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The effect of recycled water information disclosure on public acceptance of recycled water—Evidence from residents of Xi'an, China

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A R T I C L E   I N F O

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A B S T R A C T

Recycled water, the secondary water source of a city, is vital to alleviate regional water resource shortage and promote environmental conservation. The attitude and acceptance toward recycled water of the public, its direct user, hold the key to the implementation of a recycled water project. Currently, the public's low intention of using recycled water constitutes the biggest obstacle to its popularization. To identify the factors of public acceptance of recycled water and their influence path, this study analyzes the effect mechanism of information disclosure of recycled water on the public's acceptance of it based on the consciousness-context-behavior theory and by adopting a structural equation model. The results are as follows: (1) The public's consciousness of water saving, risk perception of recycled water, and consciousness of environmental responsibility can effectively promote public acceptance of recycled water; (2) The consciousness of water saving and that of environmental responsibility have a significant effect on public acceptance of recycled water, and so do the consciousness of water saving and the risk perception of recycled water; and (3) Recycled water information disclosure has the most significant regulatory effect on consciousness and public acceptance.

1. Introduction

Amid the continuous expansion of city boundaries, economic aggregate, and urban population, the public's demand for water resources has increased geometrically, extending far beyond the current carrying capacity of regional water resources (Wu, Su, Ma, Kang, & Jiang, 2018; Yang et al., 2019). Water resources shortage, a strategic global issue, has seriously threatened the survival of human beings and restricted the development of national economy (Ait-aoudia & Berezowska-azzag, 2016; Zhang, Zhang, Shi, & Fu, 2019). According to the United Nations' Sustainable Development Goals, water resources shortage, poor water quality, and inadequate health facilities take a toll on regional food security and livelihood selection. At least a quarter of the population are likely to live in countries affected by cyclical or recurrent freshwater shortage as of 2050. Worldwide, China is listed as one of the 13 countries stricken by water resource shortage, with over three-fourths of more than 660 cities being short of water (Gao & Liu, 2019). As such, the problem of water resource shortage calls for an immediate yet efficient solution.

Recycled water use, an efficient solution to water resource shortage, assumes great significance for the alleviation of regional water resource shortage and the promotion of environmental conservation, thus drawing much attention from the international community (Archer, Luffman, Andrew, Joyner, & Nandi, 2019; Fielding, Dolnicar, & Schultz, 2019; Lazaridou, Michailidis, & Mattas, 2019). As early as 1920, the United States established the first dual water supply system in Arizona to address the problem of insufficient rainfall and scarce fresh water. Since then, recycled water has gained all-round popularization in Israel, Japan, South Africa, Australia, Russia, and other countries (Liu, Yang, & Fu, 2019). Before the 1990s, owing to the backward sewage treatment technology, treated recycled water could only be used for agricultural irrigation in areas with serious water shortage. Currently, this type of technology has become increasingly developed, and recycled water enjoys considerably superior quality (Wan & Xia, 2017), allowing it to be theoretically used in various fields of production and living. However, it remains difficult to promote recycled water use in practical terms (Rice, Wutich, White, & Westerhoff, 2016). Studies found that the public's low intention of using recycled water constitutes the biggest obstacle to its use and popularization (Gao & Liu, 2019). As the direct user of recycled water, the public often has a lower intention of using recycled water compared with other water resources due to its view on the raw water quality, health risks, and other factors of recycled water.
(Mendoza-espinosa, Burgess, Daeshlé, & Villada-canela, 2019). Therefore, the sound and effective improvement of public acceptance of recycled water represents a key link in its popularization.

In recent years, scholars have conducted studies on factors influencing public acceptance of recycled water. Among them, the major ones are the source of sewage (García-cuerva, Berglund, & Binder, 2016), treatment scheme (Aitken, Bell, Hills, & Rees, 2014; Wester, Timpano, Cek, & Broad, 2016), quality (Mainali et al., 2013; Pham et al., 2011), and the price of recycled water (Fu et al., 2020; Ross, Fielding, & Louis, 2014). Studies also found that the possible harmful microorganisms and chemical residues in recycled water pose a potential threat to human health (Gerrity et al., 2018), raising concerns about the safety of recycled water use (Dolnicar, Hurliman, & Grün, 2011). Therefore, the public is reluctant to use recycled water in consideration of the health risks (Chen et al., 2014). Some scholars also found that the public's psychological factors and perceptions (West, Kenway, Hassall, & Yuan, 2016) have a significant effect on their intention of using recycled water (Genia, Wei-haur, Nasha, Faridah, & Md, 2015; Gu et al., 2015) and that sociodemographic indicators such as age (Gifford & Nilsson, 2014), gender (Dunlap, Xiao, & Mecright, 2001), and education level (Gao & Liu, 2019) significantly influence public acceptance of recycled water. However, most studies were designed to explore the effect of one or several factors on public acceptance of recycled water; few have explored the relationship between the factors and their influence on public acceptance from a comprehensive perspective.

