INDIVIDUAL CONSUMPTION OF WATER: A SYSTEMATIC LITERATURE REVIEW

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Abstract:
Given the challenges posed by climate change and the increasing demand for water, understanding consumer behaviors regarding water usage is crucial to formulate effective conservation strategies for this resource. In this context, a systematic literature review on individual water consumption has been conducted. Eighty-two articles published since 2000 in recognized management science journals were rigorously collected and analyzed. A theoretical model was developed based on the five main themes emerging from the analysis of the selected articles: (1) individual predispositions towards water consumption, (2) the consumer's environment, (3) individual water consumption behaviors, (4) water conservation and efficiency strategies, and (5) influence policies for preserving water resources. This systematic review provides clear and objective conclusions on the current state of knowledge and identifies gaps as avenues for future research. A research agenda on individual water consumption is proposed, integrating managerial implications to suggest how water stakeholders can support consumers in transitioning towards more responsible water usage.

Keywords:
Water consumption; Sobriety; Conservation; Systematic literature review; Research agenda

1. Introduction

In its sixth report, the IPCC (Intergovernmental Panel on Climate Change) highlights the impact of human activities as a cause of climate change and warns of a global temperature rise of 1.5°C potentially occurring by 2030. This urgency necessitates a profound transformation of production and consumption models (Rémy et al., 2024). Among the most pressing sustainability issues, water is at the forefront. Not only has water demand been steadily increasing in recent years (Shahangian et al., 2021), but its quality and availability are also deteriorating, endangering many ecosystems and generating severe tensions among populations. With the global population now exceeding 8 billion, individual water demand constitutes a significant proportion of total water needs (Chen et al., 2023). Currently, household water consumption represents about 15% of global freshwater demand, with notable differences between countries and regions, ranging from 7% in India to 35% in South Africa (Russell and Knoeri, 2020). Thus, it is particularly important to study consumer behaviors regarding water usage and formulate strategies aimed at its preservation. In this context, this article provides a synthesis of research on individual water consumption, proposes a unified theoretical framework, and identifies research avenues. Based on a systematic literature review (SLR), this research has three objectives:

1. Provide a comprehensive account of current knowledge on individual water consumption.
2. Propose a theoretical model of individual water consumption and its determinants.
3. Identify research gaps in this field and develop a research agenda accordingly.

This article is divided into three main sections. Section 2 is dedicated to the methodology, where the use of a systematic literature review is justified, and its process is described. Section 3 presents the findings of this literature review, structuring current knowledge on individual water consumption. This results in a theoretical model based on a categorization of themes addressed in the existing literature. Finally, Section 4 identifies gaps in the current research and proposes a comprehensive research agenda to address these issues.

2. Methodology: A Systematic Literature Review on Water Consumption

To meet the research objectives, we conducted a systematic literature review (SLR). Unlike traditional "narrative" reviews (Pittaway and Cope, 2007), an SLR is based on a rigorous and transparent methodology (Antonova et al., 2021; Safargholi, 2023). It allows researchers to locate, analyze, and report evidence in a way that provides reasonably clear and objective conclusions about what is and what is not known (Denyer and Neely, 2004; Denyer and Tranfield, 2009). Specifically, the steps defined by Rogeon, Michaud-Trevinal, et al. (2022) for conducting a systematic literature review were followed: formulating an article selection protocol, determining an analysis method to identify and analyze research objects, and proposing a conceptualization of the results. The methodology is detailed in Appendix 1. Following this procedure, 82 articles were retained (Appendix 2). The final analysis grid is presented in Appendix 3.

3. Results: Individual Water Consumption in the Literature

The following points detail the five main themes emerging from the analysis of the selected articles. The theoretical model of individual water consumption is presented in Appendix 4. A final subsection presents the quantification work and descriptive analyses.

3.1. Individual Predispositions towards Water Consumption

Individual water consumption and conservation behaviors are largely influenced by various socio-demographic, behavioral, and psychological variables. Socio-demographic variables such as gender, age, education level, and income often play a crucial role in determining water consumption habits. For example, consumers with higher education levels tend to perceive the necessity to preserve the resource more (Amaris et al., 2021; Su et al., 2021), although the impact on actual water conservation behaviors is not unanimous (Costa Freitas et al., 2022). Numerous studies have examined the influence of psychological variables such as environmental concerns (Alvarado Espejo et al., 2021; García-Valiñas et al., 2023) or emotions (Diaz et al., 2020; Peter and Honea, 2012), on water consumption and conservation efforts, frequently using the *Theory of Planned Behavior model* (e.g. Shahangian, Tabesh et Yazdanpanah, 2021 ; Untaru *et al.*, 2016). It is also noted that consumers already engaging in responsible daily behaviors are more likely to participate in water conservation efforts (Dieu-Hang et al., 2017; Dolnicar et al., 2012).

3.2. The Consumer's Environment

The analyzed articles reveal the significant role of the consumer's environment in their water consumption. This environment includes material elements such as the place of residence – contrasting rural and urban areas – (Fan et al., 2020; March et al., 2012), the type of dwelling and its size (Domene and Saurí, 2006; Suárez-Varela, 2020), and the presence of a garden and irrigation system at home (Domene and Saurí, 2006; Wichman et al., 2016). According to Alvarado Espejo *et al.* (2021), homeownership encourages households to adopt more responsible practices to reduce their water consumption. Beyond material elements, the consumer's social environment is also determinant. As Singha *et al.* (2022) point out, the consumer's commitment to water conservation is stronger when another household member is already engaged in such an effort. Close relationships (Chen et al., 2023; Rosenberg Goldstein et al., 2024) as well as social and cultural norms (Lowe et al., 2015; Shahangian et al., 2022) also shape water consumption behaviors. Finally, several studies mention the importance of what we call the "organizational water ecosystem": water quality (Brei and Tadajewski, 2015; Faulkner et al., 2001; Rosenberg Goldstein et al., 2024); the accessibility and reliability of distribution systems (Smith et al., 2023; Vásquez et al., 2009); and water pricing (Brent and Ward, 2019; Casado-Díaz et al., 2020; Lam et al., 2016) are frequently studied to better understand water consumption behaviors with sometimes contradictory observations.

3.3. Individual Water Consumption Behaviors

Most research on individual water consumption has focused on direct water consumption. This direct consumption synthetically includes personal hygiene, maintenance and domestic needs, cooking and food, and irrigation (Kumar et al., 2021; Su et al., 2021). Measuring this direct consumption is essential to understand usage patterns and potential improvements (Kumar et al., 2021; Willis et al., 2011). Some studies have measured direct water consumption using smart meters. Based on these technologies installed in 132 Australian households, Willis *et al.* (2011) initially indicated that the average overall household consumption was 152 liters per person per day. Additionally, they specified that the most significant end-use was the shower (31%), followed by laundry (20%). Tap usage, toilets, and irrigation followed with end-use percentages of 17%, 14%, and 12%, respectively. While the volume of outdoor water consumption varies considerably depending on climatic characteristics, Aina *et al.* (2023) and Gössling (2015) warn about the considerable volumes of water dedicated to irrigation in dry and hot environments. Additionally, few studies have examined indirect and virtual water consumption (e.g. Gössling *et al.*, 2012 ; Sun and Hsu, 2019 ; Sun and Pratt, 2014). This refers to the amount of water used in the production and transport of goods and services consumed by the individual. Sun and Pratt (2014) highlighted the importance of the quantities of water needed for food and fuel production at the individual level.

