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Ecological Awareness and Water Conservation Behavior under Climate Change in Uzbekistan and Kazakhstan

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ABSTRACT

In the context of climate change and increasing pressure on global water resources, water conservation is becoming increasingly important. This study aims to examine the relationship between environmental awareness, human behavior,

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and water conservation practices. The study used a mixed-method approach that combines systematic review and quantitative research. In the first stage, a systematic review of 54 publications indexed in Scopus was conducted. VOSviewer and RStudio (Bibliometrix suite) helped to identify key research areas and thematic clusters in this area. In the second stage, a survey was conducted among 210 respondents from Uzbekistan and Kazakhstan using questionnaires to assess environmental awareness, water consumption, and attitudes towards water conservation. The results show that the majority of respondents demonstrate a relatively high level of awareness of environmental issues related to water scarcity and the impact of climate change on water resources. However, the study results also show a gap between awareness of environmental issues and actual behavior, especially the limited use of water-saving technologies. Economic factors were also found to influence water consumption: many respondents indicated that they would reduce their water consumption if prices increased significantly in the future. In addition, a large proportion of respondents expressed a strong sense of environmental responsibility and stressed the importance of reporting water leaks and waste in their communities and households. Overall, the study highlights the importance of raising environmental awareness and promoting responsible water use practices to ensure sustainable and efficient management of water resources, despite ongoing challenges related to climate change.

Keywords: Environmental Awareness; Pro-Environmental Behavior; Water-Use Behavior; Climate Change

1. Introduction

Freshwater resources are under increasing pressure as a result of climate change, rapid population growth, urbanization, and increasing demand for water for agricultural, industrial, and domestic purposes [1]. In recent decades, water scarcity has become one of the most pressing environmental problems of the 21st century [2,3]. Global estimates suggest that billions of people already live in water-scarce areas , and this number is expected to increase significantly in the coming decades due to increasing water demand and environmental pressures [4]. Among the various factors leading to water scarcity, climate change is one of the most influential factors [5]. Changes in temperature and precipitation regimes disrupt the natural hydrological cycle and alter the spatial and temporal distribution of water resources [6]. In addition, climate change is leading to an increase in extreme weather events such as droughts and floods, further exacerbating water scarcity in many regions of the world [7,8]. Global warming accelerates evaporation and reduces the availability of surface water, while prolonged droughts and erratic rainfall exacerbate water scarcity in many regions [9]. As a result, many countries are increasingly facing challenges in ensuring a reliable water supply for ecosystems and populations [10]. These impacts are particularly severe in arid and semi-arid regions [11], making water resource management and conservation strategies crucial for sustainable development [12]. In addition to negative environmental impacts, human activities also contribute significantly to water scarcity [13]. Rapid population growth, urban expansion, and intensive agricultural activities are increasing the demand for freshwater resources and placing additional pressure on existing water systems [14]. Inefficient water use, water losses in infrastructure, and inadequate water management exacerbate the problem [15]. As a result, sustainable water resources management has become a central issue in global environmental policies and development strategies [16]. Addressing the problem of water scarcity requires a comprehensive approach that includes technological, institutional, and behavioral aspects [17]. While improving water infrastructure and water resources management policies are important, attention is also being paid to the role of human behavior and environmental awareness in promoting responsible water use [18]. Therefore, promoting water conservation measures at the household and community levels in the face of climate change is an important component of sustainable water resources management [19].

Water conservation refers to the efficient and responsible use of water resources to reduce unnecessary waste and ensure long-term sustainability [20]. As water scarcity becomes an increasingly serious global problem, improving water conservation practices has become an important component of sustainable water resources management

strategies [21]. Effective water conservation helps maintain a balance between water supply and demand, protects ecosystems, and ensures sufficient water resources for future generations [17,22]. Various strategies have been proposed to encourage water conservation at institutional and household levels [23]. These strategies include technological solutions such as water-saving devices, improved irrigation systems, and water recycling technologies [21]. In addition, policy instruments such as water pricing mechanisms, regulation, and public awareness campaigns are widely used to encourage responsible water use [24]. While technical and policy measures are important [25], many researchers argue that long-term water conservation depends largely on changes in human behavior and consumption patterns [26]. In many countries, domestic water consumption accounts for a large proportion of total water consumption, making individual behavior an important factor in water conservation efforts [27]. Studies have shown that everyday habits such as reducing water consumption, fixing leaks, and implementing water-saving technologies can significantly contribute to reducing overall water demand [19,28]. As a result, raising public awareness and promoting environmentally responsible behavior are critical to improving water conservation practices [29,30].

