Research

Validity and Reliability Evidence of a Water-saving Instrument in the Colombian Population*

[English version]

Evidencia de validez y fiabilidad de un instrumento de ahorro de agua en población colombiana

Evidência de validade e confiabilidade de um instrumento de economia de água na população colombiana

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Abstract

Objective: To present evidence of the validity and reliability of the Water-Saving Questionnaire in the Colombian population. **Methodology:** A cross-sectional study with a psychometric approach was conducted, surveying 1,500 participants. The Water Savings Report Questionnaire was administered, and an exploratory factor analysis was conducted. Internal consistency was assessed using McDonald's ω and Cronbach's α. **Results:** The full scale accounted for 41.55% of the explained variance, with items clustering into two distinct categories. The internal consistency analysis yielded a McDonald's ω of .849 (95% CI = .838-.860) and a Cronbach's α of .843 (95% CI = .831-.854). **Discussion:** The findings indicate that the "Water Savings Report Questionnaire" meets the criteria for adequate psychometric quality. However, further studies are recommended to explore the influence of social and health factors on the results. **Conclusions:** The "Water Savings Report Questionnaire" demonstrated reliability and validity indicators that enable the identification of behaviors related to the environmental management of water use and conservation.

Keywords: water saving; validity; reliability; psychometrics; pro-environmental behavior (obtained from UNESCO thesaurus).

Resumen

Objetivo: presentar evidencia de validez y fiabilidad del cuestionario de ahorro de agua en población colombiana. **Metodología:** se realizó una investigación de tipo transversal, con un estudio psicométrico en el que se encuestaron 1500 participantes. Se aplicó el Cuestionario reporte de ahorro de agua, se realizó un análisis factorial exploratorio y un análisis de consistencia interna con ω de McDonald y α de Cronbach. **Resultados:** se evidencia que la prueba completa explica el 41.55% de la varianza, y los ítems se agrupan en dos categorías; el análisis de consistencia interna refiere un ω de McDonald de .849 (I.C. 95% = .838-.860) y un α de Cronbach de .843 (I.C. 95% = .831-.854). **Discusión:** se declara que la versión del «Cuestionario reporte de ahorro de agua» cuenta con los criterios de calidad psicométrica suficiente, y se sugiere llevar a cabo nuevos estudios teniendo en cuenta factores sociales y sanitarios que puedan tener alguna incidencia en los resultados. **Conclusiones:** en el «Cuestionario Reporte de ahorro de agua» se presentaron indicadores de confiabilidad y validez que permiten la identificación de conductas asociadas a la gestión ambiental de uso y cuidado del agua.

Palabras clave: ahorro de agua; validez; fiabilidad; psicometría; conducta proambiental (obtenido del tesauro de la UNESCO).

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Resumo

Objetivo: apresentar evidências de validade e confiabilidade do questionário de economia de água na população colombiana. **Metodologia:** foi realizada uma pesquisa transversal, com um estudo psicométrico no qual foram pesquisados 1.500 participantes. Foi aplicado o Questionário de Relatório de Economia de Água, foi realizada uma análise fatorial exploratória e uma análise de consistência interna com o ω de McDonald e o α de Cronbach. **Resultados:** é evidente que o teste completo explica 41,55% da variação, e os itens são agrupados em duas categorias; a análise de consistência interna relata um ω de McDonald de 0,849 (95% C.I. = 0,838- 0,860) e um α de Cronbach de 0,843 (95% C.I. = 0,831- 0,854). **Discussão:** afirma-se que a versão do "Water Saving Report Questionnaire" atende aos critérios de qualidade psicométrica suficiente, e sugere-se a realização de mais estudos levando em conta fatores sociais e de saúde que possam ter impacto sobre os resultados. **Conclusões:** o "Water Saving Report Questionnaire" apresentou indicadores de confiabilidade e validade que permitem a identificação de comportamentos associados à gestão ambiental do uso e do cuidado com a água.

Palavras-chaves: economia de água; validade; confiabilidade; psicometria; comportamento pró-ambiental (obtido do tesauro da UNESCO).

Introduction

Global greenhouse gas emissions have increased by approximately 70% since 1970 (Córdova et al., 2018). This has resulted in a global temperature increase of approximately 1.15 degrees Celsius since the pre-industrial era. Consequently, the last eight years have been the hottest on record (Intergovernmental Panel on Climate Change [IPCC], 2022). These emissions are primarily caused by the burning of fossil fuels for power generation, transportation, and industry, as well as by deforestation and land use changes (World Meteorological Organization [WMO], 2023b).

