



Pro-environmental behaviour in household water use. A gender perspective

Lucía Granda¹ · Pablo José Moya-Fernández² · Rosa María Soriano-Miras¹ · Francisco González-Gómez^{1,3}

Received: 30 April 2023 / Accepted: 27 December 2023
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Abstract

Efficiency in the use of water resources is one of the SDG 6 in all sectors. This research focuses on the efficient use of water in households. Specifically, we analyse differences in people's behaviour towards ten household water uses. Compared to previous research, the main contribution of this study is the emphasis placed on the gender perspective. This research is carried out for Andalusia, a region in southern Spain with high water stress. OLS and probit estimations were made with a database of 2650 observations from 2018. No gender differences are found in the number of habits applied to make efficient use of water in the household. On the other hand, after studying ten household water uses in isolation, gender differences are found in certain pro-environmental habits. We cannot conclude the existence of a gender gap in environmental awareness of water use. However, the results suggest that there are differences in the adoption of pro-environmental habits in water use due to the distribution in the household chores, especially in those which are traditionally female or male.

Keywords Pro-environmental actions · Gender · Sustainability · Water efficiency · ODS 6

Introduction

According to the United Nations (2015), one of the main challenges facing the world's population is access to water for different uses. Water scarcity affects more than 40% of the global population and this figure is expected to increase in the coming years (OECD 2012; United Nations and World Bank 2018). Several different factors, including global population growth and the effects of climate change, make it likely that the risk of water stress will rise in many of the world's regions in the near future (Mekonnen and Hoekstra 2016). Greater efforts are needed to implement measures that make water access targets compatible with water conservation and sustainability (United Nations 2018).

The United Nations' sustainable development goal (SDG) 6 encompasses a commitment to use water resources more

efficiently in all sectors (United Nations 2018). Although agriculture is the sector that accounts for the greatest demand for water, households must also contribute to alleviating water stress. Citizens have two options for making more efficient use of water in the home. They can purchase water-saving technology for the home and they can adopt more sustainable behavioural habits.

Water-saving technologies include efficient shower heads, dual-flush push-button toilets and efficient washing machines and dishwashers. But technology alone is not enough as increases in water-use efficiency can trigger a rebound effect (Lindsay and Supski 2017; Freire-González 2019). Unsustainable behaviour in water use may be due to the personal sacrifice involved in putting pro-environmental attitudes into practice (Ananga et al. 2019) or simply because human behaviour is not always rational and is guided by habits or automatic routines (Steg and Vlek 2009). To ensure the sustainable use of water, it is not enough to invest in technology; we also have to incorporate efficient habits in the use of water, such as turning off the tap while brushing our teeth or waiting until the dishwasher and washing machine are full before running them.

Previous studies have analysed the explanatory factors for efficient water-use behaviour in the household. The interest of these studies lies in the fact that they provide valuable

✉ Rosa María Soriano-Miras
rsoriano@ugr.es

¹ Department of Sociology, Faculty of Political Science and Sociology at Granada University, Granada, Spain

² Faculty of Economic and Business Science, University of Granada, Granada, Spain

³ Water Institute at Granada University, Granada, Spain

information for the design of public awareness campaigns and educational programmes to promote pro-environmental behaviour in household water use (Gómez-Llanos et al. 2020; Moore et al. 1994). The literature highlights people's degree of concern for and sensitivity to the environment (Gilg and Barr 2006; Willis et al. 2011). In addition, different sociodemographic factors such as age, income level or country of origin (Aprile and Fiorillo 2017; Ibáñez-Rueda et al. 2023) or other political-knowledge-related variables (Lafuente et al. 2021) have been considered to explain differences in water management preferences together with gender. Indeed, the present research is aimed at a more in-depth exploration of the relationship between gender and different saving water habits at home. Thus, unlike previous research in which gender has been incorporated into the analysis as just one of several explanatory variables, the main contribution of this study is that the central focus is on the issue of gender. For more than 20 years the European Union has been raising the need to structure *gender mainstreaming* into public policies (Council of Europe 1998). This gender approach is still needed to achieve equality between men and women (United Nations Women 2020).

In our research, ordinary least squares (OLS) and logit regression analyses were conducted using data from 2650 observations collected through a survey carried out in Andalusia, a region in southern Spain with a high level of water stress. The results regarding the relationship between gender and pro-environmental behaviour in household water use are ambivalent. While no gender differences are found in the number of habits indicative of an efficient use of water in the home, an important finding is that there are gender differences in the adoption of pro-environmental habits according to the household chore in which water is used. Specifically, there are significant differences in the use of water for activities considered typically female and typically male. Pending the achievement of gender equality in the division of household chores, the main recommendation is that gender should be taken into account in the design and targeting of awareness campaigns about the use of water in the home.