Studies have found that the public's consciousness or quality needs to be improved in current environmental conservation and resource recycling, as they pose the biggest obstacle to the promotion of resource use in China (Wang, 2015). Improving the public's consciousness of water resources conservation and encouraging them to recycle resources has become a crucial strategic task and a central mission. Few studies have explored the effect of psychological factors on public acceptance of recycled water from the perspective of the public's consciousness. The public's behavior decision (or behavior intention) is dominated by their perception of things, while perception is affected by the surrounding environment. As such, based on the consciousness-context-behavior theory, a comprehensive study of the effect of recycled water information disclosure on public acceptance of recycled water from the perspective of behavioral psychology holds great theoretical and practical significance.

According to the consciousness-context-behavior theory, context assumes an intermediary and coordinating role among consciousness, context, and behavior. Consciousness has a direct effect on individual behavior, while individual consciousness is affected by external context (Bandura, 1999). This provides a theoretical basis for the study of the effect of recycled water information disclosure on public acceptance of it. As the direct user of recycled water, the public's behavior is affected by its consciousness of water resource conservation and environmental responsibility and attitude toward recycled water. Therefore, it is necessary to explore the factors that affect public acceptance of recycled water from their perception of water resource issues, consciousness of water saving, personal sense of responsibility, and risk perception of recycled water use.

As public judgment of the environment is not always rational, the symmetry of information and the degree of information disclosure exert a strong influence on the environmental perception of individuals or groups. Studies have shown that the public's mastery of relevant information has a significant effect on their consciousness and even directly affects their decision-making (Zhou & Tang, 2017). The existing studies on the effect of information disclosure on the behavior of individuals or groups are conducted primarily from the perspective of economics (Board & Lu, 2018; Goldstein & Yang, 2017; Kolotilin, 2018). Few studies exist on the effect of the ecological environment information disclosure on the public's behavior, and seldom studies have been conducted on the public's intention of using recycled water from the perspective of environmental information disclosure. By introducing factors such as the degree of recycled water information disclosure into the study of the factors influencing public acceptance of recycled water, these factors and the effect mechanism of public acceptance can be comprehensively analyzed. This will help promote measures for recycled water use and further improvement of the public's consciousness and behavior regarding environmental conservation, thus promoting regional environmental conservation and the sustainable development of the social economy.

As such, the study explores the effect mechanism of the degree of recycled water information disclosure on the public's acceptance of recycled water and proposes measures encouraging the residents to use recycled water. Thus, this study compensates for the shortcomings of previous studies, which have focused on the public's behavior characteristics, improves the validity of the study results, and provides sound policy suggestions for the promotion of recycled water.

2. Theoretical review and study design

2.1. Theoretical review

To study the effect of the public's environmental consciousness and the perception of recycled water on public acceptance of recycled water, it is necessary to understand the psychological mechanism behind the public's behavior intention. Through a literature review, it is found that scholars have proposed different theories to explain public behavior intention as well as the psychological mechanism behind it.

Social psychologist Lewin (1976) proposed the Lewin Meta of Behavior based on many experiments. Lewin indicates the effect of various factors on the pattern, intensity, and trend of individual behavior by distinguishing internal factors and the external environment. Among them, internal factors include the specific internal conditions and characteristics of individuals, such as feelings, perceptions, emotions, learning, memory, motivation, attitude, gender, age, personality, etc. The external environment includes various external factors of individuals, such as scientific and technological status, economic level, institutional structure, cultural background, etc. According to the Lewin Meta of Behavior, individual behavior is the product of the interaction between the individual and the environment, which reveals the general law of individual behavior to a certain extent, summarizes and sorts out the various factors that affect behavior, and shows high generality and wide applicability. Therefore, the Lewin Meta of Behavior has been widely valued and recognized by the academic community and has become a fundamental theory for understanding individual behavior. Ajzen (1985) proposed the theory of planned behavior (TPB) to explain individual behavior more reasonably. There are three determinants of behavior intention in TPB: attitude, subjective norm, and perceived behavioral control. The intentions to perform behaviors of different kinds can be predicted with high accuracy from the attitudes toward behavior, subjective norms, and perceived behavioral control. Individual behavior can be reasonably inferred, to some extent, by behavior intention, and individual behavior intention is determined by the attitude and subjective norm of behavior. Perceived behavioral control refers to the perception degree to which an individual controls their behavior and is determined by control beliefs and perceived promoters. TPB is commonly used in behavior models and the most influential behavior theories. However, it only emphasizes the instrumental components of attitude (useful-harmful, valuable-valueless, etc.), while neglecting its emotional components (like-dislike, merry-painful, etc.), restricting their interpretation of behavior.