According to the Intergovernmental Panel on Climate Change (IPCC), human activity is highly likely to be the primary driver of the global warming observed in recent decades (IPCC, 2019; 2022). Climate change leads to an increase in the frequency and intensity of extreme weather events, such as storms, heatwaves, floods, droughts, air pollution, mass reduction of glaciers, acidification, and the rising of sea levels (Lavergne et al., 2019). These events can cause irreversible damage to ecosystems and situations that will significantly compromise human life, such as forced displacement of communities, food insecurity, and others (WMO, 2023a).

Water sources have been particularly affected by this phenomenon. Consequences include: a) a decrease in water availability, driven by rising temperatures and reduced rainfall, which impact the availability of drinking water, hydroelectric power generation, and agricultural production; b) changes in water quality, caused by the proliferation of bacteria in bodies of water, posing a greater risk to consumer health; c) impacts on aquatic ecosystems, such as coral reefs and mangroves, which negatively affect biodiversity and economic activities like fishing; d) increasingly recurrent extreme weather events (Dupar, 2019; WMO, 2022).

According to the World Bank (2015), approximately two billion people worldwide lack access to safe drinking water, 3.6 billion do not have basic sanitation services (sanitary units), and 2.3 billion lack at least one basic handwashing facility. This situation explains the gaps in access to drinking water supplies and basic sanitation, which are exacerbated by factors such as rapid population growth, intensive water usage in agriculture and industry, and rainfall variability; a consequence of climate change.

Water pollution is another global issue that impacts the quality and safety of water resources, as well as human health, aquatic biodiversity, and associated ecosystems. According to the World Health Organization (2023), approximately one million people lose their lives each year due to diarrheal diseases contracted from unsafe water or poor hand hygiene. The Ecological Threat Register (2020)

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reported that Southeast Asia, the Middle East, and North Africa are the regions most vulnerable to water scarcity. In Latin America, Chile and Mexico are the countries at the highest risk of water stress.

In addition to the above, these regions, in addition to having vast desert territories, also face high water demand from domestic consumption, the impact of industrialization, and the water requirements for agricultural activities. This report also highlights that Greece and Spain yearly consume between 40% and 80% of the total annual water resources available to them.

The National Water Study conducted by the Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM) is a research and monitoring initiative aimed at assessing water availability, quality, and usage, as well as the impact of climate change on water resources and the generation of early warnings in Colombia (IDEAM, 2023). A section is dedicated to the country's contribution to the goals and indicators of Sustainable Development Goal (SDG) 6: "Clean Water and Sanitation."

The progress made in monitoring the indicators associated with the targets of SDG 6 by the IDEAM includes the following indicators: "6.3.2 Proportion of good quality bodies of water," "6.4.1 Change in the efficient use of water resources over time," "6.4.2 Level of water stress: extraction of freshwater in proportion to available freshwater resources," and "6.5.2 Proportion of the surface of transboundary basins subject to operational arrangements for water cooperation." Each of them can be detailed in depth in the aforementioned National Water Study (IDEAM, 2023).

One of the most relevant allies in achieving these objectives is education, which, in addition to being an engine of economic development (Haddad et al., 1990), serves as a fundamental strategy to raise awareness regarding climate change (largely driven by global warming) and help populations adapt to scenarios of environmental degradation (UNESCO, 2014). This is achieved through the increase of knowledge of habitats and their threats, promoting environmental values and convictions that encourage changes in behaviors and lifestyles contributing to the planet's deterioration (Severiche et al., 2016; Villadiego et al., 2015), while also fostering social and sustainable development (Saza-Quintero et al., 2023).

This approach requires reflection on the essential role of human behavior in environmental impact (Gifford & Nilsson, 2014; Mendoza, 2021; Oskamp, 2000; Sierra-Barón et al., 2022), and how it can be understood, evaluated, measured, and reoriented to contribute to the sustainable use and conservation of water resources.