Following this introduction, the paper is structured as follows: A brief review of the literature is presented in “[Background](#)”. Then, the methodology is described in “[Methodology](#)”. In “[Results and discussion](#)”, the results are detailed and discussed. Lastly, in “[Summary, conclusions and recommendations](#)”, the conclusions and recommendations are presented.

Background

Various cross-national studies indicate that women engage more in environmental behaviour and show greater concern

for the environment than men (Ramstetter and Habersack 2020; Franzen and Meyer 2010). There is evidence of this for different countries, including Canada (Kennedy et al. 2009), the United States (Arbuckle and Mercer 2020; Dietz et al. 2003; McCright 2010; Xiao and McCright 2012), Sweden (Elert and Lundin 2022), China (Xiao and Hong 2010) and Great Britain (Norris 1997; Clements 2012; Christie and Jarvis 2002).

But it has also been found that sex is not the most significant variable for predicting environmental behaviour (Gómez et al. 1999); rather, there are other, overlapping sociodemographic factors that need to be taken into account in the analysis. People with a higher level of education show more pro-environmental behaviour (Meyer 2015; Báez 2016). Similarly, older people tend to be more ecologically minded and to care more about the environment (Echavarren 2016). Living arrangements also have an influence, since couples without children and people who live alone are more engaged in environmental actions in the home (Longhi 2013).

Beyond individual psychological or biological explanations to analyse this environmental disparity, since the 1990s there have been numerous studies indicating that this difference is linked to gender socialization. These studies focused on the difference in values and attitudes that prompt women to care more about the environment and how gender roles give rise to greater differentiation in the field of social action, such as unpaid domestic work being considered a woman's job (Davidson and Freudenburg 1996; Blocker and Eckberg 1997; Kennedy and Dzialo 2015).

The disparity in pro-environmental behaviour with respect to gender socialization

The theory of gender socialization holds that men and women acquire the social expectations, attitudes and behaviours associated with each sex (Domínguez 2012). It is well known that, from an early age, men traditionally develop values oriented to competitiveness, the market, control over one's environment, etc., while women develop values of care, cooperation, altruism and compassion—what Gilligan (1982) referred to as the “ethics of care”. These values and attitudes extend to the field of environmental protection and conservation, giving rise to different levels of environmental awareness (Stern et al. 1993; Dietz et al. 2003; Kennedy and Kmec 2018).

In addition to the difference in values, other factors related to socialization have been put forward as an explanation for this disparity. Thus, recent studies claim that this gender gap in pro-environmental behaviour is caused by differences in political knowledge, being the women who

are more prone to adopt measures in the domestic sphere as they have less information about environmental management (Lafuente et al 2021). Similarly, the *institutional trust theory* indicates that women are more reluctant to trust institutions to solve problems (especially institutions related to science, technology and government—areas with which they have traditionally been less familiar). Due to this reluctance, they have higher levels of concern for the environment, viewing it a personal responsibility (McCright and Xiao 2014).

At any rate, there are other studies showing that this concern has no specific cause. Conversely, women's socialization in compassion and care for the environment means they have a heightened perception of the risk (Stern et al. 1993; Subiza-Pérez et al. 2020), and are more concerned about the direct impact of environmental degradation on health (Bryson et al. 2001).

Bearing in mind these propositions, we can expect to see differences in pro-environmental behaviour by gender. We thus formulate the following hypothesis:

H1: Women show more pro-environmental behaviour in household water use than men.

The disparity in pro-environmental behaviour associated with inequality in housework

In line with the school of thought focused on the values and attitudes that condition women to be more concerned about the environment, it has been proposed that it is their *gender role* in the domestic sphere—associated with care-giving and raising children—that causes this difference (Blocker and Eckberg 1997; Hamilton 1985).

However, there does seem to be a consensus that women demonstrate a higher level of environmental action in the private or domestic sphere (Pisano and Lubell 2017; Tindall et al. 2003; Hunter et al. 2004; Franzen and Meyer 2010; Ternes and Donovan 2020). Indeed, environmental actions in the home are closely related to household chores and care-giving (reusing washing-up water, recycling, buying organic food, etc.).

The incorporation of water management tasks as an extension of the housework can lead to a gender imbalance in the responsibility for sustainability actions, given the feminization of household chores (Mellor 2019; Kennedy and Dzialo 2015). Women tend to spend more time than men on housework, despite the fact they live together and spend the same amount of time on paid work (Murphy and Parry 2021). This results in a “second shift” for women, which includes environmental tasks coupled with household chores (Hochschild 1989; MacGregor 2014).

