, R. G., Lorena, D. R., Sujii, E. R. & Alves, R. T. (2017). Heterogeneity in intention to adopt organic strawberry production practices among producers in the federal district, Brazil. *Ecological Economics 140*, 177–189. https://doi.org/10.1016/j.ecolecon.2017.04.026.

Bagheri, A. & Teymouri, A. (2022). Farmers' intended and actual adoption of soil and water conservation practices. *Agricultural Water Management 259*, 107244.

Burnham, M. & Ma, Z. (2017). Climate change adaptation: Factors influencing Chinese smallholder farmers' perceived self-efficacy and adaptation intent. *Regional Environmental Change 17*, 171–186. https://doi.org/10.1007/s10113-016-0975-6.

Castillo, G. M. L., Engler, A. & Wollni, M. (2021). Planned behavior and social capital: Understanding farmers' behavior toward pressurized irrigation technologies. *Agricultural Water Management 243*, 106524. https://doi.org/10.1016/j.agwat.2020.106524.

Chang, G., Wang, L., Meng, L. & Zhang, W. (2016). Farmers' attitudes toward mandatory water-saving policies: A case study in two basins in northwest China. *Journal of Environmental Management 181*, 455–464. https://doi.org/10.1016/j.jenvman.2016.07.007.

Chang, G., Meng, L., Wang, J. & Wang, L. (2017). Attitudes and influencing factors of farmers in inland river basins in China towards mandatory agricultural water-saving policies. *Journal of Arid Land Resources and Environment 31*(09), 38–42.

Durán-Sánchez, A., del Río-Rama, M. D. L. C., Álvarez-García, J. & Cabezas-Hernández, M. T. (2022). Water markets: Mapping scientific knowledge. *Water 14*(12), 1907. https://doi.org/10.3390/w14121907.

Feng, Y., Chang, M., He, Y., Song, R. & Liu, J. (2023). Can property rights reform of China's agricultural water facilities improve the quality of facility maintenance and enhance farmers' water conservation behavior? A typical case from Yunnan Province, China. *Water 15*(4), 757. https://doi.org/10.3390/w15040757.

Gholamrezai, S. & Sepahvand, F. (2017). Farmers' participation in water user association in western Iran. *Journal of Water and Land Development 35*(1), 49–56. https://doi.org/10.1037/0033-2909.84.5.888.

Gibson, K. E., Lamm, A. J., Lamm, K. W. & Holt, J. (2023). Integrating the theory of planned behavior and motivation to explore residential water-saving behaviors. *Water 15*(17), 3034. https://doi.org/10.3390/w15173034.

Guan, X., Wang, B., Zhang, W. & Du, Q. (2021). Study on water rights allocation of irrigation water users in irrigation districts of the Yellow River Basin. *Water 13*(24), 3538. https://doi.org/10.3390/w13243538.

Guo, H., Chen, X., Liu, J., Zhang, H. & Svensson, J. (2020). Joint analysis of water rights trading and water-saving management contracts in China. *International Journal of Water Resources Development 36*(4), 716–737. https://doi.org/10.1080/07900627.2019.1657808.

Hassan, L. M., Shiu, E. & Parry, S. (2016). Addressing the cross-country applicability of the theory of planned behaviour (TPB): A structured review of multi-country TPB studies. *Journal of Consumer Behaviour 15*(1), 72–86. https://doi.org/10.1002/cb.1536.

Hu, L., Channa, A., Liu, X., Lakhan, G. R., Meraj, M., Lu, Q. & Wang, Q. (2022). Risk characteristics, government subsidies and farmers' willingness to adopt water-saving irrigation techniques. *Irrigation and Drainage 71*(1), 255–267.

Huang, Q., Wang, J. & Li, Y. (2017). Do water saving technologies save water? Empirical evidence from North China. *Journal of Environmental Economics and Management 82*, 1–16. https://doi.org/10.1016/j.jeem.2016.10.003.

Jenkins, W., Rosa, L., Schmidt, J., Band, L., Beltran-Peña, A., Clarens, A., Doney, S., Emanuel, R. E., Glassie, A., Quinn, J., Rulli, M. C., Shobe, W., Szeptycki, L. & D'Odorico, P. (2021). Values-based scenarios of water security: Rights to water, rights of waters, and commercial water rights. *BioScience 71*(11), 1157–1170. https://doi.org/10.1093/biosci/biab088.