The situation in Colombia regarding the issues affecting water use, availability, and quality is linked to the negative effects produced by the following events:

1) The discharge of untreated wastewater into Colombian rivers and seas, which receive pollutant loads from socioeconomic activities, as well as sediments from both natural and anthropogenic erosion processes; among these, domestic and industrial wastewater from livestock, coffee, and coca production and processing, as well as mercury discharge from mining operations;

2) Agrochemicals, as the primary pollutants, are found in animal waste, antibiotics, insecticides, hormones, fertilizers, and pesticides used to treat fodder crops;

3) Eutrophication, as a process of nutrient enrichment (nitrogen and phosphorus) in aquatic ecosystems, originating from domestic and agricultural sources, results in an excess of these nutrients. This imbalance disrupts respiration and photosynthesis, leading to oxygen depletion, fish mortality, the invasion of aquatic vegetation, and the overpopulation of phytoplankton;

4) Ecological effects are related to the impacts of hydrological alterations on the transformation of aquatic ecosystems, such as wetlands, which have been altered by water demand, pollution, land overuse, and ecosystem modification;

5) Deforestation, an increasing phenomenon in recent years, is associated with, among other factors, the expansion of the agricultural and livestock frontier, food demands related to population growth, the establishment of illicit crops, overexploitation of mineral resources, and the establishment of monocultures;

6) Heavy metals related to mining processes contribute a significant number of pollutants to water sources, with high concentrations of mercury, which are associated with activities such as gold mining, oil extraction, and industrial and agricultural activities;

7) Emerging pollutants, associated with chemical compounds that pose environmental consequences and health risks, are poorly understood in terms of their presence, impact, and treatment. These include pesticides, pharmaceuticals, illicit drugs, personal care products, and other substances not yet regulated;

8) Salinization of surface and groundwater, coastal erosion, and flooding of certain areas are effects caused by sea level rise. One of its consequences is the disruption of migration patterns for reproduction in some aquatic species (IDEAM, 2023; Ruiz et al., 2020).

This scenario has had repercussions in various regions of the country, and the Southern Colombian region is no exception to this issue. In the specific case of the department of Huila, the deterioration of water basins is driven by deforestation and hydroelectric power generation. The Institutional Action Plan 2020-2023, "Huila Biodiverso, Sostenible y Productivo," presents indicators that reflect the impact on water quality and vulnerability to shortages, highlighting critical conditions in certain areas. The primary sources of pollution in water

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bodies in the department of Huila stem from domestic wastewater (Corporación Autónoma Regional del Alto Magdalena [CAM], 2020).

There is evidence suggesting that behaviors and certain psychological dispositions, such as personal attitudes, promote environmental care and preservation (Carmi, 2013; De Sario et al., 2023; Franzen & Meyer, 2010; Ogunbode & Arnold, 2012; Schultz et al., 2005). These factors also counteract non-ecological and unsustainable consumption patterns (Molano et al., 2023). In this sense, identifying the factors that most influence pro-environmental behavior makes improving the design and management of development measures and policies possible (World Bank, 2015). This also helps determine the most appropriate routes and strategies to promote greater awareness, responsibility, and respect for the environment, along with understanding the effects of one's own behavior (Navarro et al., 2022; Pérez & Camacho, 2023; Richardson et al., 2009).

The scientific literature defines behaviors that are performed in favor of the environment as "pro-environmental behaviors." These behaviors are described as those that "consciously seek to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002, p. 240). Steg and Vlek (2009) suggest that these behaviors are actions undertaken by individuals with the primary intention of benefiting the environment or minimizing harm to it. These behaviors are often motivated by awareness of environmental issues and a desire to contribute to the preservation or restoration of the environment.

Kurisu (2015) notes that several alternative terms are commonly used to refer to pro-environmental behaviors, including environmental behavior (Van Liere & Dunlap, 1978), ecological behavior (Kaiser & Fuhrer, 2003), environmentally responsible behavior (Thøgersen, 2004; Hines et al., 1987), environmentally significant behavior (Stern, 2000), and environmentally related behavior (Bamberg, 2003). A special mention should be made of the concept of "sustainable behavior," which refers to actions taken by individuals or groups to meet present needs while ensuring that the ability of future generations to meet their own needs is not compromised (Corral-Verdugo, 2010). This concept integrates environmental, social, and economic considerations into decision-making processes, emphasizing the balance between these three dimensions. Sustainable behavior extends beyond environmental protection, incorporating practices that promote social equity, economic viability, and support long-term ecological health and human well-being (Corral-Verdugo, 2012).