Based on the theory of gender roles, we question whether specialization in the different household chores involving the use of water is associated with water-saving behaviours that also differ. We formulate the following hypothesis to be tested:

H2: Women adopt more pro-environmental habits than men in the uses of water for household chores considered typically female.

Methodology

Data

The research focuses on Andalusia. This region in southern Spain covers an area of 87,268 km² and has a population of about 8.5 million people. Andalusia suffers from a major shortage of water due to high demand, mainly for agricultural uses, and a low level of rainfall. The climate is Mediterranean, although conditions vary throughout the region. The average number of rainy days per year is between 50 and 100, depending on the area, and the average rainfall ranges from less than 300 mm per year to a maximum of 1000 mm per year; rainfall is unevenly distributed by season leading to dry and humid cycles (Junta de Andalucía, 2023). The entire Andalusian territory is in a situation of severe water stress. In fact, the Andalusian river basins have water stress levels above 40% (Eurostat 2022), as shown in Fig. 1.

The seriousness of the situation is such that some municipalities are forced to take specific measures in the summer months, such as banning some uses of water, implementing supply cuts, or using tanker trucks to guarantee supply. Faced with this situation, it is essential to improve the management of water resources. Establishing water-saving actions and habits in households is a determining factor in achieving a more efficient use of water in the domestic sphere.

The data used in this research were collected in *Social Survey 2018. Households and Environment in Andalusia*, carried out by the Institute of Statistics and Cartography of Andalusia (IECA 2021). This survey has several objectives, all of them linked to households' habits, norms and attitudes in relation to the environment. The survey has seven blocks, the first of which focuses on the topic of *Water*, and is aimed at people aged 16 and over living in Andalusian family homes. It was distributed between May and July 2019 using simple random sampling and stratified by province and level of urbanisation. A total of 3005 survey responses were received, of which 2650 are complete and used in this study. The sample size is sufficiently representative, as the size required for a margin of error of 5% and a significance level of 95% is 384.

Variables

The main objective of this research is to assess pro-environmental behaviour in household water use from a gender perspective. To that end, 10 water-saving habits or behaviours