In recent years, increasing attention has been paid to the social and behavioral aspects of water resources management [31]. Therefore, understanding how people perceive water scarcity and how their attitudes affect water consumption is crucial for developing effective water conservation strategies [28]. Environmental awareness refers to people's understanding of environmental problems and the need to protect natural resources [32]. Research shows that people with high environmental awareness are more likely to engage in environmentally responsible behaviors, including saving water, conserving energy, and consuming responsibly [18,33]. A responsible attitude towards the environment includes actions that contribute to the protection of the natural environment and the sustainable use of resources [34]. From a water resource management perspective, such actions include reducing unnecessary water consumption, eliminating leaks, using water-saving devices, and supporting policies that improve water conservation [35]. Previous studies have shown that psychological factors, environmental attitudes, and social norms play an important role in shaping water conservation behaviors at the household level [19,28]. However, several studies highlight that the relationship between environmental awareness and actual behavior is not always simple [36]. While many people express concern about environmental issues, this awareness does not always lead to consistent changes in behavior [37]. Researchers have described this phenomenon as the "awareness-behavior gap" that occurs when people are aware of environmental issues but do not fully implement sustainable practices into their daily lives [30,38]. In addition to awareness, water consumption is influenced by many factors, including economic conditions, infrastructure, cultural norms, and institutional frameworks [39]. Studying these behavioral aspects can provide valuable information about how people respond to environmental issues and how sustainable water use can be promoted in different social settings [39,40].

Despite the growing body of research on water conservation and environmental stewardship, there are a number of gaps in understanding how environmental awareness influences water use practices in different regional settings [41]. While previous studies have focused mainly on developed countries, relatively little attention has been paid to the behavioral aspects of water conservation in developing and transition countries [19,42]. In particular, empirical research examining the relationship between environmental protection and water consumption in Central Asian countries remains limited [43,44].

Central Asia is a region facing serious challenges in water resource management due to climate change, population growth, and increasing demand for water resources [43,45]. Countries like Uzbekistan and Kazakhstan are highly dependent on public water supply systems and are particularly prone to water scarcity and unsustainable water use [46]. Therefore, it is important to understand public attitudes and behaviors related to water conservation in order to develop effective strategies to promote sustainable water resource management in the region [47]. To fill this gap, this study examines the relationship between environmental protection, human behavior, and water conservation practices. The study combines a systematic review of scientific publications with a survey of participants in Uzbekistan and Kazakhstan. This approach provides an understanding of global research trends and public perceptions of water

conservation issues in the context of climate change.

The aim of this study is to examine the role of environmental culture and human behavior in protecting water resources in the context of climate change. In particular, it aims to examine how environmental awareness influences environmentally responsible behavior and promotes the adoption of water conservation practices. A systematic analysis was conducted to identify key research themes and guide the development of the questionnaire. The identified clusters helped to structure the questionnaire sections and interpret the empirical findings.

2. Materials and Methods

A mixed-method approach (**Figure 1**) combining systematic review and quantitative research methods was used to achieve the research objectives. This approach provides a comprehensive understanding of research trends and individual behavioral patterns related to water conservation [48,49].

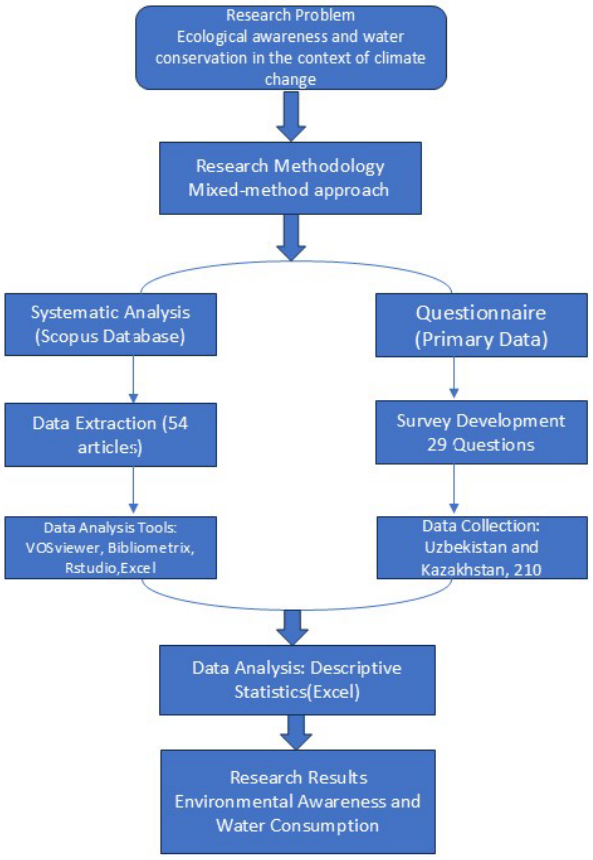

Figure 1. Methodological foundations of the study, combining systematic analysis and questionnaires.

2.1. Systematic Analysis

The first part of the study involved a systematic review of the scientific literature on water purification and environmental stewardship. A systematic review is a broad term for assessing research trends, influential publications, and thematic structures in a particular scientific field [50]. Systematic analysis is widely used to identify key research areas, influential publications, and thematic structures in a particular scientific field [51]. Data for the systematic review were retrieved from the Scopus database. The literature search was performed on January 15, 2026 in the Scopus database. The search query used was: TITLE-ABS-KEY ("water conservation") AND TITLE-ABS-KEY ("environmentally responsible behavior"). Only peer-reviewed journal articles published in English between 2021 and 2025 were included. Conference papers and non-English publications were excluded. After removing duplicates and screening titles and abstracts, 54 articles were retained for bibliometric analysis.