Although closely related to pro-environmental behavior, sustainable behavior encompasses a broader range of actions and considerations, integrating long-term ecological health with social equity and economic frugality. While pro-environmental behavior often focuses specifically on actions that benefit the environment, sustainable behavior requires a more holistic approach, balancing environmental,

social, and economic dimensions. In this regard, while all pro-environmental behaviors can be considered part of sustainable behavior, not all sustainable behaviors are strictly pro-environmental.

In his review, Kurisu (2015) identified a list of widely recognized pro-environmental behaviors, which he classified into categories aimed at reducing: a) greenhouse gases, b) air pollutants, c) water pollutants, d) resource consumption, and e) alterations to the natural environment. Examples of pro-environmental behaviors include recycling, reducing energy consumption, using public transportation to lower carbon emissions, and conserving water.

Therefore, developing approaches that assess different types of pro-environmental behaviors for which appropriate tools for accurate measurement are needed is essential. These tools include general and domain-specific self-report measures (such as surveys and questionnaires), field observations assisted by key informants, the use of technical devices, and controlled behavioral tasks conducted in laboratory environments (Lange & Dewitte, 2019). In general, self-report measures assess the frequency of various behaviors with an environmental impact, such as recycling, using transportation alternatives, and conserving energy and water. These measures are commonly used for their convenience and ease of analysis, although they are more susceptible to socially desirable responses and acquiescence bias (Deltomme et al., 2023).

Many of the psychometric instruments available for measuring behaviors related to environmental care and preservation in various contexts (Herrera et al., 2018; Sierra-Barón et al., 2021; Sierra-Barón et al., 2023; Sierra-Barón et al., 2018; Sierra & Meneses, 2022; Sierra-Barón & Saza-Quintero, 2023; Vanegas et al., 2018) are primarily based on the "Theory of Reasoned Action" (TAR) (Fishbein & Ajzen, 1975; 2011) and the "Theory of Planned Behavior" (TPB) (Ajzen, 1991; 2011; 2020). Both theories have been widely used to explain the factors that precede pro-environmental behaviors in educational contexts (Sandoval-Escobar et al., 2019; Saza-Quintero et al., 2021), organizational settings, and among the general population (Lam, 2006; Sierra-Barón & Meneses, 2018), as well as in the acquisition of healthy behaviors (Fishbein, 2008). Other instruments used to measure pro-environmental behaviors in the Latin American context are discussed in Arteta (2022).

Pro-environmental behavior is a significant predictor of water conservation, as individuals with pro-environmental attitudes are more likely to conserve water than those without such attitudes (Adams, 2014). Several measurement instruments have been developed to assess water consumption habits in households, educational settings, and organizations (Hoekstra et al., 2011; Mendieta & Gutiérrez, 2014; Sierra-Barón et al., 2018; Solis-Salazar, 2010).

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Additionally, there are instruments that measure other psychological dispositions linked to water-saving behavior, such as attitudes, intentions, perceived rights, and beliefs (Corral-Verdugo et al., 2003; Gilg & Barr, 2006; Lam, 2006; Randolph & Troy, 2008; Reddy et al., 2023; Willis et al., 2011). The focus of this work is on water conservation and saving behavior, understanding these activities as a specific type of pro-environmental behavior, as well as the measures that study said behavior.

Among other instruments cited in the literature for measuring this construct, the Water Conservation Practices Scale (Dolnicar et al., 2012) is notable. It measures 17 specific self-reported water conservation behaviors. Additionally, measures that have previously been found to influence conservation behavior—such as environmental attitudes, altruism, pro-environmental behavior, moral obligation, environmental knowledge, the search for information about water, and the social influence of conservation behavior—are also included. In this study, Dolnicar et al. (2012) identified two key factors that promote water conservation behavior: a high level of pro-environmental behavior and the proactive search for information about water.

Studies report the use of instruments designed for water conservation in residential settings, aiming to guide the design of behavioral interventions for water consumption in households. The design of these interventions could be influenced by factors such as promoting efficient water use, supporting the environment, and saving money. Interventions may include providing information, implementing mandatory water restrictions, and adjusting water pricing (Shan et al., 2015). Other studies use more precise measurement instruments, such as water meters, to identify factors that promote water conservation, including social norms, social identity, and personal identity approaches (Seyranian et al., 2015).