3.4. Water Conservation and Efficiency Strategies

Considering the sustainability challenges of water resources, numerous studies have focused on adopting water conservation and efficiency strategies. For instance, Amaris *et al.* (2021) explored greywater recycling, which involves reusing water from showers and sinks for toilets or garden irrigation (Roshan and Kumar, 2020; Tsaneva, 2013). The authors suggest that individuals with higher education levels are more inclined to recycle greywater. Another water conservation strategy involves water storage devices. Vásquez *et al.* (2009) note that it is common for Mexican households to privately invest in tanks or reservoirs installed on rooftops to address water quality issues and interruptions in the water supply system. Additionally, installing and using water-saving technologies, such as low-flow showerheads, faucet aerators, and dual-flush toilets, can significantly reduce direct water consumption (Lee and Tansel, 2013; Suárez-Varela, 2020). Although rainwater harvesting systems or greywater reuse generally save more water than water-saving technologies, the latter are often preferred by consumers due to their lower costs and minimal structural changes in the home (Aina et al., 2023). Beyond strategies requiring financial investment, consumers can also adopt water-saving behaviors in their direct water consumption, such as taking shorter showers (Borden et al., 2017; Lam et al., 2016), quickly repairing leaks (Untaru et al., 2016), and avoiding certain activities like car washing or pool filling (Domene and Saurí, 2006). Furthermore, water conservation can extend to indirect and virtual water consumption; this includes favoring products and services that require less water for their production and delivery. For example, adopting a vegetarian diet (Survis and Root, 2017) and avoiding high water footprint products, such as certain textiles and foodstuffs (March et al., 2012; Sun and Hsu, 2019; Willis et al., 2011).

3.5. Influence Policies to Preserve Water Resources

Finally, this systematic literature review highlights several influence policies implemented to encourage the adoption of water-saving and conservation behaviors. We distinguish four processing paths for individuals: Reflective, Semi-reflective, Automatic, and Prescriptive. Reflective policies involve conscious information processing, where behaviors form in light of rational arguments and relevant experiences (Koop et al., 2019). Communication campaigns are regularly implemented based on the premise that the more consumers are informed about water resource issues, the more likely their behaviors will evolve towards greater conservation and efficiency (Borden et al., 2017; Martínez-Espiñeira et al., 2014). However, Chen *et al.* (2023) and Shahangian *et al.* (2022) warn that knowledge transfer is meaningful only when consumers know how to modify their behavior and consider it feasible. Semi-reflective policies rely on simplified information processing through message personalization and/or social conformity. Rahim *et al.* (2021) suggest providing individuals with precise information about their own water consumption to help them identify where water is wasted. This information could be accompanied by advice and concrete examples to suggest ways consumers can reduce their water usage (Jessoe et al., 2021). Beyond their own water consumption, Céspedes Restrepo and Morales-Pinzón (2020) exposed households to their neighbors' water consumption during an experiment. The researchers highlight that comparative information stimulates the adoption of water-saving strategies by allowing individuals to compare their water usage with that of other consumers (Haeffner et al., 2023; Han and Hyun, 2018). Automatic policies aim to encourage water-saving behaviors more subtly and intuitively (Koop et al., 2019). For example, *nudges* modify choice architecture to make the "better" option more convenient or prominent (Brick et al., 2023). Discreet reminders or subtle environmental changes, such as strategically placed messages encouraging faucet closure (Borden et al., 2017) or the installation of water-saving devices (Aina et al., 2023; García-Valiñas et al., 2023; Lam et al., 2016), facilitate more sustainable choices. Finally, although voluntary restriction policies (reflective, semi-reflective, and automatic) show promising results, Wichman, Taylor et Von Haefen (2016) demonstrate that individual water consumption decreases more significantly

following prescriptive policies. These include policy measures such as increasing water price (Gabarda-Mallorquí et al., 2022; Lam et al., 2016; Suárez-Varela, 2020), water rationing programs (Suárez-Varela, 2020), or outdoor water use restrictions or bans (Survis and Root, 2012, 2017). Aiming to impose direct constraints on consumers to reduce their water consumption, these policy measures are typically taken during periods of drought or high-water stress (Lam et al., 2016; Survis and Root, 2012).

3.6. Quantification and Descriptive Analyses

The analysis reveals that the annual number of articles on individual water consumption has not been constant over the considered period. The number of publications on this topic has grown significantly: the past five years have produced more than half of all selected articles (Appendix 5). Most of these articles are based on quantitative data collection (51/82), with a predominance of studies using questionnaires or conducting experiments. Few studies use only qualitative data (3/82), often in addition to quantitative data (3/82). Although primary data collection is the most common approach, a considerable number of articles rely on existing data (actual or meta-analysis) to develop econometric models (20/82). It is also noteworthy that during the examined period, the *Journal of Environmental Management* published more than half of the selected articles (Appendix 2). Appendix 6 shows the classification of the 82 articles based on their contribution to at least one of the major themes associated with individual water consumption. While the majority of articles contribute to several major themes, these themes are not addressed in the same proportions in the literature: socio-demographic variables and psychological variables represent respectively 49% and 56% of the total number of selected articles. The consumer's environment is also well documented. Conversely, certain influence policies, such as the stimulation of emotions (1/82) and the personalization of information (7/82), are under-studied. Knowledge about indirect water consumption and its representations in the consumers' minds is also limited (5/82).

4. Discussion

4.1. Development of a Theoretical Model of Individual Water Consumption

Based on a rigorous methodology in collecting and analyzing selected articles, this research provides an overview of the state of knowledge on individual water consumption. Each selected article underwent thematic content analysis, which identified and grouped various themes to create a theoretical model. Five major themes are identified: (1) individual predispositions to water consumption, (2) the consumer's environment, (3) individual water consumption behaviors, (4) water conservation and efficiency strategies, and (5) influence policies to preserve water resources. Theoretically, the developed model presents several advantages. It is, first and foremost, a pioneering proposal for an integrative theoretical model of individual water consumption. Moreover, unlike other models or conceptualizations, such as that of Antonova *et al.* (2021), this model adopts a holistic approach that goes beyond a specific activity or sector (e.g., hospitality). Finally, adopting the consumer's unique perspective shifts from a multipartite analysis, centered on interdependence effects between actors, to an idiosyncratic perspective, inviting the formulation of reasonable strategies for the consumer to fully participate in water resource preservation.