The titles, abstracts, and keywords of these publications were carefully screened for relevance to the topic. VOSviewer and RStudio (Bibliometrix package) [52] were used for data processing and visualization. VOSviewer was used to create keyword-related networks and identify thematic clusters in the research area [53]. RStudio was also used to conduct a descriptive systematic analysis, including keyword frequency analysis and visualization of research trends. The data were also systematized and pre-processed using Microsoft Excel. The discussion section used a Venn diagram.

2.2. Questionnaire Development and Data Collection

The second phase of the study involved conducting a questionnaire-based survey to collect primary data on environmental awareness and behavioral practices related to water conservation. The questionnaire was developed based on previous research in the field of environmental behavior and water resources management [54]. To ensure clarity and consistency, the questionnaire was pre-tested with a small group of respondents. Minor adjustments were made based on feedback. The questionnaire consisted of 29 questions and was divided into six main sections: The first section in-

cluded questions about the demographic characteristics of the respondents (gender, age, education level, country and place of residence, and household size). The second section assessed participants' environmental awareness of water resources, climate change, and water conservation. The third section examined daily behavioral practices related to water use, including water conservation habits and attitudes toward responsible consumption. The fourth section focused on household water use practices, such as washing cars and washing machines. The fifth section examined water consumption levels and economic factors, including monthly water consumption, water prices, and the impact of pricing and metering systems. The final section examined participants' attitudes toward water waste in public spaces, as well as water leakage and inefficient water use. The detailed questionnaire used in this study is provided in **Appendix A**.

2.3. Sample and Data Analysis

The survey was completed online using Google Forms and was available in two languages (Uzbek and Russian) to ensure convenience and better understanding by participants. Data collection took place in January 2026.

The survey was conducted in Uzbekistan and Kazakhstan. A total of 210 respondents participated, of whom 108 were from Uzbekistan and 102 from Kazakhstan. Participation was voluntary and responses were collected anonymously. Including respondents from both countries allowed for a broader understanding of environmental awareness and behavioral practices related to water conservation. The collected data were analyzed using descriptive statistics. The survey data were processed in Microsoft Excel, which allowed for the identification of patterns in respondents' environmental awareness, attitudes, and behaviors related to water conservation. Systematic analysis and integration of survey data provide a comprehensive understanding of both the scientific and practical behavioral aspects of water conservation in the context of climate change.

3. Results

3.1. Results of the Systematic Analysis

The analysis of the term "co-occurrences" revealed four main thematic clusters, which are shown in three colors in **Figure 2**. The network visualization shows several groups of interconnected keywords that represent the main research topics related to water conservation and environmental responsibility. The size of each node in the network map represents the frequency of occurrence of the keyword, and the connections between the nodes indicate the strength of the relationship between the terms. The keyword "water conservation" is the most prominent and central on the Internet. It shows strong connections with several related terms, such as water management, environmentally responsible behavior, and sustainable development. One of the clusters contains keywords related to water management and water use, including water supply, water use, and water resource management. Another group includes keywords related to environmentally responsible behavior, such as "environmentally responsible behavior," "environmentally responsible behavior models," and "behavioral research." A separate cluster contains keywords related to sustainable development, indicating that the network contains concepts related to sustainable development. Overall, the structural network consists of several clusters of related keywords representing research topics related to water conservation, water management, environmentally responsible behavior, and sustainable development.

3.2. Survey Results

3.2.1. Socio-Demographic Characteristics of Respondents

The socio-demographic characteristics of the respondents are presented in **Table 1**. The survey was completed by 210 respondents, including 108 from Uzbekistan and 102 from Kazakhstan. The majority of respondents were women (56.7%) and 43.3% were men. In terms of age distribution, the largest group of respondents belonged to the 30–50 age group (48.5%), followed by the 18–20 age group (39.5%). Regarding education, the majority of participants had secondary or higher education, indicating a relatively diverse educational background among the participants. In addition, the majority of participants lived in urban areas (82%), while 18% lived in rural areas. The majority of households consisted of 5–6 people (46.2%), followed by 3–4 people (41%), reflecting typical family structures in the surveyed countries.