The Home Water Conservation Scale (Fielding et al., 2013) measures water conservation behaviors both inside and outside the home, with a Cronbach's Alpha of 0.86. This instrument aimed to identify key factors for designing effective water use campaigns. It highlighted the importance of viewing water use as a collective behavior influenced by household dynamics. By promoting good water-saving habits, it emphasized the need for policies that foster long-term cultural changes.

Most of these instruments have been used in European countries, some in Australia and others in the Latin American context. In Mexico, the "Water Savings Report" scale, consisting of 14 actions related to water conservation ($\alpha = 0.84$), was used to identify relationships between saving behaviors, perceptions of justice, and the legitimacy of authorities (Estrella, 2016). A total of 472 people participated in this study, contributing to the payment of monthly water consumption and/or performing household cleaning tasks. The structural model proposed in the study presented an explanatory percentage of nine.

Among the Colombian psychometric studies aiming to contribute to the reliability and validity indices of instruments for measuring pro-environmental behaviors is the work of Sierra-Barón and Saza-Quintero (2023). They conducted a convergent and divergent validation of the Pro-Environmental Behavior Index (PBI) using an environmental knowledge scale, an exploratory factor analysis, and an internal consistency analysis with McDonald's ω, based on a sample of 980 participants. The full instrumentation explained 52.83% of the variance, with most items having a saturation exceeding 0.40, and they were grouped into five categories. This instrument measures the PBI with adequate levels of validity and reliability.

Another Colombian study aimed to establish psychometric indicators for the Pro-Environmental Attitudes Questionnaire (PEAQ) using a sample of 415 participants. The linguistically adapted PEAQ for the country demonstrated one-dimensionality, with an explained variance of 43%, and reliability coefficients of $\alpha = 0.95$ and $\Omega = 0.95$. The Rasch analysis yielded a person reliability of 0.90 and item reliability of 0.95. In this study, statistically significant correlations were also found with other scales, including the Environmental Awareness scale 0.859, ($p \leq 0.001$), the Environmental Values scale = 0.795 ($p \leq 0.001$), and the Pro-Environmental Behavior Questionnaire at Work 0.885 ($p \leq 0.001$). The psychometric indicators of the Colombian version support the PEAQ as a valid and reliable instrument for measuring pro-environmental attitudes in the country (Sierra & Meneses, 2022).

In Colombia, there are few instruments available that focus on promoting and improving sustainable environmental practices, particularly those that influence human behavior (Sierra-Barón & Meneses, 2022). Moreover, there is a lack of measurement instruments specifically designed to assess water conservation, which would allow for establishing baselines for intervention design and monitoring behaviors related to water care and saving. Such actions could contribute to promoting and strengthening the sustainable use, conservation, and saving of water resources.

Given that water sources are essential for the survival and development of life on Earth, and, of course, in Colombia, conducting psychometric studies that contribute to the construction, adaptation, translation, validation, and good practices in evaluating psychological constructs related to pro-environmental behaviors is necessary. These studies should specifically focus on the conservation of water resources, supporting the promotion of sustainable water use and conservation. For this purpose, the guidelines outlined in works such as Muñiz et al. (2013) and Muñiz and Fonseca-Pedrero (2019) are considered, as they provide methods for obtaining measurements with high reliability indices, allowing for a more accurate assessment of water conservation behavior. Additionally, having

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self-reporting measurement instruments that enable the evaluation of the impact of behaviors related to water use is crucial.

Therefore, the aim of this article is to present evidence of the validity and reliability of the water-saving questionnaire for the Colombian population.

Methodology

This study, which presents the psychometric properties of the "Water Savings Questionnaire" developed for the Mexican population (Estrella, 2016), is defined as cross-sectional research (Kesmodel, 2018). It is characterized by the analysis of psychological measurement instruments, either adapted from existing ones or newly created.

Participants

A total of 1,500 people (50.2% men) participated in this study, with the majority coming from the urban sector (60.1%). The average age of participants was 32.11 years (SD = 10.10), from various regions in southwestern Colombia. Of the participants, 90.9% belonged to socioeconomic strata 1 and 2, and more than half (65.9%) reported being employed. Of the participants, 45.7% reported having a technical or technological education, while 45.3% held a university degree (see Table 1).