Jia, S., Sun, Y., Svensson, J. & Mukherjee, M. (2016). Comparative analysis of water rights entitlements in India and China. *Water Policy 18*(S1), 50–67. https://doi.org/10.2166/wp.2016.004.

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour – a meta-analysis. *Global Environmental Change 23*(5), 1028–1038. https://doi.org/10.1016/j.gloenvcha.2013.05.014.

Kumar, S., Singh, D. R. & Mondal, B. (2022). Influence of psychological and institutional factors on adoption of soil and water conservation practices: An analysis using structural equation modelling. *Agricultural Economics Research Review 35*(conf), 195–195.

Li, X. (2022). Can collecting water fees really promote agricultural water-Saving? Evidence from seasonal water shortage areas in South China. *Sustainability 14*(19), 12881. https://doi.org/10.3390/su141912881.

Liao, N., Gu, X., Wang, Y., Xu, H. & Fan, Z. (2020). Analyzing macro-level ecological change and micro-level farmer behavior in Manas River Basin, China. *Land 9*(8), 250. https://doi.org/10.3390/land9080250.

Ma, J., Cui, Y., Kong, X. & Chen, Z. (2021). Water rights system, water access permit management, and farmers' adoption of water saving technologies: An empirical study on the water saving effect of water rights reform based on difference model. *Statistical Research 38*(04), 116–130.

Mahdavi, T. (2021). Application of the 'theory of planned behavior'to understand farmers' intentions to accept water policy options using structural equation modeling. *Water Supply 21*(6), 2720–2734. https://doi.org/10.2166/ws.2021.138.

Martínez-Espiñeira, R. & García-Valiñas, M. Á. (2013). Adopting versus adapting: Adoption of water-saving technology versus water conservation habits in Spain. *International Journal of Water Resources Development 29*(3), 400–414. https://doi.org/10.1080/07900627.2012.721695.

Oberkircher, L. & Hornidge, A. K. (2011). 'Water is life'–Farmer rationales and water saving in Khorezm, Uzbekistan: A lifeworld analysis. *Rural Sociology 76*(3), 394–421. https://doi.org/10.1111/j.1549-0831.2011.00054.x.

Pino, G., Toma, P., Rizzo, C., Miglietta, P. P., Peluso, A. M. & Guido, G. (2017). Determinants of farmers' intention to adopt water saving measures: Evidence from Italy. *Sustainability 9*(1), 77. https://doi.org/10.3390/su9010077.

Qiao, D., Lu, Q. & Xu, T. (2017). Social networks, promotion services, and the adoption of water-saving irrigation technology by farmers – taking Minqin County, Gansu Province as an example. *Resource Science 39*(03), 441–450.

Rahimi, F., Yazdanpanah, M., Forouzani, M., Mohammadzadeh, S. & Burton, R. (2016). Investigating the role of social capital on intentions and water conservation behavior of farmers in the Aleshtar county. *Rural Development Strategies 3*(2), 237–253.

Rezaei, R., Safa, L., Damalas, C. A. & Ganjkhanloo, M. M. (2019). Drivers of farmers' intention to use integrated pest management: Integrating theory of planned behavior and norm activation model. *Journal of Environmental Management 236*, 328–339. https://doi.org/10.1016/j.jenvman.2019.01.097.

Rodriguez-Sanchez, C. & Sarabia-Sanchez, F. J. (2020). Does water context matter in water conservation decision behaviour?. *Sustainability 12*(7), 3026. https://doi.org/10.3390/su12073026.

Sabbagh, M. & Gutierrez, L. (2022). Micro-irrigation technology adoption in the Bekaa Valley of Lebanon: A behavioural model. *Sustainability 14*(13), 7685. https://doi.org/10.3390/su14137685.

Sarabia-Sánchez, F. J., Rodríguez-Sánchez, C. & Hyder, A. (2014). The role of personal involvement, credibility and efficacy of conduct in reported water conservation behaviour. *Journal of Environmental Psychology 38*, 206–216. https://doi.org/10.1016/j.jenvp.2014.02.003.

Sarstedt, M. & Cheah, J. H. (2019). Partial least squares structural equation modeling using SmartPLS: A software review. *Journal of Marketing Analytics 7*, 196–202. https://doi.org/10.1057/s41270-019-00058-3.

Shahangian, S. A., Tabesh, M. & Yazdanpanah, M. (2021). How can socio-psychological factors be related to water-efficiency intention and behaviors among Iranian residential water consumers?. *Journal of Environmental Management 288*, 112466. https://doi.org/10.1016/j.jenvman.2021.112466.