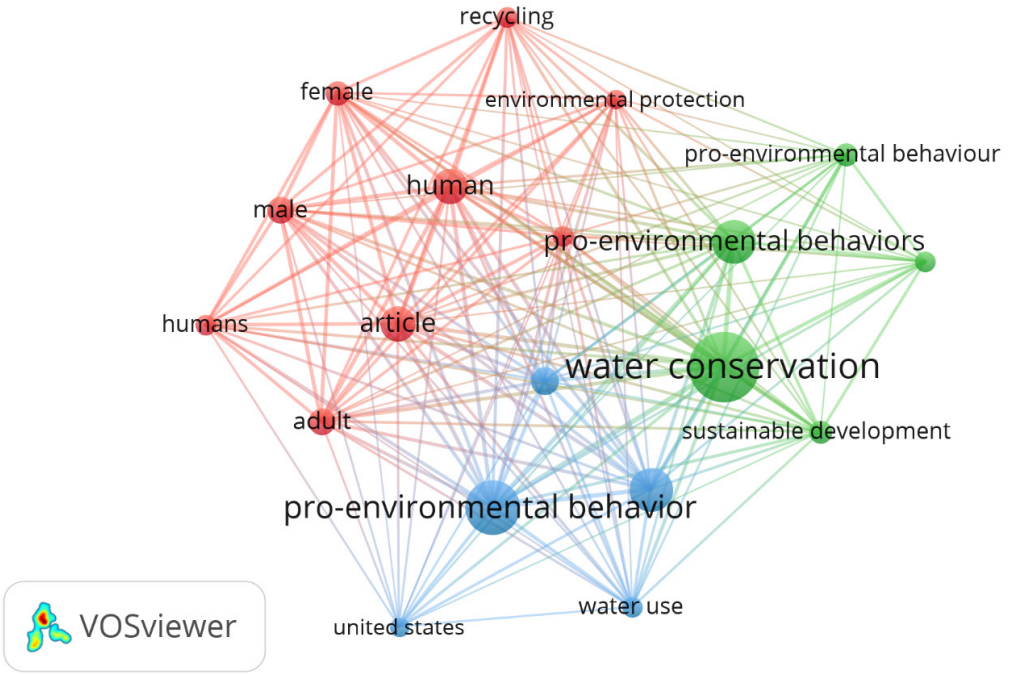

Figure 2. Results of the term co-occurrence analysis.

Table 1. Socio-demographic characteristics of respondents.

Variables	Uzbekistan(108)	Kazakhstan (102)	Total
Gender			
Male	47	44	91
Female	61	58	119
Age			
18–20	43	40	83
21–30	9	9	16
31–50	52	50	102
50+	4	3	7
Educational Level			
Secondary	30	29	59
Vocational/sec special	12	11	23
Higher education	24	22	46
Master's degree	30	29	59
Postgraduate	12	11	23
Place of Residence			
Urban	88	84	172
Rural	20	18	38
Family Size			
1–2 people	10	6	16
3–4 people	42	44	86
5–6 people	50	47	97
7+	6	5	11

3.2.2. Environmental Awareness and Attitude

The respondents' environmental awareness regarding water resources and climate change is presented in **Table 2**. The results show that most respondents recognize the scarcity of drinking water and the impact of climate change on water availability. In addition, all respondents agree that saving water is the duty of every citizen and that there is a need to increase environmental awareness regarding water conservation.

3.2.3. Water Consumption Behavior

The results on the respondents' daily water consumption and their household water use practices are presented in **Table 3**. These data show that the majority of respondents demonstrate water-saving practices in their daily activities. The majority of participants reported that they turn off the tap while brushing their teeth and try to avoid excessive water consumption. A large proportion of respondents also indicated that they repair leaking taps or pipes in their homes. Regarding household habits, more than half of the respondents said that they do not own a car, and those who do usually prefer professional car wash services. Most respondents also believe that washing cars at home increases water consumption. Regarding laundry practices, the majority of respondents said that they use washing machines once a week and try to use washing machines only when they are full.

Table 2. Respondents' environmental awareness regarding water resources and climate change.

Question	Yes (%)	Partially (%)	No (%)
Drinking water resources are limited	65.2	13.0	21.7
Climate change affects water resources	82.6	17.4	–
Water scarcity may become a serious global problem in the future	82.6	17.4	–
Water conservation is the responsibility of every citizen	100	–	–
It is necessary to improve ecological culture regarding water conservation	100	–	–

Table 3. Water consumption behavior and household water use practices among respondents (n = 210).

Indicator	Response Option	Percentage (%)
Turn off the tap while brushing teeth	Always	69.6
	Sometimes	30.4
	Never	–
Use water economically when washing dishes	Always	60.9
	Sometimes	30.4
	No	8.7
Try to avoid unnecessary water consumption	Always	87.0
	Sometimes	13.0
	No	–
Repair leaking taps or pipes	Yes	95.7
	Sometimes	4.3
	No	–
Use water-saving technologies	Yes	21.7
	Partially	21.7
	No	13.0
Recommend others to save water	Yes	78.3
	Sometimes	13.0
	No	8.7

Table 3. *Cont.*

Indicator	Response Option	Percentage (%)
Frequency of car washing	1–2 times per month	13.0
	Less frequently	34.8
	No car	52.2
Place of car washing	Car wash	64.3
	Both home and car wash	35.7
Washing a car at home increases water use	Yes	69.6
	Partially	26.1
	No	4.3
Frequency of washing machine use	Every day	8.7
	Several times per week	30.4
	Once per week	56.5
	Less frequently	4.3
Run washing machine only with full load	Yes	78.3
	Sometimes	8.7
	No	13.0

3.2.4. Water Consumption and Economic Factors

The results presented in **Table 4** show that the majority of respondents reported average (39.1%) or low (34.8%) water consumption, while only 8.7% reported high consumption. More than half (56.5%) said they would reduce their water consumption if prices increased, and 43.5% indicated a strong intention to do so. In addition, 87% believe that water meters help reduce water consumption.