4.2. Proposal for a Research Agenda: Priority Research Areas and Directions

Our literature analysis also reveals themes with more limited or non-existent current knowledge. For instance, water representations are largely unexplored. Similarly, the articulation of various water-saving and conservation practices in consumers' daily lives remains under-studied. While the role of knowledge in adopting responsible behaviors has been documented, the process of acquiring and integrating water-related knowledge is still to be studied. Finally, although

research on nudges and emotional stimulation is still rare, their potential to promote water-saving and conservation is high. Consequently, a research agenda proposes research directions articulated around four major axes (Appendix 7): (1) water representations, (2) consumer knowledge acquisition, (3) personalizing information and stimulating emotions policies, and (4) water conservation and efficiency practices. Moreover, making consumers evolve towards greater water conservation and efficiency requires social, political, economic, and organizational changes (Brick et al., 2023; Cauberghe et al., 2021; Katz et al., 2016). Hence, these research directions entail managerial implications, suggesting how various water stakeholders can support consumers in their transition towards more responsible water use.

4.3. Managerial and societal recommendations

Based on the five main themes emerging from this systematic review, the following recommendations are proposed to guide public policies in promoting sustainable water consumption: (1) Public policies should design targeted campaigns, depending on socio-demographic factors, that address the psychological factors influencing water consumption. For instance, messaging could emphasize environmental values, tailored to specific audiences such as younger consumers or high-income households, to strengthen their predispositions toward conservation. (2) Policymakers should invest in infrastructure that supports water-efficient practices. This includes upgrading water distribution systems to reduce leakage, promoting water recycling technologies, and offering subsidies for installing home irrigation systems. (3) Public policies can enhance consumer awareness by introducing smart water meters that provide real-time consumption data. This technology can empower individuals to identify wasteful practices, such as excessive irrigation or long showers, and adopt more sustainable behaviors. (4) Public policies should encourage the adoption of water-saving technologies, such as low-flow showerheads or faucet aerators, by lowering perceived barriers, such as cost and installation complexity. (5) Public policies should implement multi-layered policies combining reflective, semi-reflective, and automatic interventions. These could range from awareness campaigns and personalized feedback to nudges like social comparison tools that encourage competition in conservation.

4.4. Limitations

Despite its contributions, this research has several limitations.

First, we did not consider all disciplines in our article selection process. Additionally, our literature review did not include 4-ranked journals, conference proceedings, or books. Although this is justified on scientific and subject focus criteria (Raddats *et al.*, 2019), it remains a limitation.

Second, it is essential to question the micro-individual level of analysis of this research. Although adopting the exclusive consumer point of view is essential to move towards water sobriety and conservation, this individual consumption represents only a fraction of total water use. Consequently, it would be beneficial for future research to (1) adopt another scale of observation and (2) integrate the analysis of social mechanisms and phenomena between the different water stakeholders (e.g. public authorities, associations, companies, etc.) to offer a more complete and holistic vision of the challenges related to water preservation.

Third, another limitation of this research is the difficulty of reconciling the very different contextual realities between developed countries, where access to water is generally secure and stable, and developing countries or areas where water resources are very limited. Water consumption behaviors are strongly influenced by local conditions, such as infrastructure, resource availability, and government policies. Findings from studies conducted in water-abundant contexts (e.g., Warner et al., 2022) may not be directly applicable to water-scarce regions (e.g., Gulyani, Talukdar, & Mukami Kariuki, 2005; Koehler et al., 2021; Reddy, 2002), and vice versa. Therefore, this theoretical work needs to be complemented by field research.

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Appendix 1. Detailed Methodology

Article Selection Process

A keyword search was conducted using the following terms: "water consumption," "water use," "water representation," "water perception," and "water conservation." The search extended to the titles, abstracts, and keywords of the articles. Four inclusion-exclusion criteria were applied:

- To ensure that the systematic literature review (SLR) is both contemporary and comprehensive, only articles published from January 2000 onwards were selected. A significant increase in water-related publications is observable during this period (Baudoin and Arenas, 2020);
- Articles were selected from journals ranked 3 or higher by the FNEGE to focus on the most recognized works;
- With the aim of identifying the maximum number of contributions to knowledge on individual water consumption, articles were selected from the 26 journals in the following FNEGE disciplines: "Marketing"; "Reg&Env"; "Sector"; "General Management"; "Psychology"; "Sociology." This resulted in an initial dataset of 395 articles;

Articles meeting these three search criteria were then fully read. Subsequently, articles were retained (or excluded) based on whether they provided (or did not provide) knowledge on individual water consumption. At the end of this process, 82 articles were retained (Appendix 2).

Article Analysis Process

The selected articles were then subjected to thematic content analysis (Bardin, 2017).

This analysis was conducted inductively without a predefined framework (Miles et al., 2014). The analysis is termed "thematic" because its unit of analysis is the theme, which defines the content of a subject (Point and Fourboul, 2006). Initially, words, lines, phrases, or paragraphs in these articles were coded and assigned to one or more ideas (themes). These themes were then grouped into higher-level themes with a "conceptualizing" role that goes beyond description (role of initial themes) to constitute a progressive categorization. Through iterative processes aimed at confronting the emerging thematic analysis with the 82 selected articles and articulating the articles among themselves, a final multi-level framework (first-level themes, second-level themes) was stabilized (Appendix 3).

In a second phase, this final framework was used to recode and analyze the entire set of selected articles. Finally, in a third phase, a quantification process was implemented through thematic recurrence counting (Bryman et al., 2022). Although sometimes criticized (Gavard-Perret et al., 2018), the quantitative dimension of thematic content analysis is preferred in SLRs (e.g. Antonova, Ruiz-Rosa et Mendoza-Jiménez, 2021 ; Rogeon, Michaud-Trévinal et Collin-Lachaud, 2022) as it highlights the occurrences of a theme in the dataset, reflecting the predominance of certain themes addressed in the literature.

Appendix 2. selected articles

Review	Rank	Field	Authors	Year	Title
European journal of marketing	2	Marketing	(Brei and Tadajewski, 2015)	2015	Crafting the market for bottled water: a social praxeology approach
Journal of business research	2	Marketing	Gonzalez-Perez *et al.*	2023	Analyzing the real size of the tourism industry on the basis of an assessment of water consumption patterns
			Hu, Krishen et Barnes	2023	Through narratives we learn: Exploring knowledge-building as a marketing strategy for prosocial water reuse
Journal of marketing management	3	Marketing	Lowe, Lynch et Lowe	2015	Reducing household water consumption: a social marketing approach
Journal of public policy and marketing	2	Marketing	Peter et Honea	2012	Targeting Social Messages with Emotions of Change: The Call for Optimism
International journal of advertising	3	Marketing	Maduku	2021	Water conservation campaigns in an emerging economy: how effective are they?
Regional studies	2	Reg&Env	March, Perarnau et Saurí	2010	Exploring the Links between Immigration, Ageing and Domestic Water Consumption: The Case of the Metropolitan Area of Barcelona
Urban studies	2	Reg&Env	Domene et Saurí	2006	Urbanisation and Water Consumption: Influencing Factors in the Metropolitan Region of Barcelona
			Gulyani, Talukdar et Mukami Kariuki	2005	Universal (Non)service? Water Markets, Household Demand and the Poor in Urban Kenya
Tourism management	1	Sector	Gabarda-Mallorquí *et al.*	2022	How guest profile and tourist segment explain acceptance of economic-based water-saving measures. A mediterranean destination case study
			Gössling	2015	New performance indicators for water management in tourism
			Gössling *et al.*	2012	Tourism and water use: Supply, demand, and security. An international review
Journal of sustainable tourism	3	Sector	Borden, Coles et Shaw	2017	Social marketing, sustainable tourism, and small/medium size tourism enterprises: challenges and opportunities for changing guest behaviour
			Casado-Díaz *et al.*	2022	Tourists' water conservation behavior in hotels: the role of gender
			Garcia *et al.*	2023	Zero tourism due to COVID-19: an opportunity to assess water consumption associated to tourism