Guagnano, Stern, and Dietz (1995) proposed the theory of attitude-context-behavior (ABC) and argued that environmental behavior is the result of the interaction between environmental attitude variables and contextual factors. When contextual factors are extremely favorable or unfavorable, they may significantly promote or prevent the occurrence of environmental behaviors. Guagnano et al. also verified the
theoretical relationship of this function in the empirical study of Curbside Recycling. The contribution of ABC lies in having determined the effect of two kinds of factors (internal attitude factor and external contextual factor) on behavior and having verified the regulatory effect of the contextual factor on the relationship between environmental attitude and behavior. On this basis, through qualitative research, Wang (2015) constructed the consciousness-context-behavior system model of the effect of resource consciousness on resource behavior, noting that resource consciousness is the pre variable of resource behavior and that the consciousness-behavior relationship is regulated by contextual factors. This sheds light on the effect mechanism of recycled water information disclosure on public acceptance of recycled water.

2.2. Study design

Based on the above research theories, this study hypothesizes that perception of water resource issues, consciousness of water saving, personal sense of responsibility, and risk perception of recycled water have a direct effect on public acceptance of recycled water. Further, it assumes that the relationship between consciousness and behavior intention is regulated by the external contextual variable (recycled water information disclosure). The path of consciousness- (perception of water resource issues, consciousness of water saving, personal sense of responsibility, and risk perception of recycled water) context- (recycled water information disclosure) behavior intention (public acceptance of recycled water) is constructed to analyze the effect mechanism of recycled water information disclosure on public acceptance.

2.2.1. Direct effect of consciousness on behavior intention

With regard to the factor of consciousness, Wang (2015) constructed and verified the theoretical hypothesis of consciousness-behavior theory and found that the consciousness of resource saving has a greater effect on the behavior of resource saving. Pan and Wang (2018) and Liu and Hu (2019) found that the public’s environmental behavior intention is directly affected by specific environmental perception and that environmental perception has a significant positive effect on the public’s environmental behavior. He (2018) found that environmental values, ethics, beliefs, emotions, etc. have a direct and significant positive effect on behavior intention. Evidently, the study conclusions on the effect of environmental emotion on environmental behavior are highly consistent; in other words, the perception of environmental issues and the consciousness of environmental conservation have a significant effect on environmental behavior intention.

With respect to sense of responsibility, Shi and Gao (2017) found that a positive correlation exists between the public’s sense of responsibility of environmental conservation, sensitivity, and conservation behavior. Yu (2019) conducted an empirical study on the relationship between consumer responsibility and sustainable consumption behavior and found that environmental sense of responsibility has a significant effect on the consumption behavior of environmentally friendly products. According to the study on the recycling behavior of household waste by Chu and Chiu (2003), moral responsibility improves the predictability of household waste recycling. Wu, Yu, Wang, Wei, and Huo (2019) found that waste minimization intentions is the important driving factor that determines the behavior of construction waste minimization. Some scholars have studied a concept closely related to the sense of responsibility, namely altruism. Straughan and Roberts (1999) found that altruism is the second important psychological variable that affects ecological consciousness and behavior. Evidently, a sense of responsibility, or altruism, is an indispensable variable that impacts the behavior of resource conservation.

Regarding risk perception, when studying environmental knowledge, risk perception, and environmentally friendly behaviors of young people (18–35 years old), Zhu (2017) found that environmental knowledge and risk perception have a significant correlation with the environmentally friendly behaviors of young people. Wester et al. (2016) found that environmental risk influences the public’s choice of environmental behavior when studying the influence path of the public’s environmental risk perception on behavior choice. The public’s risk perception appears to be a key variable of their environmental behavior intention.

Based on the above theories and research review, this study hypothesizes that the four dimensions of consciousness of perception of water resources issues, the consciousness of water saving, sense of responsibility, and risk perception of recycled water have a significant and direct effect on public acceptance of recycled water. The corresponding study hypotheses are as follows:

H1. Perception of water resource issues has a significant and direct effect on public acceptance of recycled water.
H2. Consciousness of water saving has a significant and direct effect on public acceptance of recycled water.
H3. Consciousness of environmental responsibility has a significant and direct effect on public acceptance of recycled water.
H4. Risk perception of recycled water has a significant and direct effect on public acceptance of recycled water.

The above hypotheses consider the independent effect of the four dimensions of consciousness on public acceptance of recycled water but not the interaction effects among the same. If the effect of one explanatory variable on the outcome variable varies with the level of the other explanatory variable, the two variables have an interaction effect. Individual behavior is the result of the interaction between these factors. For example, the effect of perception of water resource issues on public acceptance of recycled water may differ with different personal consciousness of environmental responsibility. The hypothesis that the influence factors are independent and parallel with no interaction effect between them is undoubtedly unrealistic and shall be at least verified further. To this end, this study proposes the following hypothesis:

H5. There are significant two-way interactions between the four dimensions of consciousness.