Figure 3 shows the distribution of respondents in Kazakhstan and Uzbekistan by the amount of their monthly water bills. In Kazakhstan, the majority of respondents (30.5%) reported monthly bills of $8–16, with 26.1% reporting lower bills and 4.3% reporting higher bills. In Uzbekistan, the largest share (39.8%) reported spending up to $4 per month, followed by 23.1% spending between $4 and $8, and 26.9% being unsure about their monthly expenses. Overall, low and average wage levels prevail in both countries.

Table 4. Water consumption, cost perceptions, and attitudes towards water conservation.

Indicator	Response Option	Percentage (%)
Monthly water consumption	Low (1–10 m^3)	34.8
	Medium (11–20 m^3)	39.1
	High (>20 m^3)	8.7
	Do not know	17.4
Monthly water payment	Up to $4	26.1
	$4–$8	26.1
	$8–$16	30.4
	More than $16	–
	Do not know	8.7
Reaction to water price increase	Yes	43.5
	Possibly	56.5
	No	–
Water meter helps save water	Yes	87.0
	Partially	13.0
	No	–

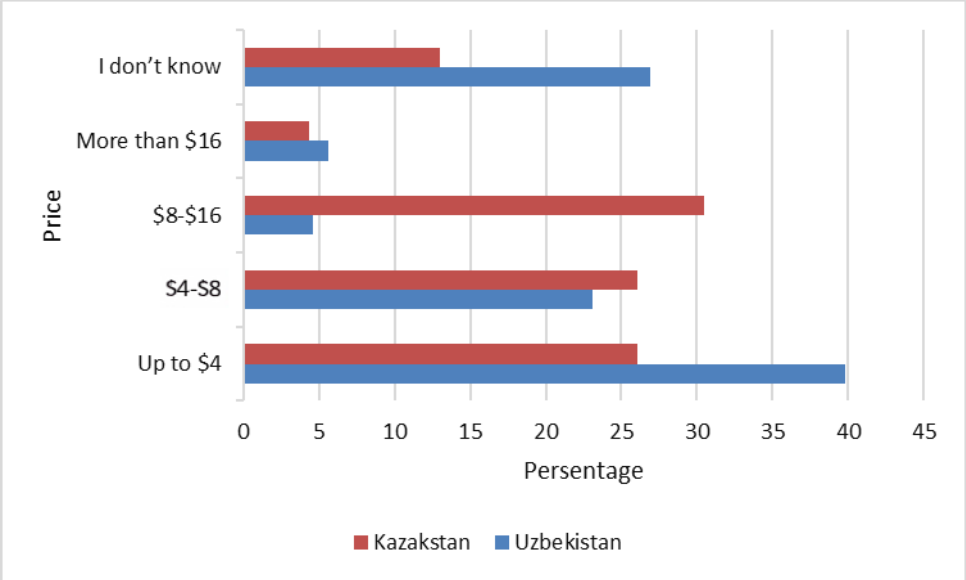

Figure 3. Distribution of respondents by monthly water bill amount in Kazakhstan and Uzbekistan.

3.2.5. Attitudes toward Water Waste

The results on respondents' attitudes towards water waste are presented in **Table 5**. The majority of respondents (65.2%) said that they would report water waste to the relevant authorities, 21.7% would draw the attention of others, and 13% would take no action. The majority of people (91.3%) consider water leakage in public places to be a serious problem, and a similar proportion of respondents believe that citizens should report such incidents, reflecting a high level of environmental responsibility.

Table 5. Attitudes toward water waste and public responsibility.

Indicator	Response Option	Percentage (%)
Reaction to water waste	Report to authorities	65.2
	Warn others	21.7
	Notice but take no action	13.0
	Ignore	–
Water leakage as a serious problem	Yes	91.3
	Partially	8.7
	No	–
Responsibility to report water misuse	Yes	91.3
	Partially	8.7
	No	–

4. Discussion

The results of this study provide important insights into the relationship between environmental awareness, human behavior, and water conservation under climate change [55]. The results of the study show that respondents demonstrate a relatively high level of awareness about the environment, especially regarding the impact of climate change on water resources and the need to conserve water [56]. This observation is consistent with previous studies, which highlight that environmental awareness plays an important role in shaping environmentally responsible behavior and promoting sustainable water use practices [57]. People who are more aware of environmen-