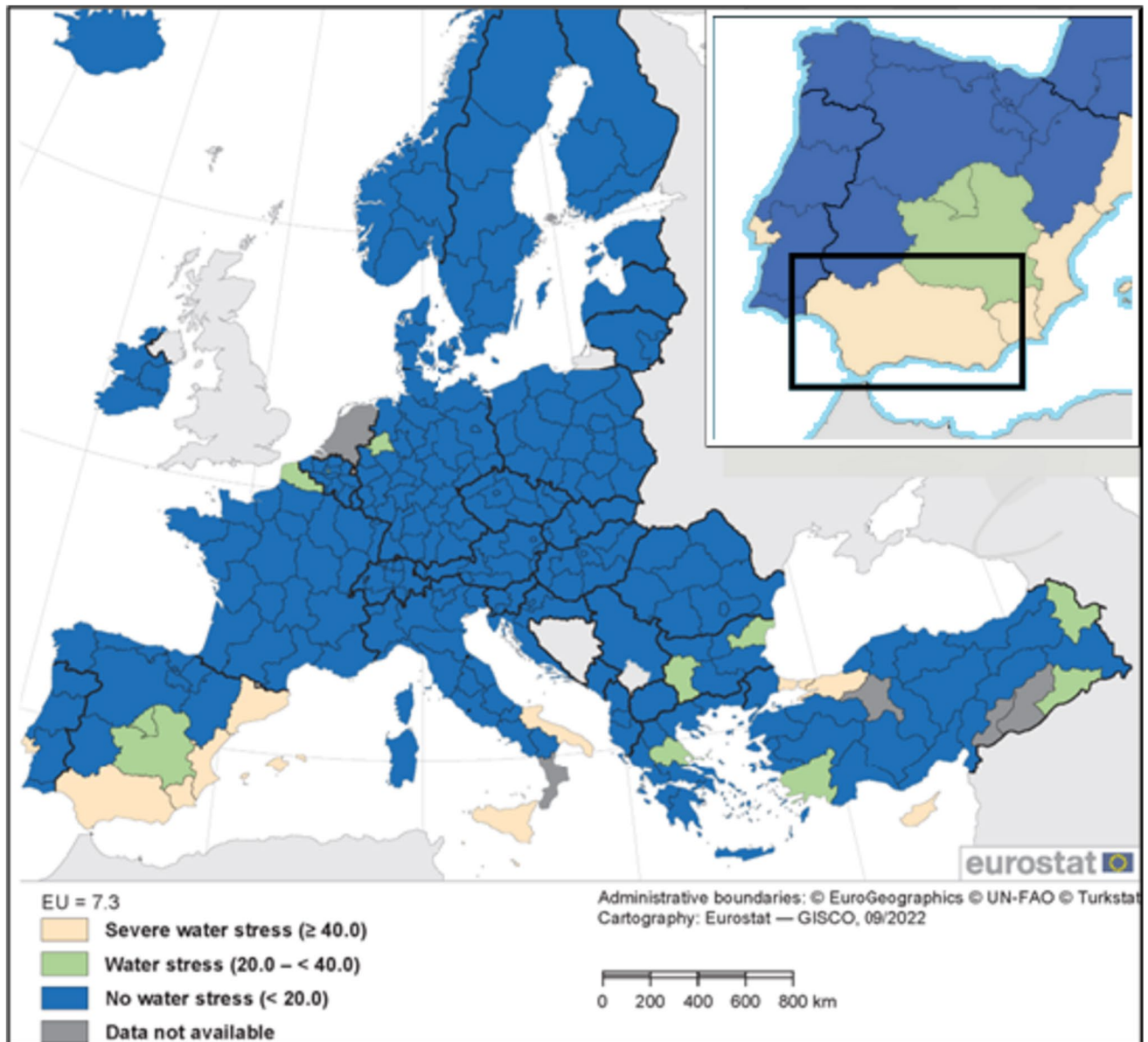


Fig. 1 European water exploitation index (freshwater abstraction minus returns as a % share of renewable freshwater resources) in 2019 by Eurostat (2022)

are considered. It should be noted that some of these habits have been included in previous studies (for example, in Alvarado Espejo et al. 2021; Martínez-Espiñeira and García-Valiñas 2013; Pérez-Urdiales and García 2016). Each habit is represented by a dichotomous variable that takes the value of 1 if it is done by the individual and 0 otherwise. Table 1 shows the questions included in the questionnaire along with the name of the variable. An additional column has been included to indicate whether the activity associated with water use is identified as typically female, typically male or neutral. To make this distinction, the routine chores carried out inside the home—such as ironing,

cleaning and cooking—are considered typically female; while men are associated with occasional or outdoor tasks, such as gardening, taking out the rubbish and doing minor repairs (Bianchi et al. 2000; Doucet 2015).

In addition, a synthetic indicator has been constructed to represent the number of water-saving behaviours adopted by the individuals. This indicator is aimed at summarizing the respondent's pro-environmental behaviour in household water use. It is calculated by summing all the dichotomous variables of each water-saving behaviour.

Table 2 contains the main descriptive statistics of the rest of the variables included in the study. Of all the variables included,

Table 1 Main study variables and description

Do people in your household engage in any of the following habits to reduce water consumption? (No/Yes)		Activity by gender role
HABIT 1	Recycling water, for example, making use of the shower water while waiting for it to get hot	Female
HABIT 2	Keeping a bottle of cold water in the refrigerator so as not to leave the water running	Neutral
HABIT 3	Defrosting food in advance to avoid doing it under the tap	Female
HABIT 4	Filling up the sink before washing the dishes	Female
HABIT 5	Waiting until the dishwasher and washing machine are full before running them	Female
HABIT 6	Turning the stopcock a little to reduce the flow of the taps	Male
HABIT 7	Having a wastebasket in the bathroom so as not to use the toilet as a rubbish bin	Neutral
HABIT 8	Having some type of tank for storing water	Neutral
HABIT 9	Low-flush mechanisms for cisterns	Male
HABIT 10	Other savings systems	Neutral

Table 2 Descriptive statistics of independent variables

Independent	Mean/%	S.D.	Min	Max
Gender (woman)	52.87%			
Household type				
Single person	8.94%			
Couple without children	22.04%			
Couple with children	50.83%			
Single parent home	7.32%			
Other	10.87%			
Age				
16–29	16.34%			
30–44	27.77%			
45–64	37.96%			
65 and over	17.93%			
Employment				
Other situation	51.85%			
Self employed	5.85%			
Employee, permanent contract	27.28%			
Employee, fixed-term contract	15.02%			
Educational attainment				
Compulsory education not completed	16.27%			
Compulsory education	30.15%			
Non-university post-compulsory education	31.77%			
University education	21.81%			
Income				
Less than 900	24.08%			
From 901 to 1600	36.30%			
From 1601 to 2500	21.55%			
From 2501 to 3000	8.45%			
More than 3000	9.62%			
Concern for the environment	8.4472	1.6138	1	10

Gender is the key variable in this study. The rest of the socio-economic variables are *Household type*, *Age*, *Employment*, *Educational attainment*, *Income* and *Concern for the environment*. These characteristics are used as control variables.