2.2.2. The regulatory effect of recycled water information disclosure on consciousness-behavior relationship

According to the theoretical overview, consciousness-behavior relationship is affected by an external contextual variable, and the contextual variable has a regulatory effect (significant or insignificant, positive or negative effect) on consciousness-behavior relationship. Individual behavior intention determines the social form in the environment and is also affected by the external context; information can regulate the individual perception of things and affect the behavior intention. People’s judgments do not always reach a state of rationality; instead, they depend on automatically activated cognition or information in the form of organization in mind, external resources and opportunities, and internal consciousness. Personal experience is not the only source of people’s cognitions and responses to environmental issues. In the era of information explosion, people’s exposure to environmental knowledge and information sources may change the relationship between environmental cognitions and behaviors. Environmental information and the level of environmental cognitions impact people’s intentions toward environmental behaviors, affecting the process of decision-making on environmental issues. Whereas, the lack of environmental information and cognitions limits individual environmental behaviors. Guasch and Hahn (1999) argue that mastering more information can enhance public decision-making. Dishman, Sherrard, and Rebhun (1989) pointed out that disclosing a certain type of environmental information to the public will provide additional incentives for facilities to improve environmental management and performance over time. As such, the following hypothesis is proposed in this study.

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Based on the above mentioned theories and hypotheses, this study establishes a mechanism model of the effect of recycled water information disclosure on public acceptance of recycled water (Fig. 1). This effect is analyzed by using the measurement scale of public acceptance of recycled water and recycled water information disclosure as well as that of perception of water resource issues, the consciousness of water saving and environmental responsibility, and risk perception of recycled water. The scale contains 6 main variables and 22 observational indicators.

3. Data source and reliability and validity test

3.1. Data source

To determine the functional mechanism of recycled water information disclosure on public acceptance of recycled water, this study collects data through a questionnaire. The questionnaire comprises two parts: the first part includes the basic information of the subjects, such as age, gender, and number of family members; the second part includes the degree of recycled water information disclosure, perception of water resource issues, the consciousness of water saving and environmental responsibility, risk perceptions of recycled water, and public acceptance of recycled water (Table 1). Recycled water information disclosure cannot be measured directly, and the residents’ knowledge of recycled water information can indirectly explain the degree of disclosure. Therefore, this study chooses four indicators to show the extent of recycled water information disclosure: (1) “Do you know the source of recycled water?”; (2) “Do you know the treatment process of recycled water?”; (3) “Do you know the quality of recycled water?”; and (4) “Do you know the price of recycled water?” All the questions are measured on a 5-point Likert scale. The method of individual subjective evaluation is adopted to obtain scores that represent the degree of recycled water information disclosure. Among them, 1 means “not know at all,” 2 “not know much,” 3 “neutral,” 4 “somewhat know,” and 5 “very much know.” In other questions, 1 means “strongly disagree,” and 5 means “strongly agree.”
Recycled water requires special pipelines, and recycled water use in China is first promoted in the cities. Therefore, the respondents of this survey are urban residents. To ensure that the questionnaire is less affected by regional attributes and social habits, the survey chooses Xi’an, China as the research area. Xi’an is a western city saddled with water resource shortage. Xi’an has underground water reserves of 1.991 billion cubic meters. In December 2001, the principal part of the water conservancy project in Heihe was completed, supplying 400 million cubic meters of water to Xi’an every year and forming a daily water supply capacity of 1.2 million cubic meters. With the underground water resource counted in, Xi’an has a daily water supply capacity of 1.72 million cubic meters, meeting the water consumption demand for urban production and living. However, in recent years, amid the acceleration of industrialization and urbanization, the rapid expansion of the population and the improvement of living standards, and the imbalance between economic and social development, water resources and environment have gained increasing relevance in Xi’an. Therefore, as a research area, Xi’an is highly representative.

To prevent the homogeneity of survey data and ensure the randomness, effectiveness, and objectivity of the survey, and in light of the outbreak of COVID-19, this study entrusted the platform www.wjx.cn to distribute the questionnaire to the public. According to the principle that the number of questionnaires ought to be more than 10 times the number of questions, the number of questionnaires in the current study is more than 20 times the number of questions—approximately 650. The survey was conducted in January 2020, and 621 valid samples were recovered, excluding respondents who did not complete the survey and whose survey duration was less than half of the median of the total survey duration. Finally, 616 valid questionnaires were obtained, with the valid questionnaire rate being 94.8 %.

Among the 616 subjects, there are 306 males (49.7 %) and 310 females (50.3 %). Their ages are between 18 and 76, with an average age of 35, which reflects the features of China’s population. In addition, 30 % of the subjects are employed by companies, 26.8 % are students, 16 % are employees of administration departments, 12.2 % are retired, 7.2 % are freelancers, and 7.8 % are from other industries; this ensures the social-demographic diversity of the subjects.