Table 1. *Sample Description.*

Gender	**f**	**%**	**Currently working**	**f**	**%**
Male	753	50.2	Yes	988	65.9
Female	747	49.8	No	512	34.1
Sector			**Educational Level**		
Urban	902	60.1	Elementary	10	.7
Rural	598	39.9	High School	31	2.1
Socioeconomic Stratum			Technician	312	20.8

1	175	11.7	Technology	373	24.9
2	1188	79.2	Undergraduate	679	45.3
3	128	8.5	Graduate	95	6.3
4	9	.6			

Instruments

The "Water Savings Report Questionnaire", reviewed in a study by Estrella (2016) on the Mexican population, achieved a Cronbach's α of 0.84. It consists of 14 items focused on the care and conservation of water, as well as its use in public services such as supply, drainage, sewage, wastewater treatment, and disposal. The items were assessed using a four-point Likert scale, ranging from "Never" to "Always." Sociodemographic variables were assessed using an *Ad Hoc questionnaire*, specifically designed for this study.

Procedure

The researchers structured the research protocol and advanced the respective institutional arrangements for its development, in accordance with the ethical considerations established for research with human subjects in Colombia (Resolution 8430 of 1993 and Law 1090 of 2006). The data collection instruments were administered online using *Google Forms*. The data were collected in 2022, following the World Health Organization's (WHO) declaration of the post-pandemic phase of COVID-19. All participants voluntarily agreed to take part in the study and signed the informed consent form, in which they were informed about the research objectives and the associated risks, in accordance with Resolution 8430 of 1993 and Law 1090 of 2006 issued by Colombia's Ministry of Health. In this case, there were no risks, and the confidentiality and anonymity of the data were guaranteed.

Data Analysis

A description of the items was provided, considering their mean, standard deviation, skewness, and kurtosis. Additionally, a Kolmogorov-Smirnov analysis was conducted to assess whether the variable followed a parametric distribution. A

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comparative analysis was also carried out to determine statistical differences in the scores based on sample characteristics, using *Students' t-test* and *one-way ANOVA*.

To determine factor groupings, an exploratory factor analysis using principal component analysis was conducted, with a direct Oblimin rotation. Finally, the internal consistency analysis was done with McDonald's ω and Cronbach's α. For the development of the statistical procedures, the SPSS-26 ® and JAMOVI 2.3 ® software were used.

Results

Table 2 shows the descriptive statistics of the items. All items exhibit negative skewness and a platykurtic tendency. This is confirmed by the Kolmogorov-Smirnov test, which indicates a non-parametric data distribution.

Table 2. *Item Descriptions.*

	Mean (95% C.I.)	Of	Skewness	Kurtosis
Item 1	3.3 (3.26-3.34)	.82	-.92	-.02
Item 2	3.42 (3.48-3.46)	.88	-1.41	.98
Item 3	3.38 (3.34-3.43)	.92	-1.29	.46
Item 4	3.32 (3.27-3.37)	.98	-1.23	.23
Item 5	3.27 (3.22-3,32)	1.02	-1.11	-.13
Item 6	3.24 (3.18-3,29)	1.06	-1.10	-.21
Item 7	3.39 (3.34-3,43)	.90	-1.34	.74
Item 8	3.36 (3.31-3,41)	.95	-1.32	.55
Item 9	3.32 (3.27-3,37)	.96	-1.22	.29
Item 10	3.3 (3.25-3,35)	.99	-1.22	.23
Item 11	3.25 (3.20-3,20)	1.04	-1.13	-.11
Item 12	3.28 (3.23-3,33)	.99	-1.14	.03
Item 13	3.28 (3.23-3,33)	.97	-1.14	.09
Item 14	3.31 (3.26-3,36)	1.00	-1.21	.13

The comparative analysis based on sociodemographic variables (Table 3) revealed significant differences across all criteria, except for sex.