			Han et Hyun	2018	Eliciting customer green decisions related to water saving at hotels: impact of customer characteristics
			Hitchings, Browne et Jack	2018	Should there be more showers at the summer music festival? Studying the contextual dependence of resource consuming conventions and lessons for sustainable tourism
			Hu *et al.*	2019	Sustainable water demand management in the hotel sector: a policy network analysis of Singapore
			Liu, Browne et Iossifova	2022	Creating water demand: bathing practice performances in a Chinese hot spring tourist town
			Olmsted *et al.*	2020	Leveraging support for conservation from ecotourists: can relational values play a role?
			Warren, Becken et Coghlan	2017	Using persuasive communication to co-create behavioural change – engaging with guests to save resources at tourist accommodation facilities
Journal of travel & tourism marketing	3	Sector	Casado-Díaz *et al.*	2020	Predictors of willingness to pay a price premium for hotels' water-saving initiatives
Energy policy	2	Sector	Köhler	2017	Individual metering and debiting (IMD) in Sweden: A qualitative long-term follow-up study of householders' water-use routines
Journal of travel research	2	Sector	Sun et Hsu	2019	The Decomposition Analysis of Tourism Water Footprint in Taiwan: Revealing Decision-Relevant Information
			Sun et Pratt	2014	The Economic, Carbon Emission, and Water Impacts of Chinese Visitors to Taiwan: Eco-efficiency and Impact Evaluation
Current issues in tourism	3	Sector	Gabarda-Mallorquí *et al.*	2021	Are hotel stay characteristics influencing guests' environmental behaviour? Predicting water conservation habits
Food policy	3	Sector	White et Brady	2014	Can consumers' willingness to pay incentivize adoption of environmental impact reducing technologies in meat animal production?
International journal of hospitality management	3	Sector	Han *et al.*	2018	Water conservation and waste reduction management for increasing guest loyalty and green hotel practices
			Untaru *et al.*	2016	Predictors of individuals' intention to conserve water in a lodging context: the application of an extended Theory of Reasoned Action
Journal of economic psychology	3	Psychologie	Bhanot	2017	Rank and response: A field experiment on peer information and water use behavior
Development and change	3	Sociologie	Reddy	2002	Quenching the Thirst: The Cost of Water in Fragile Environments
Journal of development studies	3	Sociologie	Grover et Lucinda	2021	An Evaluation of the Policy Response to Drought in the City of São Paulo, Brazil: An Election Cycle Interpretation of Effectiveness

			Tsaneva	2013	The Effect of Risk Preferences on Household Use of Water Treatment
Journal of environnemental management	2	Sociologie	Aina, Thiam et Dinar	2023	Economics of household preferences for water-saving technologies in urban South Africa
			Alvarado Espejo *et al.*	2021	Water saving practices conditioned by socioeconomic factors: A case study of Ecuadorian households
			Amaris *et al.*	2021	Capturing and analysing heterogeneity in residential greywater reuse preferences using a latent class model
			Brent et Ward	2020	Price perceptions in water demand
			Brick, De Martino et Visser	2023	Behavioural nudges for water conservation in unequal settings: Experimental evidence from Cape Town
			Cauberghe, Vazquez-Casaubon et Van De Sompel	2021	Perceptions of water as commodity or uniqueness? The role of water value, scarcity concern and moral obligation on conservation behavior
			Céspedes Restrepo et Morales-Pinzón	2020	Effects of feedback information on the household consumption of water and electricity: A case study in Colombia
			Chen *et al.*	2023	A study on urban household water consumption behavior under drought conditions
			Costa Freitas *et al.*	2022	A composite indicator to measure sustainable water use in Portugal: A compromise programming approach
			Deyà Tortella et Tirado	2011	Hotel water consumption at a seasonal mass tourist destination. The case of the island of Mallorca
			Diaz, Odera et Warner	2020	Delving deeper: Exploring the influence of psycho-social wellness on water conservation behavior
			Dieu-Hang *et al.*	2017	Household adoption of energy and water-efficient appliances: An analysis of attitudes, labelling and complementary green behaviours in selected OECD countries
			Dolnicar, Hurlimann et Grün	2012	Water conservation behavior in Australia
			Du *et al.*	2021	Evaluating the effectiveness of the water-saving society construction in China: A quasi-natural experiment

			Fan, Chen et Zhang	2020	Inequality of household energy and water consumption in China: An input-output analysis
			Faulkner *et al.*	2001	Residents' perceptions of water quality improvements following remediation work in the Pymme's Brook catchment, north London, UK
			Faust, Abraham et DeLaurentis	2013	Assessment of stakeholder perceptions in water infrastructure projects using system-of-systems and binary probit analyses: A case study
			Fielding *et al.*	2013	An experimental test of voluntary strategies to promote urban water demand management
			García et Brown	2009	Assessing water use and quality through youth participatory research in a rural Andean watershed
			García-Valiñas, Arbués et Balado-Naves	2023	Assessing environmental profiles: An analysis of water consumption and waste recycling habits
			Haeffner, Jackson-Smith et Barnett	2023	Categorizing relative water use perception bias using household surveys and monthly water bills
			Jessoe *et al.*	2021	Residential water conservation during drought: Experimental evidence from three behavioral interventions
			Jorgensen *et al.*	2013	Some difficulties and inconsistencies when using habit strength and reasoned action variables in models of metered household water conservation
			Jorgensen, Graymore et O'Toole	2009	Household water use behavior: An integrated model
			(Katz *et al.*	2016	Evaluating the effectiveness of a water conservation campaign: Combining experimental and field methods
			Koop, Van Dorssen et Brouwer	2019	Enhancing domestic water conservation behaviour: A review of empirical studies on influencing policies
			Kumar *et al.*	2021	Indoor water end-use pattern and its prospective determinants in the twin cities of Gujarat, India: Enabling targeted urban water management strategies
			Lam *et al.*	2016	Comparison of water-energy trajectories of two major regions experiencing water shortage