3.2. Reliability and validity test

In this study, SPSS software was applied to examine the reliability and validity of the values of the observed variables. In the reliability examination, the Cronbach’s alpha coefficient of potential variables was between 0.623 and 0.901 (Table 1), which was greater than the threshold value. Corrected Item Total Correlation (CITC) was also used to evaluate the convergence of the scale. The results showed that CITC values of each item and the whole were above the recommended value of 0.4. It appears that the internal consistency, reliability, and stability of this scale are relatively good, and the internal reliability is relatively ideal.

Before forming the scale, we conducted in-depth interviews with relevant experts and the representative public to conclude and revise the original scale. Subsequently, we conducted a preliminary survey on the public, analyzed its results, summarized the reasonable opinions of the respondents, and further revised and improved the scale. In general, this scale is in line with the survey objectives, and its content validity is relatively ideal. In the validity examination, the KMO value of potential variables was greater than the threshold value 0.5 (Table 1), and the P value of the Bartlett test of potential variables was lower than 0.00. The results of the factor analysis indicated that the absolute value of the loading coefficient of the observed variables on the factors they relate to was between 0.579–0.819, greater than the threshold value 0.5. Therefore, the samples have good reliability and validity, and the data meet the qualification of the examinations.

3.3. Research methods

This study employs a structural equation model to examine the functioning mechanism of recycled water information disclosure on public acceptance of recycled water and identify its functioning paths and effects. First, this study establishes a structural model of the influence mechanism of recycled water information disclosure on public acceptance of recycled water. Next, it analyzes the direct effects of the four dimensions of consciousness on public acceptance of recycled water, and on this basis, further studies the interaction effect of the four dimensions on public acceptance of recycled water. Finally, it considers recycled water information disclosure as the regulating item to explore its regulating effect on consciousness and public acceptance of recycled water.

4. Model verification and result interpretation

4.1. Model verification

First, the mean value of variables and their correlation are described. The mean value of variables and the Pearson Correlation Coefficient matrix between them are shown in Table 2.

From the level of consciousness, the scores of the three dimensions of perception of water resource issues, the consciousness of water saving, and the consciousness of environmental responsibility are the highest (the mean value reaches or exceeds 4.15), and the score of risk perception of recycled water is relatively low (the mean value is 2.80). Evidently, the public has strong perception of resource issues and environmental conservation, strong consciousness of environment responsibility, and weak perception of health risks of recycled water. Public acceptance of recycled water scores 3.66, slightly higher than the medium level. The public has a low knowledge of recycled water, with a score of 2.53. It is evident that recycled water information disclosure is relatively low, and the public has limited information of recycled water.

The three dimensions of consciousness of water saving, consciousness of environmental responsibility, and risk perception of recycled water.
water are all significantly correlated to public acceptance of recycled water at 0.001. Perception of water resource issues is significantly correlated to public acceptance of recycled water at 0.01. Judging from the Pearson Correlation Coefficient between consciousness variables and public acceptance of recycled water, consciousness of environmental responsibility, followed by risk perception of recycled water, has the largest correlation with public acceptance of recycled water, while consciousness of water saving and perception of water resource issues have the least correlation with risk perception of recycled water.

In this study, the structural equation model is adopted to analyze the effect mechanism of recycled water information disclosure on public acceptance of recycled water. Perception of water resource issues, consciousness of water saving, consciousness of environmental responsibility, and risk perception of recycled water are used as independent variables, while recycled water information disclosure is used as a regulatory variable to analyze the effect of such disclosure on public acceptance of recycled water. In H1, H2, H3 and H4, four possible influence paths of consciousness-behavior intention are constructed: “Perception of water resource issues → public acceptance of recycled water,” “consciousness of water saving → public acceptance of recycled water,” “consciousness of environmental responsibility → public acceptance of recycled water,” and “risk perception of recycled water → public acceptance of recycled water.” In H5, four interactive paths among the dimensions of consciousness are proposed. In H6, four regulatory paths of consciousness-context-behavior intention are constructed, namely the regulatory paths of recycled water information disclosure on consciousness-behavior intention. The correlation between the observational variables and the latent variables of each group constitutes a measurement model of the impact of recycled water information disclosure on public acceptance of recycled water.

The model shows a sound initial test effect. However, the two influence paths of recycled water information disclosure on the consciousness of environmental responsibility and perception of water resource issues on public acceptance of recycled water show poor significance in the significance test. Through continuous modification of the model, the optimal model is obtained (Fig. 2).

