

*STIMULATING WATER CONSCIOUS  
BEHAVIOUR: THE INFLUENCE OF  
PERSONAL AND EXTERNAL  
CHARACTERISTICS ON DOMESTIC WATER  
CONSUMPTION.*

A case study in the city of Groningen, the Netherlands

Author: Lieke Mijnheer  
Studentnumber: S3198561  
Degree programme: Human Geography and Planning  
Supervisor: dr. G. Mallon  
Date: 15-01-2021



**university of  
groningen**

**faculty of spatial sciences**

## Summary

Due to population growth and climate change, pressure on fresh water availability is becoming more and more a problem making it even more important to reduce water consumption. The literature shows that personal and external factors such as age, gender, education, income, household size, home ownership, type of dwelling, and awareness can influence a persons' domestic water consumption. Furthermore, the literature also shows a gap between intentions to be water conscious, and actual water conscious behaviour. Collecting information about what needs to be done in order to fill this gap is needed in order to come up with fitting policies and campaigns aiming to reduce residential water consumption. The research question that this research attempts to answers is therefore as follows: What factors influence people's water consumption in the city of Groningen and what is needed to stimulate them to live more water conscious? An answer to this question is given through the use of a questionnaire and a literature review. The results show that people, regardless of their personal and external factors, are not consciously taking action to consume less water and that more information and more awareness is needed to push people to live a more water conscious lifestyle.

# Table of content

|   |           |
|---|-----------|
| <b>1. Introduction</b> .....                    | <b>4</b>  |
| 1.1 Background.....                             | <b>4</b>  |
| 1.2 Research problem .....                      | <b>4</b>  |
| 1.3 Reading guide .....                         | <b>5</b>  |
| <b>2. Theoretical framework</b> .....           | <b>6</b>  |
| 2.1 Awareness .....                             | <b>6</b>  |
| 2.2 Personal factors .....                      | <b>8</b>  |
| 2.3 External factors .....                      | <b>8</b>  |
| 2.4 Conceptual model .....                      | <b>9</b>  |
| 2.5 Hypothesis .....                            | <b>9</b>  |
| <b>3. Methodology</b> .....                     | <b>11</b> |
| 3.1 Method and population.....                  | <b>11</b> |
| 3.2 Questionnaire .....                         | <b>12</b> |
| 3.3 Ethics and reflection.....                  | <b>12</b> |
| <b>4. Results and discussion</b> .....          | <b>14</b> |
| <b>5. Conclusions and recommendations</b> ..... | <b>19</b> |
| <b>References</b> .....                         | <b>20</b> |
| <b>Appendix</b> .....                           | <b>24</b> |
| Questionnaire: Water consumption.....           | <b>24</b> |

# 1. Introduction

## 1.1 Background

According to the RIVM (2010), as a result of climate change the Netherlands is at risk of periods of drought during the summer months due to a decrease in precipitation and an increase in evaporation. The worst case scenario for the Netherlands in 2050, as compared to 1990, shows a summer precipitation decline of 19%, while the average precipitation in winter will increase with 14% (RIVM, 2010).

Simultaneously, the water demand during these dry periods will increase as well (Bates et al., 2008). A possible consequence of this scenario is the failure to meet drinking water standards (RIVM, 2010). This prediction became reality during the summer of 2018. A period of above average hot and dry weather was experienced during this year's summer in the Netherlands, resulting in a precipitation deficit (Philip et al., 2020). This drought impacted various sectors, like agriculture and shipping. In addition to this, a reduced quantity and quality of surface water influenced drinking water facilities in a negative way (Philip et al., 2020).

Furthermore, it is expected that the global population will increase with 2 billion within the next 30 years (United Nations, 2019). For the Netherlands specifically, a population growth up to 19.6 million inhabitants by 2060 is expected (CBS, 2019). According to Memon & Ward (2015), the anticipated population growth will have serious effects for fresh water dependent sectors. By 2030, water demand is estimated to have increased by 30% (Memon & Ward, 2015).

The combination of an increase in droughts and population growth can in the future result in pressure on the Dutch water system. Among other things, a change in people's water use can contribute to a better balance that fits the newfound situation(s).

According to De Oreo et al., (2016), residents usually have the highest water demand of any sector. This is confirmed by data from Statline (2020), showing that within the Netherlands in 2018, private households are the largest group of tap water users (837,2 million m<sup>3</sup> of a total 1140 million m<sup>3</sup>). Changing households' water habits is therefore of great importance in order to be resilient to the effects of climate change and population growth on the freshwater availability. Specifically water conservation in urban households plays a big role in ensuring water security in the future (Ferdous Hoque, 2014).