tal issues are more likely to support environmental initiatives and practice responsible consumption habits. The results show that the majority of respondents are aware of the global risks associated with limited water resources and water scarcity [55]. This reflects the growing public concern about environmental sustainability and water resource issues. Similar patterns have been identified in previous studies, highlighting the growing awareness of water scarcity and the potential impact of climate change on water availability. However, despite the relatively high level of awareness, the study did not identify significant differences in actual behavior. Despite the high level of awareness, the implementation of water-saving technologies remains limited. This finding highlights a well-documented gap between awareness and behavior that has been widely discussed in the literature on environmental responsibility [58]. Previous research suggests that awareness alone is not sufficient to achieve sustainable behavioral change, as behavior is influenced by a complex interplay of psychological, economic, and infrastructural factors [59]. In this context, psychological barriers such as habituation, perceived discomfort, low acceptance of personal values, and lack of immediate benefits can hinder the implementation of awareness. Even when people understand the importance of saving water, ingrained daily habits and behavioral inertia can limit the adoption of new practices [60]. In addition to psychological factors, structural and institutional conditions also play an important role in shaping water consumption [61]. In many regions of Central Asia, such as Uzbekistan and Kazakhstan, water is perceived as an abundant and cheap resource due to outdated systems inherited from historical water management practices [62]. Such historical perceptions can reduce the relevance of water conservation measures and weaken the link between awareness and behavior [47]. Additionally, limited access to water-saving technologies, inadequate infrastructure, and the lack of widespread water metering systems can also hinder behavioral change [63].

The results of the study show that water pricing is an important factor influencing water consumption [64]. A large proportion of respondents said that they would reduce their water consumption if prices increased, and highlighted the role of economic incentives in encouraging water conservation. This finding is consistent with existing research that suggests that pricing mechanisms and tariff policies can significantly influence household water consumption patterns [65]. However, it is important to note that the effectiveness of pricing policies may vary by income level. Higher-income households may be less sensitive to price increases, while lower-income groups are more likely to adjust their consumption in response to price increases [66]. Therefore, socio-economic differences should be taken into account when designing policies to ensure equitable and effective water resource management strategies [67]. Another important finding of the study is the strong sense of environmental responsibility among respondents. Many participants considered water leakage in public places to be a serious problem and expressed their willingness to report such problems to the relevant authorities. This reflects a growing sense of collective responsibility and public participation in environmental protection. Previous studies have also highlighted the importance of public participation and individual responsibility in improving environmental performance and promoting sustainable resource management [68]. Active citizen participation can significantly improve the effectiveness of environmental policies and contribute to more sustainable water resource management [69].

Chi-square analysis (**Table 6**) showed that there were no statistically significant differences in socio-demographic variables between respondents from Uzbekistan and Kazakhstan. No significant associations were found for gender, age, education level, place of residence, or number of family members (all $p > 0.05$). These findings indicate that the two country samples are demographically comparable. The lack of significant socio-demographic differences between the Uzbek and Kazakh subsamples supports the comparability of the two groups. This demographic similarity strengthens the interpretation of subsequent cross-country comparisons related to environmental awareness and water conservation behaviors, as the observed differences are less likely to be due to sample composition.

Table 6. Chi-square test for socio-demographic differences between Uzbekistan and Kazakhstan.

Variable	χ^2	Df	*p*-Value
Gender	0.18	1	0.671
Age	0.12	3	0.989
Educational level	0.09	4	0.999
Place of residence	0.03	1	0.863
Family size	1.62	3	0.655

Figure 4 provides a comparative overview of water conservation behaviors in Uzbekistan and Kazakhstan. The overlapping parts of the Venn diagram highlight several common practices observed in both countries. Respondents reported following basic water conservation rules, such as turning off the tap when brushing their teeth, using water efficiently at home, and avoiding unnecessary water consumption. In addition, many participants mentioned repairing leaking taps and encouraging others to save water, demonstrating a general understanding of responsible water use. However, the analysis reveals small differences between the two countries. In Uzbekistan, environmental awareness and concerns about water scarcity seem to play a more important role in shaping behavior [70]. In contrast, respondents in Kazakhstan tend to associate water conservation more with economic aspects such as water prices and household expenses. Furthermore, awareness and knowledge of water conservation technologies seem to be relatively low among respondents in Kazakhstan [71]. The lower awareness of water-saving technologies among respondents in Kazakhstan may be associated with differences in public awareness campaigns, availability of technologies, and variations in household infrastructure. This difference can be explained by differences in public awareness campaigns, access to technologies, and institutional support systems in the two countries [72]. Overall, the results show that while basic water conservation practices are widespread in both Uzbekistan and Kazakhstan, the reasons behind them differ. Bridging the gap between awareness and behavior requires not only increasing environmental knowledge, but also improving access to water-saving technologies, strengthening infrastructure, and implementing effective policies. In particular, integrating environmental education with economic incentives and technological solutions can significantly increase the effectiveness of water-saving efforts in climate-vulnerable regions such as Central Asia [47,71].