			Lee et Tansel	2013	Water conservation quantities vs customer opinion and satisfaction with water efficient appliances in Miami, Florida
			Levêque et Burns	2017	A Structural Equation Modeling approach to water quality perceptions
			Martínez-Espiñeira, García-Valiñas et Nauges	2014	Households' pro-environmental habits and investments in water and energy consumption: Determinants and relationships
			Pan *et al.*	2022	Multiple accounting and driving factors of water resources use: A case study of Shanghai
			Pawsey, Nayeem et Huang	2018	Use of facebook to engage water customers: A comprehensive study of current U.K. and Australian practices and trends
			Rahim *et al.*	2021	Advanced household profiling using digital water meters
			Rosenberg Goldstein *et al.*	2024	Evaluating the impact of water reuse educational videos on water reuse perceptions using EEG/event related potential
			Roshan et Kumar	2020	Water end-use estimation can support the urban water crisis management: A critical review
			Shahangian *et al.*	2022	Promoting the adoption of residential water conservation behaviors as a preventive policy to sustainable urban water management
			Shahangian, Tabesh et Yazdanpanah	2021	How can socio-psychological factors be related to water-efficiency intention and behaviors among Iranian residential water consumers?
			Singha *et al.*	2022	Water conservation behavior: Exploring the role of social, psychological, and behavioral determinants
			Su *et al.*	2021	What factors affect the water saving behaviors of farmers in the Loess Hilly Region of China?
			Suárez-Varela	2020	Modeling residential water demand: An approach based on household demand systems
			Survis et Root	2017	The rain-watered lawn: Informing effective lawn watering behavior
			Survis et Root	2012	Evaluating the effectiveness of water restrictions: A case study from Southeast Florida
			Vásquez *et al.*	2009	Willingness to pay for safe drinking water: Evidence from Parral, Mexico
			Warner *et al.*	2022	Evaluating connections between personal well-being and adoption of landscape best management practices: An audience segmentation study

			Wichman, Taylor et Von Haefen	2016	Conservation policies: Who responds to price and who responds to prescription?
			Willis *et al.*	2011	Quantifying the influence of environmental and water conservation attitudes on household end use water consumption
World development	2	Sociologie	Brown et Pena	2016	Water Meters and Monthly Bills Meet Rural Brazilian Communities: Sociological Perspectives on Technical Objects for Water Management
			Koehler *et al.*	2021	Institutional pluralism and water user behavior in rural Africa
			Nauges et Whittington	2017	Evaluating the Performance of Alternative Municipal Water Tariff Designs: Quantifying the Tradeoffs between Equity, Economic Efficiency, and Cost Recovery
			Smith, Atwii Ongom et Davis	2023	Does professionalizing maintenance unlock demand for more reliable water supply? Experimental evidence from rural Uganda

Appendix 3. Final Analytical Framework

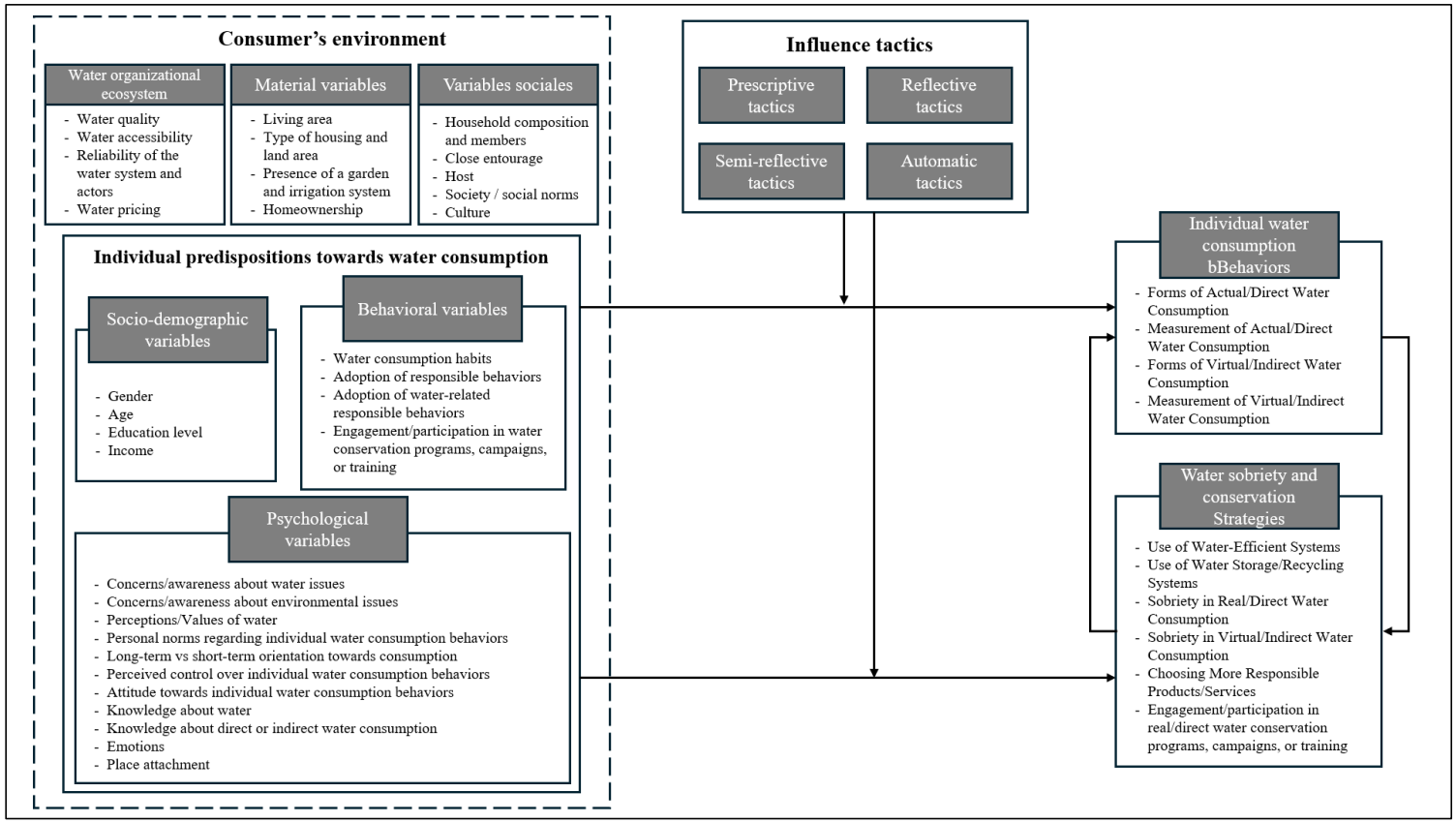
First-Level Theme	Second-Level Theme	Third-Level Theme
Individual Predispositions to Water Consumption	Socio-demographic Variables	Gender
		Age
		Education level
		Income
	Behavioral Variables	Water consumption habits
		Adoption of responsible behaviors
		Adoption of water-related responsible behaviors
		Engagement/participation in water conservation programs, campaigns, or training
	Psychological Variables	Concerns/awareness about water issues
		Concerns/awareness about environmental issues
		Perceptions/Values of water
		Personal norms (sense of responsibility, moral values) regarding individual water consumption behaviors
		Long-term vs short-term orientation towards consumption
		Self-efficacy / Perceived control over individual water consumption behaviors
		Attitude towards individual water consumption behaviors
		Knowledge about water
		Knowledge about direct or indirect water consumption
		Emotions
		Place attachment
Consumer Environment	Water Organizational Ecosystem	Water quality
		Water accessibility
		Reliability of the water system and actors
		Water pricing
	Material Variables	Living area: rural vs urban
		Type of housing and land area