Data analysis technique

A two-stage regression analysis is used to assess the relationship between gender and water-saving habits in the home. In the first stage, we analyse the relationship of the independent variables with the proposed indicator through a regression analysis. Given the nature of the dependent variable, we use OLS as the fitting method. The model is defined as follows:

$$\begin{aligned}
 \text{Indicator}_i = & \beta_0 + \beta_1 \text{Gender}_i + \beta_2 \text{Household type}_i \\
 & + \beta_3 \text{Age}_i + \beta_5 \text{Employment}_i \\
 & + \beta_6 \text{Educational attainment}_i \\
 & + \beta_7 \text{Income}_i \\
 & + \beta_8 \text{Concern for the environment}_i + \varepsilon_i
 \end{aligned}$$

where $i = 1, \dots, 2650$ represents each individual and ε_i is the error term.

Indicator_i measures the number of pro-environmental actions in the use of water in the home. Therefore, we use this model to test H1. A positive and significant relationship between Indicator_i and Gender_i will confirm the existence of a disparity in pro-environmental behaviour due to differences in *gender socialization*.

In the second stage, we focus on each of the water-saving habits. The aim is to analyse the effect that each of the independent variables has on the probability of doing each water-saving action. In other words, the relationship of the independent variables with the adoption or not of pro-environmental habits is analysed separately for each of the 10

household chores that require the use of water. We perform this analysis by fitting the following logit regression model.

$$\begin{aligned} \text{Habit}_{ji} = & \beta_0 + \beta_1 \text{Gender}_i + \beta_2 \text{Household type}_i \\ & + \beta_3 \text{Age}_i + \beta_5 \text{Employment}_i \\ & + \beta_6 \text{educational attainment}_i \\ & + \beta_7 \text{Income}_i \\ & + \beta_8 \text{Concern for the environment}_i + \varepsilon_i, \end{aligned}$$

where $j = 1, \dots, 10$ represents each of the habits for the $i = 1, \dots, 2650$ individuals and ε_i is the error term.

By running 10 regressions, one per water-use Habit_{jp} , we can test H2. In this case, we would be checking for the existence of disparity in pro-environmental behaviour in water use associated with inequality in housework, whether due to socialization in values or the traditional difference in gender roles.

Results and discussion

Main descriptive statistics

Table 3 contains the descriptive statistics of the dependent variables used in this study. The results related to the synthetic indicator show that, on average, respondents adopt 5.4 water-saving behaviours out of a total of 10.

For the variables representing each water-saving behaviour, the mean can be interpreted as the proportion of respondents who engage in the behaviour. Based on this statistic, we observe that some behaviours are very common. This is the case of the behaviours “Defrosting food in advance to avoid doing it under the tap” and “Waiting until the dishwasher and washing machine are full before running them”, which are done by approximately 93% of respondents. Other behaviours adopted by most of the respondents are “Keeping a bottle of cold water in the refrigerator so as not to leave the water running” and “Having a wastebasket in the bathroom so as not to

Table 3 Descriptive statistics of dependent variables

Dependent	Mean	S.D	Min	Max
Habit 1	0.3491	0.4767	0	1
Habit 2	0.8120	0.3907	0	1
Habit 3	0.9340	0.2483	0	1
Habit 4	0.2864	0.4522	0	1
Habit 5	0.9381	0.2410	0	1
Habit 6	0.3366	0.4726	0	1
Habit 7	0.8589	0.3482	0	1
Habit 8	0.1868	0.3898	0	1
Habit 9	0.6784	0.4671	0	1
Habit 10	0.0472	0.2120	0	1
Indicator	5.4275	1.3979	0	10

use the toilet as a rubbish bin”, both registering a proportion of over 0.8; and “Low-flush mechanisms for cisterns” with a proportion of more than two-thirds of respondents.

Conversely, the rest of the behaviours seem to have a low level of acceptance. About a third of respondents indicated they had adopted the habits of “Turning the stopcock a little to reduce the flow of the taps” and “Filling up the sink before washing the dishes”. The least commonly adopted behaviour is “Having some type of tank for storing water”, which only registers a proportion of just under 0.2. An even lower proportion of respondents (0.0436) claimed to make use of “Other savings systems”.