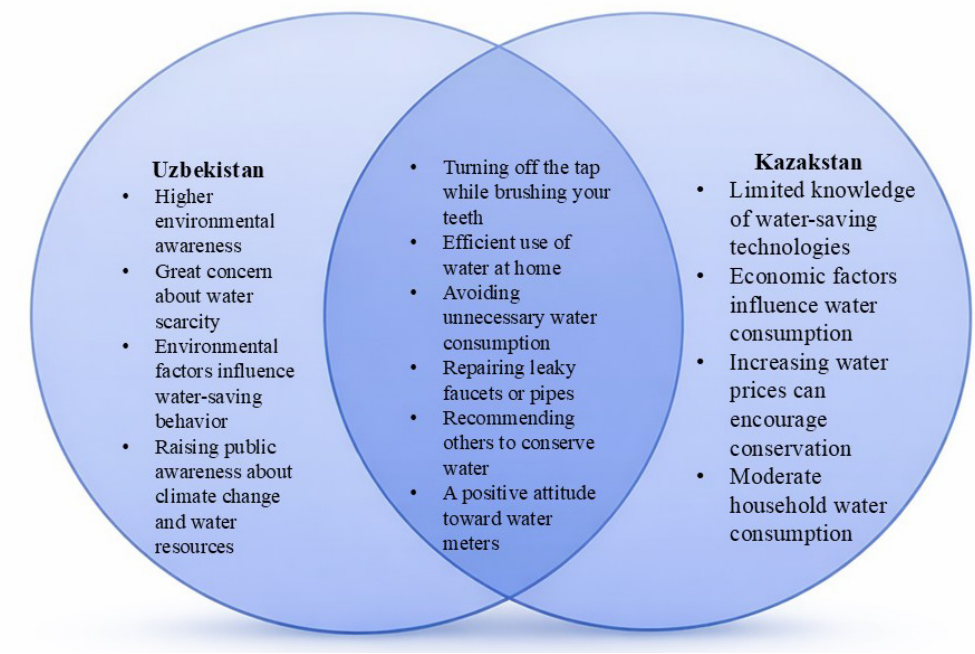

Figure 4. Comparing water conservation behavior in Uzbekistan and Kazakhstan.

5. Conclusions

This study examined the relationship between environmental awareness, human behavior, and water conservation in the context of climate change using a combination of systematic reviews and case study methods. This study shows that while environmental awareness is relatively high, actual water conservation behavior remains limited. Economic incentives, improved use of water-saving technologies, and public awareness campaigns can help promote sustainable water use. This comprehensive approach allowed us to study both academic trends in this area and respondents' practical views and behavior regarding water use. A systematic review of publications indexed in Scopus found a steady increase in academic interest in water conservation, sustainable resource management, and environmentally responsible behavior. The literature review identified several key areas of research, including water use efficiency, environmental responsibility, public participation, policy instruments, and long-term sustainability of water resources in a changing climate. These results confirm that water conservation is becoming an increasingly important topic in global environmental research. However, the study findings showed that while many respondents implement basic water conservation practices into their daily lives, such as turning off taps, reducing unnecessary water consumption, or using water more efficiently in household chores, adoption of modern water-saving technologies remains relatively limited. This indicates a significant gap between awareness of environmental issues and the practical implementation of improved water conservation measures. In other words, people may understand the importance of saving water, but this understanding does not always translate into concrete changes in behavior or investments in efficient technologies. This gap may be due to limited access, lack of information, financial barriers or low motivation. The results showed that economic factors can significantly influence the structure of water consumption. A significant proportion of respondents said they would consider reducing their water consumption if water prices increased. This suggests that economic instruments such as pricing policies, tariffs, incentives or subsidies for efficient technologies can play an important role in promoting sustainable water use practices. Thus, financial mechanisms can complement educational campaigns and environmental awareness programmes by providing direct incentives to save water. In addition, respondents demonstrated a strong sense of environmental responsibility and civic consciousness. Many participants considered water leaks in public places to be a serious social and environmental problem and believed that such incidents should be reported to the relevant authorities. This reflects a positive public attitude towards collective responsibility and citizen participation in water resource protection. It also demonstrates that many people understand that saving water is not just a personal matter, but a shared societal goal that requires cooperation between citizens and institutions. Overall, the study findings highlight the importance of raising environmental awareness and promoting long-term behavioral changes to support sustainable water resource management in the context of climate change. Raising public awareness, improving environmental education, promoting responsible water use, and increasing the adoption of water-saving technologies can help develop more effective and practical water conservation strategies. Furthermore, collaboration between governments, local authorities, businesses and local communities is essential to achieve sustainable progress in this area. Future studies could expand the geographic scope of the study to include respondents from different regions and countries, allowing for a broader comparative analysis. Additional socio-economic factors that may influence water conservation behavior, such as income level, education, age, family size, and place of residence (urban or rural), could also be examined. Such research would contribute to a deeper understanding of how environmental awareness can be translated into concrete and sustainable actions to protect global water resources. Future research may incorporate qualitative interviews or open-ended survey questions to better understand motivations and attitudes toward water conservation.