According to the requirements of the structural equation model for data quality and variable relationship, this study tests the model and finds that the chi-square degree of freedom ratio of the model is 2.644, lower than the fit index value of 3.00; the chi-square saliency value P is significant at 0.001; the CN value is 288, higher than 200; and the absolute goodness of fit, value-added goodness of fit, and concise goodness of fit of the model all meet the fitting index value criteria (Table 3). It is noted that in the case of sound goodness of fit of the model, the model can pass the robustness test.

Table 3: Index of goodness of fit of the model.

| Type of Index         | Statistics for goodness of fit | Standard Value | Test Value | Adaptability of the model |
|-----------------------|--------------------------------|----------------|------------|---------------------------|
| Absolute goodness of fit | $\chi^2$/df                   | $P < 0.05$     | 2.644      | Qualified                 |
| Added-value goodness of fit | $\chi^2$                     | $P = 0.000$    |            | Qualified                 |
| Concise goodness of fit | NFI                           | $> 0.90$       | 0.906      | Qualified                 |
|                       | CFI                           | $> 0.90$       | 0.924      | Qualified                 |
|                       | IFI                           | $> 0.90$       | 0.901      | Qualified                 |
|                       | PNFI                          | $> 0.50$       | 0.608      | Qualified                 |
|                       | PCFI                          | $> 0.50$       | 0.642      | Qualified                 |
|                       | CN                            | $> 200$        | 288        | Qualified                 |

4.2. The main effect of consciousness on behavior intention and the interactive effect among consciousness

The simulation results of the model show that, in addition to perception of water resource issues, consciousness of water saving, consciousness of environmental responsibility, and risk perception of recycled water all have an effect on public acceptance of recycled water (Table 4). Risk perception of recycled water exerts the greatest effect and is negatively correlated with public acceptance of recycled water (the coefficient is $-0.52$, and the standardized path coefficient is significant at 0.001), which indicates that the higher the risk perception of recycled water, the lower the public acceptance of recycled water. Consciousness of environmental responsibility is positively related to public acceptance of recycled water at 0.001 with a correlation coefficient of 0.24. This indicates that individuals with a strong consciousness of responsibility for resources and environmental conservation are more willing to use recycled water for tasks other than drinking. Consciousness of water saving is positively correlated with public acceptance of recycled water at 0.01 with a correlation coefficient of 0.17. This shows that the stronger the consciousness of water conservation, the more the public is inclined to use recycled water instead of tap water to reduce consumption. H2, H3 and H4 are verified, while H1 is not valid.

In H5, this study proposes three possible effecting paths from the interaction items of consciousness to the behavior intention. These are: “The interaction item of consciousness of water saving and consciousness of environmental responsibility (CWS × CER) → public acceptance of the recycled water (PARW),” “the interaction item of risk perception of recycled water and consciousness of environmental responsibility
high-risk perception of recycled water, consciousness of environmental responsibility has a weaker positive effect on public acceptance of recycled water (Fig. 4b), while a decrease in risk perception of recycled water can efficiently promote public acceptance of recycled water. In the case of low-risk perception of recycled water, consciousness of environmental responsibility has a stronger positive effect on public acceptance of recycled water.

4.3. The regulatory effect of information disclosure of recycled water on consciousness-behavioral intention relationship

According to the structural equation model of the effect mechanism of recycled water information disclosure on public acceptance of recycled water. In H6, this study proposes three possible effecting paths from the regulatory items of information disclosure of recycled water to the behavior intention. These are as follows: “The regulatory item of information disclosure of recycled water and consciousness of water saving (IDRW × CWS) → public acceptance of recycled water (PARW),” “the regulatory item of information disclosure of recycled water and consciousness of environmental responsibility (IDRW × CER) → public acceptance of the recycled water (PARW),” and “the regulatory item of information disclosure of recycled water and risk perception of recycled water (IDRW × RPRW) → public acceptance of the recycled water (PARW).” Recycled water information disclosure has the most significant regulatory effect on risk perception of recycled water and public acceptance of recycled water. Information disclosure has a regulatory effect on consciousness of water saving and public acceptance of recycled water and no significant regulatory effect on consciousness of environmental responsibility and public acceptance of recycled water. It is evident that recycled water information disclosure can weaken risk perception of recycled water, thus promoting public acceptance. It can also promote consciousness of water saving through an improvement in public acceptance of recycled water.