Differences in pro-environmental behaviour by gender

Table 4 shows the results of the OLS regression that relates the sociodemographic variables with the proposed synthetic

Table 4 Multiple linear regression for indicator dependent variable

Intercept	3.9097***
Gender (Ref. man)	
Woman	0.0203
Household type (Ref. single person)	
Couple without children	0.1991+
Couple with children	0.3056**
Single parent home	0.1393
Other household type	0.1945
Age (Ref. 16–29)	
30–44	0.1512+
45–64	0.3113***
65 and over	0.2444*
Employment (Ref. other situation)	
Self employed	0.1046
Employee, permanent contract	0.0386
Employee, fixed-term contract	0.1948*
Educational attainment (Ref. compulsory education not completed)	
Compulsory education	0.0751
Non-university post-compulsory education	– 0.0577
University education	– 0.1451
Income level (Ref. Less than 900)	
From 901 to 1600	– 0.2151**
From 1601 to 2500	– 0.2444**
From 2501 to 3000	– 0.2044+
More than 3000	– 0.2517*
Concern for the environment	0.1452***
R^2	0.0544
Adj. R^2	0.0476
Overall significance	7.97***
Num. obs	2650

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.1$

indicator. Recall that our indicator represents the number of water-saving behaviours adopted. The gender variable is not significant. In other words, no relationship is found between the number of behaviours adopted and being a man or a woman. Thus, these results do not support H1: *Women show more pro-environmental behaviour in household water use than men*. Regarding the control variables, as expected, there is a significant positive relationship between people who are more concerned about the environment and the number of water-saving behaviours. Likewise, people with an income of less than €900 seem to be more committed to saving water. Couples with children have a higher number of habits on average compared to couples without children, while young people aged between 16 and 29 are the ones who adopt the fewest habits compared to other age groups. These results agree with other empirical studies that older people have more sustainable water consumption habits (Gregory and Leo 2003; Gabarda-Mallorquí et al. 2018).

Delving into the issue of gender, our results rule out the notion that women are more engaged in environmental protection, which was presented as a possible consequence of socialization oriented to greater environmentalism (Dietz et al. 2003). At an empirical level, this research is in line with the studies by Lam (2006) and Millock and Nauges (2010), which also report no significant relationship between gender and the number of water-saving habits adopted in the home. Conversely, Martínez-Espiñeira and García-Valiñas (2013) suggest there is a positive relationship between the percentage of women in the household and the number of water-saving habits adopted. Along the same lines, Addo et al. (2018) and Ternes and Donovan (2020) conclude that women are more predisposed to adopt water-saving habits. Nevertheless, we draw attention to the fact that these studies have addressed gender as just one variable among several (Lafuente and Moyano 2011; Dean et al. 2021). Only a few studies analyse gender as the central issue in specific contexts (Lafuente et al. 2021; Diakite et al. 2020).

Differences in pro-environmental behaviour by gender and housework

Table 5 shows the results of the logit regression for each of the water-saving habits, since we believe that the contradictions found in the aforementioned studies may be due to the type of chore. Our results suggest that the gender variable is statistically significant for most water-saving habits. In other words, there is a relationship between the gender variable and the probability of adopting certain water-saving behaviours. However, the coefficients have different signs. In the regression analysis, we took men as the reference group. Positive and significant coefficients are observed for *Habits 1, 3 and 5*. In other words, women are more likely to engage

in these behaviours than men. On the contrary, negative and significant coefficients are observed for *Habits 2, 6 and 9*. That is, there is a positive relationship between being a man and the probability of performing these actions. For the rest of the behaviours, no significant differences were found between men and women. In other words, gender has no effect on the likelihood of adopting *Habits 4, 7, 8 and 10*.

Our results are consistent with the findings of Alvarado Espejo et al. (2021), who also identified significant gender relationships that differ according to the use of water. While there does not seem to be a conclusive empirical relationship between gender and water-saving habits, it can be seen that those closely related to household chores align with traditional gender roles in the household, especially in the case of women. They perform more of the routine chores that must be done more regularly and involve more time and effort (Borra et al. 2020), such as cooking, and using appliances to wash clothes and dishes—chores that are related to *Habit 3 (Defrosting food in advance to avoid doing it under the tap)* and *Habit 5 (Waiting until the dishwasher and washing machine are full before running them)*, respectively. Indirectly, there is also a female association with *Habit 1 (Recycling water, for example, making use of the shower water while waiting for it to get hot)*, since the recycled water will be used for typically female activities, such as watering plants or cleaning the bathroom. When comparing the results with previous research, we can see that Martínez-Espiñeira et al. (2014) also found a relationship between being a woman and water-saving *Habit 5*. While Pérez-Urdiales and García (2016) do not identify a significant direct effect, they do find a positive indirect relationship with being a woman.