		Presence of a garden and irrigation system at home
		Homeownership
	Social Variables	Household composition and members
		Close entourage
		Host
		Society / social norms
		Culture
Influence Policies for Water Conservation	Prescriptive Policies	Reduction/increase in water pricing
		Restrictions/bans on water use for gardens and lawns
		Restrictions/bans on water use for washing vehicles or other materials (driveways, buildings, etc.)
		Restrictions/bans on water use for filling pools
		Water rationing programs
	Reflective Policies	Knowledge transfer
		Increasing self-efficacy
	Semi-reflective Policies	Personalization of services/messages
		Social norms
	Automatic Policies	Emotion
		Nudge, framing, and incentives
Individual Water Consumption Behaviors	Forms of Actual/Direct Water Consumption	Irrigation/watering
		Toilet
		Bathtub
		Shower
		Dishwasher
		Washing machine
		Faucet/drinking
	Measurement of Actual/Direct Water Consumption	
	Forms of Virtual/Indirect Water Consumption	Food
		Energy and transportation
		Housing

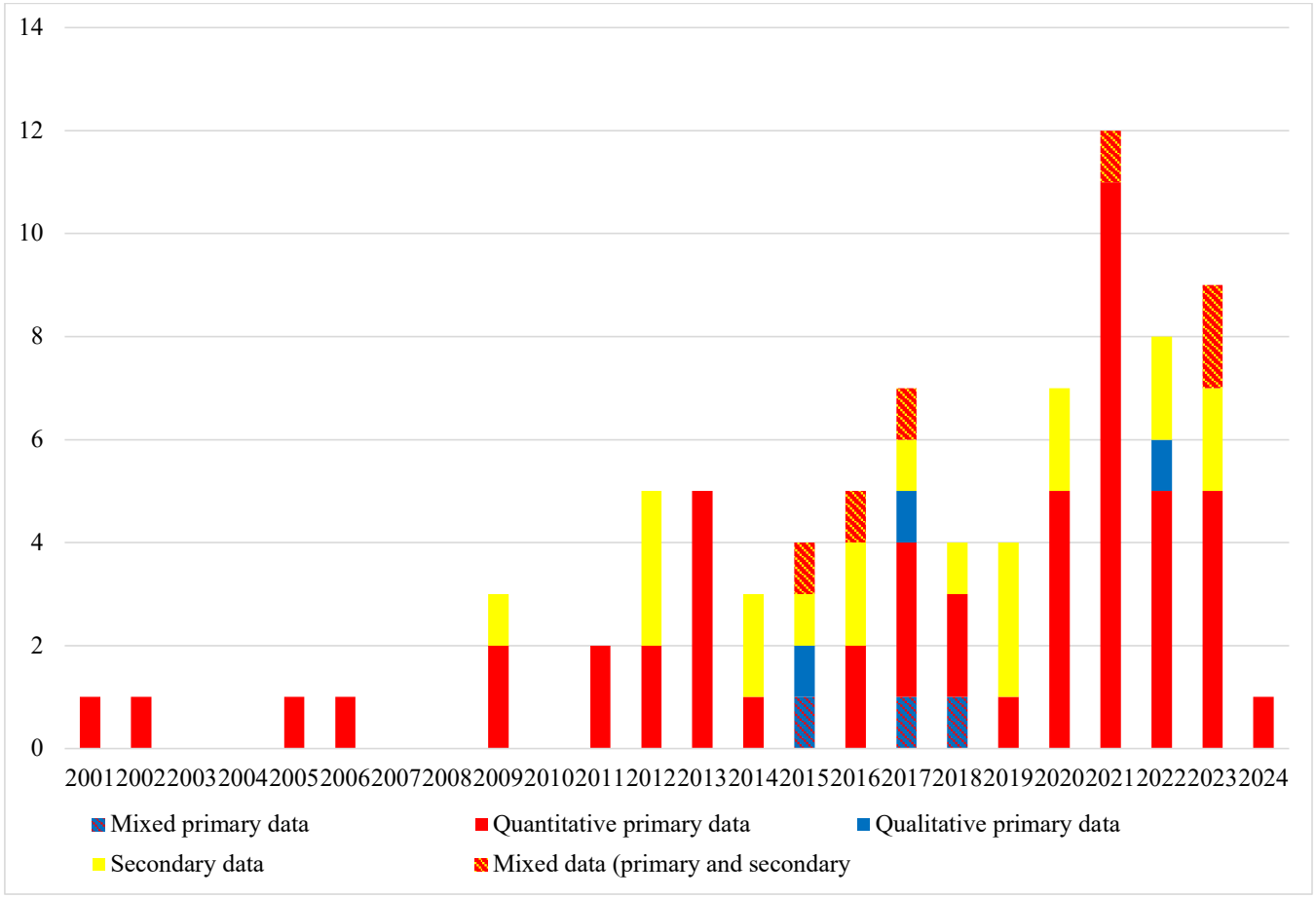
		Entertainment
	Measurement of Virtual/Indirect Water Consumption	
Water Conservation and Efficiency Strategies	Water Conservation (unspecified method)	
	Use of Water-Efficient Systems	
	Use of Water Storage/Recycling Systems	
	Sobriety in Real/Direct Water Consumption	
	Sobriety in Virtual/Indirect Water Consumption	
	Choosing More Responsible Products/Services	
	Engagement/participation in real/direct water conservation programs, campaigns, or training	