Sheeran, P. & Orbell, S. (1999). Implementation intentions and repeated behaviour: Augmenting the predictive validity of the theory of planned behaviour. *European Journal of Social Psychology 29*(2-3), 349–369.

Sun, Y., Jia, S. & Jia, R. (2023). Classification and applicable conditions of water rights systems. *Water Resources Management 37*, 4059–4073. https://doi.org/10.1007/s11269-023-03539-4.

Trumbo, C. W. & O'Keefe, G. J. (2005). Intention to conserve water: Environmental values, reasoned action, and information effects across time. *Society and Natural Resources 18*(6), 573–585. https://doi.org/10.1080/08941920590948002.

Valizadeh, N., Bijani, M., Hayati, D. & Fallah Haghighi, N. (2019). Social-cognitive conceptualization of Iranian farmers' water conservation behavior. *Hydrogeology Journal 27*(4), 1131–1142. https://doi.org/10.1007/s10040-018-01915-8.

Valizadeh, N., Bijani, M., Fallah Haghighi, N., Hayati, D., Bazrafkan, K. & Azadi, H. (2023). Conceptualization of farmers' water conservation intention and behavior through the lens of economic man worldview: Application of structural equation modeling. *Water 15*(18), 3199.

Wang, L. & Zhao, Y. (2023). Will social network relationship significantly enhance farmers' participation in the supply of small water-saving irrigation and water conservancy facilities in China? *Agriculture 13*(1), 216. https://doi.org/10.3390/agriculture13010216.

Wang, Y., Shu, Q. & Wu, J. (2017). A review of water rights market research and prospects for research on Chinese characteristic water rights market. *China's Population, Resources, and Environment 27*(06), 87–100.

Wang, Y., Wan, T. & Biswas, A. K. (2018). Structuring water rights in China: A hierarchical framework. *International Journal of Water Resources Development 34*(3), 418–433. https://doi.org/10.1080/07900627.2017.1378627.

Wang, J., Liu, L., Zhao, K. & Wen, Q. (2023). Farmers' adoption intentions of water-saving agriculture under the risks of frequent irrigation-induced landslides. *Climate Risk Management 39*, 100484.

Warner, L. A., Lamm, A. J., Rumble, J. N., Martin, E. T. & Cantrell, R. (2016). Classifying residents who use landscape irrigation: Implications for encouraging water conservation behavior. *Environmental Management 58*, 238–253. https://doi.org/10.1007/s00267-016-0706-2.

Xu, T., Zhao, M., Li, E. & Qiao, D. (2018). Analysis of the impact of technology awareness and subsidy policies on farmers' adoption of different water-saving technologies at different stages. *Resource Science 40*(04), 809–817.

Yazdanpanah, M., Hayati, D., Hochrainer-Stigler, S. & Zamani, G. H. (2014). Understanding farmers' intention and behavior regarding water conservation in the Middle-East and North Africa: A case study in Iran. *Journal of Environmental Management 135*, 63–72. https://doi.org/10.1016/j.jenvman.2014.01.016.

Yuriev, A., Dahmen, M., Paillé, P., Boiral, O. & Guillaumie, L. (2020). Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review. *Resources, Conservation and Recycling 155*, 104660. https://doi.org/10.1016/j.resconrec.2019.104660.

Zhang, B., Fu, Z., Wang, J. & Zhang, L. (2019). Farmers' adoption of water-saving irrigation technology alleviates water scarcity in metropolis suburbs: A case study of Beijing, China. *Agricultural Water Management 212*, 349–357. https://doi.org/10.1016/j.agwat.2018.09.021.

Zhang, H., Zhou, Q. & Zhang, C. (2021). Evaluation of agricultural water-saving effects in the context of water rights trading: An empirical study from China's water rights pilots. *Journal of Cleaner Production 313*, 127725. https://doi.org/10.1016/j.jclepro.2021.127725.

Zhou, X., Zhang, Y., Sheng, Z., Manevski, K., Andersen, M. N., Han, S., Li, H. & Yang, Y. (2021). Did water-saving irrigation protect water resources over the past 40 years? A global analysis based on water accounting framework. *Agricultural Water Management 249*, 106793. https://doi.org/10.1016/j.agwat.2021.106793.

First received 1 November 2023; accepted in revised form 10 March 2024. Available online 22 March 2024