These results are in line with H2 and are consistent with the theory of gender roles. The patterns of domestic behaviour shown by the Andalusian population are aligned with classic gender stereotypes (ARHOE 2017; IECA 2020), a factor that could be influencing the adoption of household water management behaviours. The fact that women are the ones who traditionally do household chores could explain why they show greater adoption of pro-environmental habits in tasks such as defrosting food and running the dishwasher and washing machine. Put simply, if the man does not enter the kitchen, he will not apply certain water-saving habits in the home, because he will not have the chance to do so. Fenstermaker and West (2002) claimed that engagement in household chores—and by extension, household water management—is a way of *doing* gender, such that women reinforce their femininity when they do these chores. In the case of men, they reinforce their masculinity when they avoid these chores that could be considered feminine or avoid certain actions that form part of these chores, despite understanding that they are beneficial for the environment (Brough et al. 2016). One of the water-saving habits done more often by men is *Habit 9 (Low-flush mechanisms for cisterns)*,

Table 5 Logit regressions for each water use habit

	HABIT 1	HABIT 2	HABIT 3	HABIT 4	HABIT 5	HABIT 6	HABIT 7	HABIT 8	HABIT 9	HABIT 10
Intercept	-1.5403***	0.8536*	0.4183	-1.1156***	-0.3419	-1.1694***	1.1964**	-2.4129***	-1.3022***	-3.9110***
Gender (Ref. man)										
Woman	0.2885***	-0.1959 ⁺	0.3631*	-0.0756	0.5242**	-0.2211**	0.1389	0.0694	-0.1993*	0.2787
Household type (Ref. single person)										
Couple without children	-0.0487	0.2132	0.3666	-0.1129	0.6646*	0.0692	0.2752	0.3399	0.1520	-0.3157
Couple with children	-0.0908	0.4396*	0.5110 ⁺	0.1471	0.7803**	0.1145	0.2073	0.4585*	0.1787	-0.3559
Single parent home	0.0584	0.3059	0.7872 ⁺	0.1418	0.6686 ⁺	-0.0275	0.4901	-0.3751	-0.2336	-0.1180
Other household type	0.0074	0.4711*	0.5272	0.0800	0.4286	-0.1764	0.5661*	0.1106	0.0049	-0.2884
Age (Ref. 16 to 29)										
30 to 44	0.0713	-0.1225	0.3027	0.1021	0.8331***	-0.3608**	0.4503*	-0.1106	0.3930**	0.4701
45 to 64	0.2083	0.1115	0.1623	0.2866*	1.1062***	-0.5372***	-0.0590	0.4369**	0.7119***	0.7393*
65 and over	0.3126 ⁺	-0.2276	-0.0023	0.2962 ⁺	0.7745**	-0.4305**	0.0108	0.3909 ⁺	0.6797***	0.1895
Employment (Ref. Other situation)										
Self employed	-0.2347	-0.2066	-0.3487	0.2961	-0.2877	0.0403	0.6752*	0.0546	0.4224*	0.1039
Employee, permanent contract	0.1511	0.2230	0.1464	-0.1352	0.2738	-0.0929	0.0191	-0.1075	0.0500	0.1570
Employee, fixed-term contract	0.1193	0.2471	-0.0675	0.1778	-0.1855	0.1340	0.5768**	0.0896	0.0079	0.2502
Educational attainment (Ref. Compulsory education not completed)										
Compulsory education	-0.0829	0.2002	0.2515	-0.3294*	0.3487	0.0789	-0.4359 ⁺	-0.1224	0.6280***	-0.1578
Non-university post-compulsory education	-0.1787	0.0734	0.4256 ⁺	-0.5160***	0.7561**	0.0026	-1.0167***	-0.1664	0.6328***	-0.1874
University education	-0.1568	0.1185	0.5325 ⁺	-0.7464***	0.6127*	0.0741	-1.2711***	-0.2270	0.5690***	-0.4847
Income level (Ref. Less than 900)										
From 901 to 1600	-0.2317*	-0.4082**	0.1092	-0.3135**	0.2222	-0.1745	-0.4102*	-0.1121	0.1171	0.2364
From 1601 to 2500	-0.4670***	-0.4596**	0.2364	-0.4287**	0.0407	-0.0460	-0.6582**	0.0503	0.1738	0.7742*
From 2501 to 3000	-0.5329**	-0.6461**	0.2633	-0.3158	0.5283	-0.0511	-0.5057*	-0.2417	0.5607**	0.5193
More than 3000	-0.7292***	-0.5082*	0.2314	-0.6345**	0.1580	-0.0540	-0.5066*	0.3237	0.2714	0.6255
Concern for the environment	0.1191***	0.0701*	0.1268**	0.0773**	0.1072*	0.1145***	0.1556***	0.0629 ⁺	0.1034***	0.0348
AIC	3370.3843	2555.8072	1286.7605	3106.4396	1194.4233	3374.3874	2062.0323	2535.6123	3246.0022	1027.3521
BIC	3488.0306	2673.4535	1404.4068	3224.0859	1312.0696	3492.0337	2179.6786	2653.2586	3363.6485	1144.9984
Log likelihood	-1665.19	-1257.90	-623.38	-1533.22	-577.21	-1667.19	-1011.02	-1247.81	-1603.00	-493.68
Deviance	3330.3843	2515.8072	1246.7605	3066.4396	1154.4233	3334.3874	2022.0323	2495.6123	3206.0022	987.3521
Num. obs	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ⁺ $p < 0.1$