Appendix 4. Theoretical model of individual water consumption

Commented [KV1]: Social variables



Appendix 5. Number of articles on individual water consumption per year



Appendix 6. The contribution of articles to individual water consumption

First-Level Theme	Second-Level Theme	Number of contributing to the theme				Most cited article	
		Total nb of articles	Articles with qualitative primary data	Articles with qualitative primary data	Articles with secondary data	Authors (date)	Nb of citations [1]
Individual Predispositions to Water Consumption	Socio-demographic Variables	40	34	3	9	Jorgensen et al. (2009)	578
	Behavioral Variables	29	25	4	7	Jorgensen et al. (2009)	578
	Psychological Variables	46	40	5	8	Jorgensen et al. (2009)	578
Consumer Environment	Water Organizational Ecosystem	28	22	4	7	Jorgensen et al. (2009)	578
	Material Variables	31	22	3	11	Gössling et al. (2012)	897
	Social Variables	34	30	6	6	Jorgensen et al. (2009)	578
Influence Policies for Water Conservation	Prescriptive Policies	14	9	0	8	Jorgensen et al. (2009)	578
	Reflective Policies	33	25	4	10	Jorgensen et al. (2009)	578
	Semi-reflective Policies	9	8	1	2	Fielding et al. (2013)	326
	Automatic Policies	16	12	3	5	Koop et al. (2019)	187
Individual Water Consumption Behaviors	Forms of Actual/Direct Water Consumption	22	14	3	10	Gössling et al. (2012)	897
	Measurement of Actual/Direct Water Consumption	29	17	1	13	Gössling et al. (2012)	897
	Forms of Virtual/Indirect Water Consumption	5	0	1	4	Gössling et al. (2012)	897

[1] Number of citation on Google Scholar as of 01/07/2024

	Measurement of Virtual/Indirect Water Consumption	6	1	0	5	Gössling (2015)	328
Water Conservation and Efficiency Strategies	Water Conservation (unspecified method)	18	13	1	3	Jorgensen et al. (2009)	578
	Use of Water-Efficient Systems	10	9	1	1	Martínez-Espiñeira et al. (2014)	113
	Use of Water Storage/Recycling Systems	14	12	1	3	Vásquez et al. (2009)	254
	Sobriety in Real/Direct Water Consumption	22	18	3	8	Fielding et al. (2013)	326
	Sobriety in Virtual/Indirect Water Consumption	3	2	0	1	Domene et Saurí (2006)	530
	Choosing More Responsible Products/Services	2	2	0	0	Deyà Tortella et Tirado (2011)	317
	Engagement/participation in real/direct water conservation programs, campaigns, or training	2	2	0	0	Han et Hyun (2018)	71

Appendix 7. Research Axes and Pathways in Consumer Studies Perspective and Their Managerial Implications

Research axis *Research objectives*	Examples of research paths	Examples of implications for different water stakeholders
Axis 1. Representations of water *Objective 1.1. Understanding representations of water*	- What imaginaries do consumers associate with water consumption? - How do consumers conceptualize water as a "good"? Through their water consumption experiences? - What do "consuming less" and "consuming better" mean regarding water? Are "less" and "better" associated with private, hedonistic, or civic experiences? Where does water overconsumption begin in relation to a sufficient quantity, from the consumer's perspective? - What are consumer perceptions regarding the water ecosystem (quality, accessibility, system reliability, stakeholders)? - Do consumers perceive their indirect/virtual water consumption? How do they represent this water consumption?	- Using narratives and visuals that resonate with consumer imaginaries to promote water sobriety and conservation initiatives. - Developing educational campaigns (e.g., water murals) to promote a holistic understanding of water as a common good and rare natural resource. - Designing advertising narratives that nurture desirable imaginations of water sobriety, emphasizing rewarding aspects and countering an image of austerity. - Providing resources and training to help consumers consume water better and less without feeling deprived. - Promoting experiential learning in schools through field visits (e.g., treatment plants, hydraulic networks, conservation workshops) involving water stakeholders (e.g., distributors, government authorities, farmers). - Encouraging consumer participation in local water management initiatives to increase their understanding and knowledge of the ecosystem. - Developing interactive tools (applications, online calculators) that allow consumers to visualize their indirect/virtual water consumption and identify ways to reduce it.

		- Introducing labels and certifications for water-efficient products and services to assist consumers in making more informed and responsible choices.
Objective 1.2. Identifying variables and policies influencing representations of water	- How do water representations vary among individuals? In different consumption situations? How do these representations converge or diverge?	- Establishing market segmentation based on variations in water representations.
	- How do consumers categorize their water needs? Which do they consider essential vs. superfluous? Does this dichotomy encompass egocentric, altruistic, and biospheric concerns?	- Developing online tools (e.g., mobile applications) for consumers to assess their water consumption and recognize essential vs. superfluous consumption patterns.
	- How do water shortages and restriction policies (voluntary and/or involuntary) influence water representations? What role do the media play in this influence?	- Developing scenarios of water shortages and usage restrictions illustrating concrete situations to identify different ways water will be perceived and used. - Using positive stories and successful examples to demonstrate how restriction policies can lead to beneficial water resource preservation for all.
	- How does water consumption present social fractures?	- Integrating messages about equity and social justice into awareness campaigns to draw attention to social fractures related to water consumption.
Axis 2. Consumer knowledge acquisition		
Objective 2.1. Defining the process of water knowledge acquisition and integration	- How do consumers acquire knowledge about water and its consumption? Through which sources? How do they evaluate information and its source?	- Training water stakeholders (e.g., distributors, government authorities, consumer associations) to communicate information clearly, convincingly, and tailored to the target audience.
	- Does psychological distance play a role in consumer water knowledge acquisition?	- Introducing certifications to help consumers discern reliable sources of water resource information and increase message credibility.
	- Which individual (socio-demographic, psychological, behavioral) and contextual variables	- Adapting water resource awareness campaigns and communication channels according to consumer

	are involved in the consumer's water knowledge acquisition process? - At what rate do consumers acquire knowledge about water and its consumption? Can key "stages" in consumer water knowledge acquisition be defined? Key "experiences"?	segments (e.g., age, gender, geographical location, income level). - Creating progressive educational pathways in educational institutions with identified key stages to increase young consumers' water knowledge. - Promoting learning about water sobriety and conservation through awareness activities (e.g., visits to watercourse developments, agroecological gardening workshops, virtual simulations, water murals, collaborative card games).
Objective 2.2. Identifying variables and policies influencing water knowledge acquisition	- How does the recurrence of sobriety messages in society increase awareness of sustainability issues regarding the environment? Specifically concerning water? - How does stimulating mental imagery associated with water increase consumer knowledge? Encourage water sobriety and conservation efforts? - How can a sobriety/conservation water approach foster questioning and ultimately consumer knowledge acquisition? - How do educational programs foster consumer water knowledge acquisition? In what form(s)? In what learning context(s)? By whom? For which population? - How can sensory-stimulating activities contribute to awareness of water conservation issues?	- Developing continuous water sobriety awareness programs reinforced at key water consumption times (e.g., before drought-prone periods). - Determining which types of visuals, inspiring narratives, and immersive activities capture consumers' attention, convey knowledge, and encourage water sobriety and conservation efforts. - Creating platforms/spaces where consumers can share their experiences of water sobriety/conservation, ask questions, and learn from others. - Develop third-party or ephemeral places to encourage consumers to experiment with different water sobriety/conservation methods. - Determining which educational formats (e.g., workshops, visits and consultancy, educational games, theater) and learning contexts promote water resource knowledge acquisition. - Promoting water conservation by stimulating the senses (e.g., applying graphic codes from water sports activities and seaside resorts).