Table 3. *Statistical Differences According to the Socio-demographic Variables Described.*

Variables	*M (Of)*	Intergroup Differences (p)
Gender		.773 (*p = .366*)
1. Woman	3.33 (.54)	
2. Man	3.31 (.56)	
Sector		5.68 (*p < .001*)
1. Urban	3.39 (.53)	
2. Rural	3.22 (.57)	
Currently working		3.10 (*p = .002*)
1. Yes	3.29 (.55)	
2. No	3.38 (.54)	
Education Level		32.60 (*p < .001*)
1. Elementary	3.00 (.53)	
2. High School	2.69 (.68)	
3. Technician	3.37 (.50)	
4. Technologist	3.41 (.47)	
5. University	3.35 (.56)	
6. Postgraduate	2.84 (.52)	
Socioeconomic Stratum		35.78 (*p < .001*)
1	2.99 (.63)	
2	3.40 (.49)	
3	3.05 (.65)	
4	2.68 (.76)	

The Kaiser-Meyer-Olkin (KMO) test KMO = 0.926, ^{Chi2} = 4777.18), p < 0.01 indicates that the sample is sufficient for conducting a reliable factor analysis. Additionally, the full test accounts for 41.55% of the variance of the construct.

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However, items 1 and 2, which form one of the two identified subscales, exhibit an item-test correlation below 0.25 (Table 4).

Table 4. *Factor Load, Extraction, Item Correlations - Test and Internal Consistency if the Item is Deleted.*

	Factor 1	Factor 2	Extraction	Item-total Correlation	Cronbach's α if element is deleted	McDonald's ω if item is deleted
Ítem 1		.753	.57	.116	.851	.852
Ítem 2		.703	.504	.231	.846	.847
Ítem 3	.591		.356	.503	.831	.831
Ítem 4	.634		.405	.534	.829	.829
Ítem 5	.678		.462	.577	.826	.826
Ítem 6	.653		.445	.54	.828	.829
Ítem 7	.472		.235	.394	.837	.838
Ítem 8	.612		.378	.522	.83	.83
Ítem 9	.619		.383	.523	.83	.83
Ítem 10	.64		.411	.545	.828	.829
Ítem 11	.688		.476	.586	.825	.826
Ítem 12	.648		.421	.554	.828	.828
Ítem 13	.614		.38	.511	.83	.831
Ítem 14	.614		.391	.53	.829	.83

Furthermore, the distribution of the items into two factors is confirmed, as shown in the sedimentation graph (Figure 1).

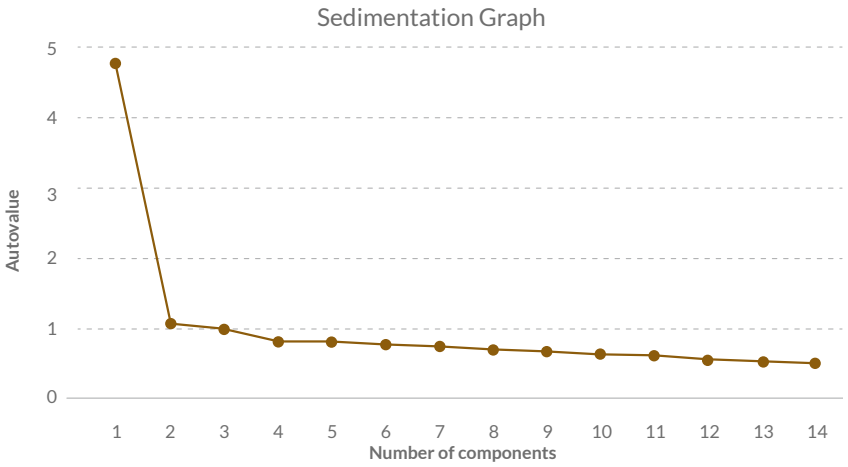

Figure 1. *Sedimentation Graph for the Water Saving Questionnaire Application.*

Finally, the internal consistency analysis indicates that the full scale has a McDonald's ω of 0.849 (95% CI = 0.838–0.860) and a Cronbach's α of 0.843 (95% CI = 0.831–0.854).

Discussion

The objective of this study was to present evidence of the validity and reliability of the "Water Savings Questionnaire" in the Colombian population. Together with other instruments designed to measure self-reported behaviors related to water use and conservation, this tool has played an important role in assessing environmental management practices across different contexts. One such instrument is the household survey developed by Estrella (2016), which emphasizes the importance of gathering information to understand behavioral dynamics related to water use and conservation in the context of household public services (such as drinking water, sewerage, wastewater treatment, and disposal), as well as the association between these practices and the economic costs of service provision.