With the median as boundary, the recycled water information disclosure index was divided into high and low groups, and a variance test was conducted on the two groups of data; the results showed a significant difference between the two (p < 0.001). The interaction effect of information disclosure of recycled water on consciousness of water saving and public acceptance of recycled water have a stronger positive correlation; in the case of low recycled water information disclosure, consciousness of water saving and public acceptance of recycled water have a stronger positive correlation; in the case of low recycled water information disclosure, consciousness of water saving and public acceptance of recycled water have a stronger positive correlation; in the case of low recycled water information disclosure, consciousness of water saving and public acceptance of recycled water have a weaker positive correlation; in the case of low recycled water information disclosure, risk perception and public acceptance of recycled water have a higher negative correlation; in the case of high recycled water information disclosure, risk perception and public acceptance of recycled water have a weaker negative correlation; in the case of high recycled water information disclosure, risk perception and public acceptance of recycled water have a stronger negative correlation (Fig. 5b). Further, in the case of high recycled water information disclosure, risk perception has reduced effect on public acceptance of recycled water. An improvement in information disclosure can efficiently promote public acceptance of recycled water. In the case of high information disclosure, risk perception and public acceptance of recycled water have a weaker negative correlation; in the case of low information disclosure, risk perception and public acceptance of recycled water have a stronger negative correlation.
disclosure can efficiently reduce the effect of risk perception on public acceptance of recycled water and promote this acceptance.

To provide a clear analysis of the regulatory effect of recycled water information disclosure on public acceptance of recycled water, the regulatory effect of each factor of information disclosure on public acceptance of recycled water is analyzed. The results show that the disclosure of recycled water price information has an effect on public acceptance of recycled water through consciousness of water saving, and that disclosure of recycled water quality information has an effect on public acceptance of recycled water through the risk perception of it. It can be seen that the regulatory effect of recycled water information disclosure on public acceptance of recycled water varies with different dimensions of consciousness.

5. Discussion

5.1. The direct influence of recycled water information disclosure on public acceptance of recycled water

The results show that recycled water information disclosure directly affects public acceptance of recycled water, which is consistent with the research results of Guasch and Hahn (1999) and Michael et al. (1989). Guasch and Hahn argue that mastering more information can enhance public decision-making. By studying the role and effect of environmental information disclosure in all 50 states in the United States, Michael et al. pointed out that disclosing a certain type of environmental information to the public will provide additional incentives for facilities to improve environmental management and performance over time. The transparency of environmental information disclosure by the government can support environmental decision-making at government level, active participation of environmental non-governmental organizations, and public participation in environmental issues. Therefore, whether governmental or non-governmental organizations disclose environmental information to the public, the move can enhance public responsibility and urgency toward the environment, thereby promoting public acceptance of environmentally friendly behaviors, such as utilizing recycled water. The importance of information disclosure on environmental behavior can also be seen from environmental policy. The evolution of environmental policy has gone through three stages: the command and control management stage, the regulation policy stage based on market approaches, and the information-based countermeasure stage (Tietenberg, 1998). Currently, environmental policies generally employed by governments worldwide are mandatory for information disclosure.

5.2. Direct effect of consciousness on public acceptance of recycled water

Consciousness is the internal drive or predisposing factor of behavior intention. Consciousness of water saving and consciousness of environmental responsibility provide the basis for public acceptance of recycled water. Such consciousness promotes behavior intention by affecting the individuals’ psychological preference for resource conservation. The absence of consciousness fails to create conscious behavior intention of resource recycling and conservation. This conclusion is consistent with that of Ajzen and Madden (1986) and of Gao and Liu (2019). Ajzen and Madden argued that the public’s perception of a certain environment determines their behavior intention. Gao and Liu found that the success of a recycled water use project is closely related to the cognition, consciousness, and behavior choice of the stakeholders, and that the public’s intention of using recycled water is greatly affected by the risk perception of it.

From the structure of the internal dimensions of consciousness, it is seen that these dimensions are not independent; rather, they interact with each other. A significant positive interaction occurs between the two dimensions of consciousness of water saving and consciousness of environmental responsibility—in other words, consciousness of water
saving has an “amplifying” effect on consciousness of environmental responsibility and public acceptance of recycled water. Consciousness of environmental responsibility will further improve the sense of responsibility toward environmental conservation, thereby enhancing public acceptance of recycled water. In light of this, when formulating measures to enhance public acceptance of recycled water, policy makers shall help improve consciousness of environmental responsibility and consciousness of water saving in order to make the related policy more efficient.

The two dimensions of consciousness of environmental responsibility and risk perception of recycled water have a significant negative interaction, that is, they play “amplifying” roles. The sense of responsibility for water resource conservation can weaken risk perception of recycled water and improve public acceptance of recycled water. In the case of the same risk perception, a higher consciousness of environmental responsibility can make individuals more willing to use recycled water. Thus, when formulating measures to enhance public acceptance of recycled water, policy makers shall help improve consciousness of environmental responsibility and reduce risk perception of recycled water to improve the efficiency of the related policy.