Objective 2.3. Studying the influence of knowledge on water consumption and adoption of sobriety/conservation practices	- How do consumers respond to different styles of persuasive communication (emotional, factual, narrative) regarding water? Which messenger is the most credible for promoting water sobriety and conservation? Which communication channel? - How and to what extent does consumer knowledge acquisition about water influence their consumption behaviors? Their water sobriety and conservation efforts?	- Using sensory marketing in physical and virtual spaces (e.g., staging dedicated environmental spaces) to engage consumers in conservation efforts. - Testing different communication styles (emotional, factual, narrative), messengers, and communication channels to identify the most effective approach for promoting water sobriety/conservation.
Axis 3. Automatic nudges and emotional stimulation Policies		
Objective 3.1. Investigating the development and effectiveness of automatic policies encouraging sobriety/conservation practices	- Which emotional valence (positive vs. negative) is most effective in encouraging water sobriety/conservation? Should guilt, anger, fear, or joy be prioritized in communication? - How do personal stories or testimonies of individuals stimulate consumer emotions? How do they influence the adoption of water sobriety/conservation practices? - How do awareness campaigns using humor and emotional lightness influence water consumption behaviors? What role does psychological distance play? - Which formats (text, image, podcast, short video, reportage) and frequencies of emotional stimuli produce the best results on water consumption?	- Determining which positive (e.g., joy, pride) and/or negative (e.g., guilt, anger, fear) emotions are most compelling to stimulate for the adoption of water sobriety/conservation practices. - Organizing community events or designing platforms where consumers can share their experiences of water sobriety/conservation, ask questions, and learn from others. - Creating videos, memes, and humorous social media posts that address water consumption in a light and engaging manner. - Testing different formats through pilot campaigns to measure emotional impact and consumer engagement in water sobriety/conservation practices.

	- Which type of channel (digital vs traditional) is most suitable and effective for water consumers? What specific types of digital channel (notifications, alerts, reminders) and how often? - What degree of information personalization sent to water consumers is the most effective? In terms of form of consumption? Frequency? Volume? Any advice and tips offered to reduce consumption?	- Designing test message campaigns for digital channels (mobile applications, websites, social media) and traditional channels (posters, flyers, brochures) and observing changes in consumer behavior after implementing messages.
	- To what extent does integrating rewards or gamification enhance the adoption of water-efficient practices?	- Encouraging water providers to develop an application or online platform that includes challenges, badges, rankings, and rewards to incentivize users to save water.
	- What is the effect of transparency and visibility of own water consumption on the adoption of sobriety behaviors? To what extent are they accepted?	- Inviting water providers to create an application or online platform where consumers can view their water consumption and individual (or collective) progress in water sobriety in real time.
Objective 3.2. Identifying consumer dispositions moderating the effectiveness of automatic policies	- Which socio-demographic variables (gender, age, income, education, location, etc.) influence the receptivity to emotional stimuli aimed at reducing water consumption?	- Designing pilot campaigns targeting different demographic segments to assess the impact of emotional appeals on water sobriety/conservation behaviors.
	- How do environmental concerns affect the response to emotional stimuli aimed at reducing water consumption?	- Developing communication campaigns highlighting the positive (vs negative) environmental impacts of reducing (vs increasing) water consumption, utilizing emotions such as pride, joy, and hope (guilt, anger, fear).
	- What is the influence of past experiences with water sobriety/conservation on receptivity to emotional stimuli?	- Developing and adjusting the tone of inspiring testimonials and narratives from consumers who have successfully reduced their water consumption, based on the target audience and their past experiences with water sobriety/conservation.

	- How does attachment to a place moderate the effectiveness of emotional stimuli aimed at reducing water consumption?	- Designing campaigns where messages emphasize local water resource preservation for consumers strongly attached to their locality. - Integrating stories and testimonials from local residents showing how water conservation has benefited their community and immediate environment.
	- Which socio-demographic variables (gender, age, income, education, location, etc.) influence the acceptance and effectiveness of personalized messages aimed at reducing water consumption? - How do environmental concerns affect the response to personalized messages aimed at reducing water consumption?	- Designing test campaigns to compare the impact of nudges on different socio-demographic segments.
	- What is the influence of past experiences with water sobriety/conservation on the acceptance and effectiveness of messages ?	- Developing and adapting messages based on the target audience and their past experiences with water sobriety/conservation.
Axis 4. Water sobriety and conservation practices *Objective 4.1. Understanding lived experiences and emotions associated with sobriety/conservation practices*	- What benefits do consumers perceive from adopting water sobriety and/or conservation practices?	- Rewarding and stimulating individual change by demonstrating the individual and collective impact of water sobriety/conservation.
	- How do habits, values, material, social, or water ecosystem-related constraints hinder water sobriety/conservation efforts?	- Addressing financial, material, social, or water ecosystem-related barriers preventing consumers from adopting water-efficient behaviors (e.g., proposing subsidies for installing water-efficient equipment).

		- Investing in the development of collaborative programs within local or cultural communities promoting water-efficient behaviors.
	- What positive and negative emotions are associated with water sobriety/conservation practices?	- Developing awareness campaigns that highlight the positive emotions associated with personally contributing to water resource preservation, and/or highlighting the negative emotions associated with lack of change.
	- How does the recurrence of sobriety messages in society reshape water consumption behaviors?	- Developing ongoing water sobriety awareness programs, reinforced at key moments of water consumption (e.g., before drought-prone periods).
	- What effect does guilt and eco-anxiety have on attitudes and effective actions towards water sobriety and conservation?	
	- How do consumers experiencing involuntary water sobriety perceive it? How can such situations generate hedonic benefits? What knowledge and capabilities do they have or need?	- Implementing specific support programs for vulnerable communities and/or geographic areas to ensure equitable access to water.
Objective 4.2. Exploring adaptations of water sobriety/conservation practices	- What posture (active vs reactive) do consumers adopt towards their water sobriety and conservation efforts?	- Implementing reward (vs sanction) programs for consumers adopting (or not adopting) water sobriety and conservation practices.
	- How do practical applications of water sobriety and/or conservation vary depending on individuals and consumption situations?	- Establishing segmentation of water sobriety and/or conservation practices to promote these practices to the right target audience and in the right situations. - Proposing solutions (technological or otherwise) that consider the different situations and characteristics of individuals (e.g., water-efficient devices adapted to household characteristics).
	- How can one approach/experience of water sobriety and conservation lead to another? How does	- Launching communication campaigns highlighting the cumulative positive effects of small actions in

	occasional transgression of sobriety/preservation fit into its adoption?	water sobriety/conservation, using concrete data and real examples (e.g., testimonials, case studies). - Organizing events or spaces for exchanging and sharing experiences among consumers to create a collective momentum for water sobriety/conservation (e.g., forums, online discussion groups, community events). - Creating guides, video tutorials, workshops, and webinars tailored to different levels of consumer experience in water sobriety/conservation.