Limitations

This study has several limitations, including a relatively small sample size, reliance on self-reported data, and limited geographic coverage. First, the sample size of 210

respondents may limit the generalizability of the findings. In addition, the sample over-represented urban residents (82%), which may not fully reflect the rural perspective. The gender distribution was slightly unbalanced (56.7% women). Future studies should include respondents from diverse socio-economic backgrounds, including different income levels, education groups, and rural populations, to improve generalizability. Second, while systematic methods provide valuable information on research trends and thematic developments, they do not fully reflect the practical application of water conservation strategies. In addition, data obtained through self-reporting may be subject to response bias, as participants may overestimate their environmental awareness or responsible behavior. Future studies should expand the geographical scope, include larger and more diverse samples, and integrate qualitative approaches to better understand the behavioral factors influencing water conservation. During the preparation of this manuscript, the authors used AI tools only for language enhancement and grammar improvement. No AI tools were used for data analysis, interpretation, or scientific content generation. All results were critically reviewed and largely edited by the authors. The authors take full responsibility for the integrity and accuracy of the work.

Author Contributions

Conceptualization, M.R.; methodology, Z.K.; formal analysis, Z.K., A.S. and S.U.; investigation, O.E. and S.T.; data curation, O.E. and S.T.; writing—original draft preparation, M.B.; writing—review and editing, M.R., Z.K., A.S., A.H. and S.K.; visualization, Z.K. and S.T.; supervision, O.E.; project administration, M.R. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The research data can be found in the Scopus database.

Institutional Review Board Statement

Ethical review and approval were waived for this study because it involved an anonymous voluntary questionnaire survey. No personally identifiable information or sensitive personal data were collected, and the study posed minimal risk to participants.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. Participation in the survey was entirely voluntary, and respondents were informed about the objectives of the research. The questionnaire was completed anonymously, and no personally identifiable information was collected.

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Conflict of Interest

The authors declare no conflict of interest.

AI Use Statement

During the preparation of this manuscript, the authors used ChatGPT for language editing and linguistic refinement purposes. The authors subsequently reviewed and edited the content as necessary and take full responsibility for the final content of the published article.

Appendix A. Survey

Appendix A.1. General Information

1. What is your gender?
- Male
- Female

2. What is your age?
- 18–25 years old
- 26–35 years old
- 36–50 years old
- 50 years old and older

3. What is your level of education?
- Secondary education
- Vocational/specialized secondary education
- Higher education

4. Place of residence:
- Urban area
- Rural area

5. How many people live in your household?
- 1–2 people
- 3–4 people
- 5–6 people
- 7 or more people

Appendix A.2. Environmental Culture and Attitude toward the Problem

6. Do you believe that drinking water resources are limited?
- Yes
- Partially
- No

7. Do you think climate change affects water resources?
- Yes
- Partially
- No

8. Do you believe that saving water is the responsibility of every citizen?
- Yes
- Partially
- No

9. Do you think water shortage could become a serious global problem in the future?
- Yes
- Partially
- No

10. Is it necessary to improve the environmental awareness of the population regarding the conservation of water resources?
- Yes
- Partially
- No

Appendix A.3. Environmental Behavior in Water Use

11. Do you turn off the tap when you brush your teeth?
- Always
- Sometimes
- Never

12. Do you try to save water when washing dishes?
- Always
- Sometimes
- No

13. Do you try to avoid unnecessary water consumption?
- Always
- Sometimes
- No

14. Do you repair leaky faucets or pipes in your home?
- Yes
- Sometimes
- No

15. Do you use water-saving technologies or methods?
- Yes
- Partially
- No

16. Do you encourage others to save water?
- Yes
- Sometimes
- No

Appendix A.4. Water Consumption and Economic Factors

17. How would you estimate your household's monthly water consumption?

- 1–5 m^3
- 6–10 m^3
- 11–20 m^3
- More than 20 m^3
- Don't know

18. How much do you usually pay for water per month?

- Up to $4
- $4–$8
- $8–$16
- More than $16
- I don't know

19. Do you think that the high price of water encourages people to save water?

- Yes
- Partially
- No

20. If the price of water rises, will you use it more sparingly?

- Yes
- Maybe
- No

21. Do you think having a water meter helps save water?

- Yes
- Partially
- No

Appendix A.5. Behavior When Washing a Car

22. How often do you wash your car?

- 1–2 times a month
- Once a week
- Less often
- I don't have a car

23. Where do you usually wash your car?

- At a car wash
- At home
- Sometimes at home, sometimes at a car wash

24. Do you think washing your car at home increases water consumption?

- Yes
- Partially
- No

Appendix A.6. Water Usage during Washing

25. How often do you use your washing machine?

- Every day
- Several times a week
- Once a week
- Less often

26. Do you try to run the washing machine only when it's fully loaded?

- Yes
- Sometimes
- No

Appendix A.7. Reaction to Wasted Water

27. How do you react if you see water being wasted (for example, from a leaky faucet or fountain)?

- I report it to the appropriate authorities
- I warn others around me
- I notice it, but I don't do anything
- I don't pay attention

28. Do you think broken fountains or water leaks in public places are a serious problem?

- Yes
- Partially
- No

29. Do you think residents should report water leaks or inefficient water use?

- Yes
- Partially
- No

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