which would be framed as a “male task” in the home as it involves maintenance. Strengers and Nicholls (2018) point out that men take on household tasks such as the installation and upkeep of systems for resource-saving and sustainability, which is due to a strong association in the home between masculinity and technology. Thus, analysis from a gender perspective is a reasonable approach to explain why men and women adopt certain water-saving habits to different extents. However, the data used do not allow us to provide a conclusive explanation for these behavioural disparities.

Finally, different control variables were introduced in the research. As with the number of behaviours adopted, people who claim to be more concerned about the environment are more likely to engage in each of the water-saving behaviours considered. In addition, households comprising a couple with children are more predisposed than single-person households to adopt *Habits 2, 3, 5 and 8*, while income level has a negative and significant relationship with various behaviours. Regarding this last variable, the results indicate that certain water-saving habits are better explained by income level than by gender; in the case of *Habit 4* (“Filling up the sink before washing the dishes”), those with a lower level of income are more likely to do it, and the probability decreases as income level rises. We understand that this habit and *Habit 5* (“Waiting until the dishwasher and washing machine are full before running them”) are conditioned not by gender or environmental awareness, but by whether or not the subjects can purchase a dishwasher.

Summary, conclusions and recommendations

The objective of this study is to assess pro-environmental behaviour in household water use from a gender perspective. Although there are previous studies that analyse environmental habits in the home, there is still not much literature focusing on the differences between the sexes in these behaviours, and more specifically on water saving. The research was carried out with data from 2650 observations collected in Andalusia, southern Spain.

First, this analysis has shown that there are no differences between men and women in the number of water-saving actions in the home. However, there is a difference by sex in habits relating to the efficient use of water, aligning with a traditional division of household chores by gender stereotypes. Men occasionally engage in traditionally “masculine” tasks related to technology, while the water-saving actions in which women most commonly engage are related to routine and feminized tasks such as cooking and washing dishes or clothes in household appliances. Therefore, when it comes to predicting

the actions that lead to effective water savings, the results of the research suggest that the classic gender-based division of housework is more important than possible differences in environmental awareness due to gender; thus, the explanation based on gender roles is more relevant than the theory of differential socialization in environmental values and attitudes.

Therefore, although we cannot establish that there is a difference in pro-environmental behaviour in household water use according to gender, the traditional division of household chores between men and women influences the habits relating to efficient use of water in the home, which explains the differences found. That is, women tend to wait until dishwashers and washing machines are full before running them, recycle water and defrost food in advance more than men do, because these are jobs that have traditionally been done by women. On the other hand, men tend to keep a bottle with cold water in the fridge, turn the stopcock and use low-flush mechanisms for cisterns more than women do, because the household chores more associated with DIY have traditionally been done by men.

A first recommendation from the study concerns the need to incorporate a gender component in campaigns to promote water saving in the home. As long as gender differences persist in the division of household chores, we have no choice but to consider the gender component when designing campaigns to achieve the desired impact on household water use. A second recommendation is to further explore the causality of the relationships found, through qualitative analyses that allow us to uncover the true nature of the relationships found at the level of each household chore.

Funding Funding for open access publishing: Universidad de Granada/CBUA.

Data availability The datasets analysed during the current study are available in the Instituto de Estadística y Cartografía de Andalucía (IECA) repository: <https://www.juntadeandalucia.es/institutodeestadisticaycartografia/descarga/encSocial/2018medioambiente/encSocial2018medioambiente.htm>.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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