Another context in which this instrument has been applied is educational settings (Ramírez-Segado et al., 2021). The measures obtained provide valuable insights into dynamics related to water consumption habits, teaching and learning processes concerning water, efficient use of institutional resources, and curricular content associated with water management. Research has been conducted both in basic education (Mendieta & Gutiérrez, 2014) and in university programs (Sierra-Barón et al., 2018).

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In organizational contexts, practices related to proper water treatment, use, management, and disposal are fundamental, framed within social, business, legal, and environmental responsibilities (Sierra-Barón & Meneses, 2018; Vallet-Bellmunt et al., 2023; Zhang et al., 2021). In these scenarios, self-report questionnaires are essential tools for evaluating, measuring, monitoring, and controlling water resources, particularly in identifying behaviors that help minimize environmental risks.

Water conservation behaviors—understood as specific actions aimed at preventing, minimizing, or mitigating the negative environmental impacts of human activity—are closely linked to both individual and social practices within various organizations. Therefore, fostering desirable behaviors and promoting good environmental practices are essential to minimizing the environmental impact on water resources (Fielding et al., 2013; Pol et al., 2010; Shan et al., 2015).

In the Colombian context, community water management within the framework of the post-conflict period with the FARC-EP also proves to be a suitable setting for applying the instrument as a resource. This can be contrasted with issues typically associated with this phenomenon, such as inadequate infrastructure for drinking water supply, deforestation, contamination of water sources, demands for water provision, and the limited capacity for institutional water resource management (Alvarado et al., 2022; Valencia & Ecuyer, 2023).

The "Water Savings Report Questionnaire" submitted for analysis is a promising instrument that can inform the design of local interventions. These interventions have demonstrated effectiveness in promoting water conservation behavior (Fielding et al., 2013). Likewise, the questionnaire can serve as a valuable input for decision-making and the development of public policies aimed at promoting water-saving behaviors in diverse contexts (Lam, 2006; Reddy et al., 2023; Shan et al., 2015; Willis et al., 2011).

The results of this study indicate that all items contributed above 0.30 to their respective factors, justifying the retention of all items (Méndez & Rondón, 2012). Likewise, the complete instrument explains over 0.40 of the total variances of the construct, demonstrating its usefulness in measuring the targeted construct. On the other hand, the instrument demonstrates high internal consistency indices without becoming redundant (Frías-Navarro, 2022). These indices are very similar to those of the original Mexican scale by Estrella (2016), which reported a Cronbach's α of 0.848. Therefore, it is expected that the instrument will yield reliable measurements without collinearity between the items.

It was evidenced that two items (1 and 2) have an item-test correlation < 0.25, grouped into a factor. These results can serve as a guide for future research that considers aspects such as relevance, wording, item placement, and the operationalization of common water use and consumption practices. They also

suggest conducting a second study to test the hypothesis that the instrument might perform better by removing these items, despite it becoming univariate and deviating from the original configuration validated in the Mexican population (Estrella, 2016).

Some limitations must be considered when interpreting the results of this study, one of which is that it was conducted with the general population. Conducting future studies focusing on specific population sectors, such as education, health, the business sector, and victims of armed conflict, among others is advisable. Another limitation is related to social and health changes documented during the pandemic and post-pandemic periods, which may have influenced water use and conservation behaviors. For this reason, carrying out new studies that consider social and health factors that may influence the results is recommended. The "Water Savings Report Questionnaire" presents certain limitations that may affect the accuracy of the measurements. One of these limitations is that the reported behaviors are self-reported rather than directly observed. This could introduce a bias related to social desirability and convenience (Brown et al., 2014; Kormos & Gifford, 2014), representing a disadvantage compared to other types of measures (Seyranian et al., 2015).

Conclusions

The "Water Savings Report Questionnaire" demonstrated reliability and validity indicators that make it a useful tool for identifying behaviors related to the environmental management of water use and care. This self-report instrument can help identify behaviors linked to the environmental management of water use and care. In turn, it can support the promotion of new environmentally responsible behaviors and good practices aimed at minimizing environmental impact. From this identification, individuals can gain insights that encourage behavioral changes and the development of habits leading to the sustainable use of water resources. Therefore, it is concluded that the version of the "Water Savings Report Questionnaire" meets sufficient psychometric quality criteria to be utilized in future research aimed at evaluating this construct within the general population. Additionally, it serves as a valuable tool for intervention and decision-making processes aimed at enhancing environmental management and promoting responsible behavior.

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