The study results show that perception of water resource issues and public acceptance of recycled water have no direct correlation, which is inconsistent with the idea proposed by Wang (2015) that the consciousness of resources issues has a positive role in promoting resource behavior. In this study, this can be explained by the following. Firstly, the public believes that it is the government’s duty to address the numerous water resource issues, that all the public can do is to save water and conserve water resources, and that recycled water use is not the solution to these issues. This study also shows that perception of water resource issues has a greater correlation with the consciousness of water saving and that of environmental responsibility but has a smaller correlation with public acceptance of recycled water. Secondly, the public has a relatively clear perception and attitude toward the water environment, and most people think the current environmental issues have become quite prominent. The perception of water resources issues designed in this study comprises three items: (1) “Water resources on Earth are very limited,” (2) “human beings are consuming natural resources at a rapid pace,” and (3) “if we keep the current development mode, we will soon face an ecological disaster.” Water resource issue is a general concept that is not specific to a certain area or a certain environmental issue. Saddled with a vague understanding of environmental issues and the broad concept of environment, most people can hardly have a specific pro-environmental behavior.

5.3. The regulatory effect of recycled water information disclosure on consciousness of water saving, risk perception and public acceptance of recycled water

In the information age, the degree of information disclosure has become an important basis for the public’s decision-making. The symmetry of information and the degree of information disclosure assume a strong role in guiding the behavior of individuals or groups. According to the study results, recycled water information disclosure has a significant regulatory effect on consciousness of water saving and public acceptance of recycled water, having an “amplifying” effect on their relationship. Guagnano et al. (1995) argued that behavior intention is the result of the interaction between consciousness variable and external contextual factor (information disclosure); consciousness and behavior intention are affected by the surrounding environmental factors. Information disclosure and media use have better regulatory effects on individuals’ environmental cognition and pro-environmental behavior. Information from different sources may lead to different degrees of trust, thereby affecting the behavioral decision-making of individuals or groups. Lee (2011) and Zhou and Tang (2017) believed that the media’s attention toward environmental issues and the information disclosure on environmental conservation promote the public’s positive values of environmental participation and enhance their intention to participate in environmental conservation activities. All these have a highly positive impact on encouraging the public to actively exercise pro-environmental behavior.

The results show that recycled water information disclosure has a significant moderating effect on public perception of risks and public acceptance of recycled water; it can also weaken the negative effect of risk perception of recycled water on public acceptance of recycled water. In general, individual perception of health risks does not come from their experiences. Without understanding risk, individuals will expand their risk perception for their own safety. In the modern society, information media, such as newspapers, television, and the internet, report and interpret risky events, popularizing risk knowledge among the public, thus reducing its perception of risk of related events.

6. Conclusions and suggestions

6.1. Conclusions

This study constructed a structural equation model of the effect of recycled water information disclosure on public acceptance of recycled water to analyze its effect path. The conclusions are as follows:

(1) Consciousness of water saving, consciousness of environmental responsibility, and risk perception of recycled water have a significant effect on public acceptance of recycled water, among which risk perception of recycled water has the most significant effect.

(2) Consciousness of water saving and that of environmental responsibility have a significant interaction on public acceptance of recycled water; consciousness of water saving and risk perception of recycled water have a significant interaction on public acceptance of recycled water.

(3) Recycled water information disclosure has the most significant regulatory effect on risk perception of recycled water and public acceptance of recycled water, followed by consciousness of water saving and public acceptance of recycled water.

6.2. Policy suggestions

Based on the results above, the study proposes the following suggestions on how the government can reduce risk perception of recycled water and improve the consciousness of water saving and that of environmental responsibility by improving recycled water information disclosure. First, the consciousness of water saving, the consciousness of environmental responsibility, and risk perception of recycled water have a direct effect on public acceptance of recycled water. Therefore, policy makers shall vigorously publicize and popularize the current environmental status and water resources utilization status, improve the consciousness of saving water, and protect water resources. Simultaneously, they shall weaken the public’s disgust and discomfort with recycled water, enhance their sense of honor, responsibility, and mission in order to promote their intention of using recycled water.

Second, recycled water information disclosure can enhance public acceptance of recycled water by strengthening consciousness of water saving and reducing risk perception of recycled water. At present, the treatment technology of recycled water has developed considerably, meaning that recycled water can be directly used by the public. Saddled with limited knowledge of the quality of recycled water, the public instinctively refuses to use unfamiliar recycled water. Therefore, policy makers shall adopt various forms of activities (theme education, knowledge contests, community consultations, etc.) though the media in order to disseminate specific and targeted information on recycled water (the quality, price, and treatment process of recycled water) among the public. By doing so, the public’s negative impression of recycled water will be reduced, and risk perception of recycled water will be alleviated, thus promoting public acceptance. With respect to
efficiency, information dissemination can be particularly targeted at individuals with high consciousness of water saving and low perception of risk, as they have an “amplifying” effect on public acceptance of recycled water. With respect to fairness, information dissemination shall extend its reach to individuals with low consciousness of water saving and high perception of risk in order to avoid “stratum differentiation” or “gap widening” in the field of recycled water use.

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