According to different studies, creating awareness can decrease people's water consumption (Bryx and Bromberg, 2009, Dolnicar et al., 2012, Abdulrazzak and Khan 1990). Thus, making it an important tool for policy makers when trying to influence people's water consumption. Gaining insight in the factors influencing the degree in which people are aware of their water consumption and their actual water habits will create the possibility for policy makers to design a fitting strategy aiming for people to be more water sustainable.

## 1.2 Research problem

Through climate change and population growth, the pressure on fresh water reserves will increase further, making it crucial that measures will be implemented to adapt to this challenge (Aprile & Fiorillo, 2017). This will result in the need for a more resilient and sustainable way of water usage, also at the residential level. According to Ferdous Hoque (2014), 'ordinary' people are usually not aware of their water consumption and as a result do not act water conscious. However, it is of great interest for policy makers to understand what people's reasons are to behave water conscious because it gives them the opportunity to translate this into successful water saving strategies and campaigns. In addition to this, finding out what people need in order to start acting more water conscious will add to this goal even more. This is confirmed in research done by Clark and Finley (2007), as they explain that more research should be done to find out what people need in order to bridge the gap between their intentions to be water conscious, and them actually adopting water saving behaviour in their daily life's.

Therefore, the aim of this research is to find out which factors influence people's water consumption and what is needed in order for people to start acting more water conscious. The following research question is thus formulated:

*'What factors influence people's water consumption in the city of Groningen and what is needed to stimulate them to live more water conscious?'*

In order to answer the main research question, the following sub questions have been formulated:

- Which factors, as found in the literature, influence people's water consumption?
- What do people need to behave more water conscious?
- Are there striking differences between groups of people and what are these?

### **1.3 Reading guide**

Chapter 2 will focus on the theoretical background. Within this chapter the factors which could potentially influence water consumption will be discussed. Next, an overview of the literature will be given in the form of a conceptual model. Chapter 3 explains the methods, data collection process and analysis. Then in chapter 4, the results from the questionnaire are discussed and analysed. The last chapter will contain conclusions and recommendations for future research.

## 2. Theoretical framework

Sustainability is a popular term which is being used in relation to all kinds of aspects. A broad definition of the concept is given by Brundtland (1987), according to this report sustainability refers to 'meeting the needs of the present without compromising the ability of future generations to meet their own needs'. With regards to water, it is expected that the availability of fresh water will decrease due to climate change and a decrease in the water quality (Kourtis et al., 2019). Linking this to the definition of sustainability by Brundtland (1987), it is of importance that the current generation will reduce its water consumption so future generations are still able to meet their water needs. According to Ferdous Hoque (2014), water conservation does not automatically mean a decrease in performance or satisfaction of water usage, it is more about water efficiency, thus achieving the same result while using less water.

### 2.1 Awareness

An important step in changing people's water consumption habits is creating awareness about water sustainability. Awareness can be seen as the application of knowledge to a specific action or situation (Clark and Finley, 2007). Environmental awareness can be defined as follows: '*knowing the impact of human behaviour on the environment*' (Kollmuss and Agyeman, 2002). Different studies have shown that creating awareness amongst people can result in less water consumption. For example, a reduction of 57% was achieved in Melbourne through the use of awareness campaigns (Bryx and Bromberg, 2009). In the region of Canberra, Australia, domestic water consumption was reduced through education programmes by 19% between 2001 and 2004 (Dolnicar et al., 2012). And according to Abdulrazzak and Khan (1990), water consumption in Zaragoza, Spain decreased with 18% due to greater water awareness. This is also confirmed by Kollmuss and Agyeman (2002). They created a model explaining pro-environmental behaviour, of which water conservation is an example (Clark and Finley, 2007). One of the factors they mention that can lead to pro-environmental behaviour (or a lack there of) is indeed awareness (See figure 1).

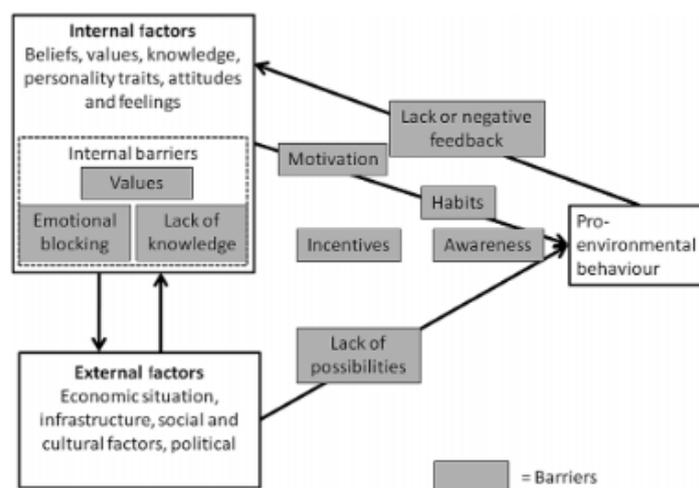
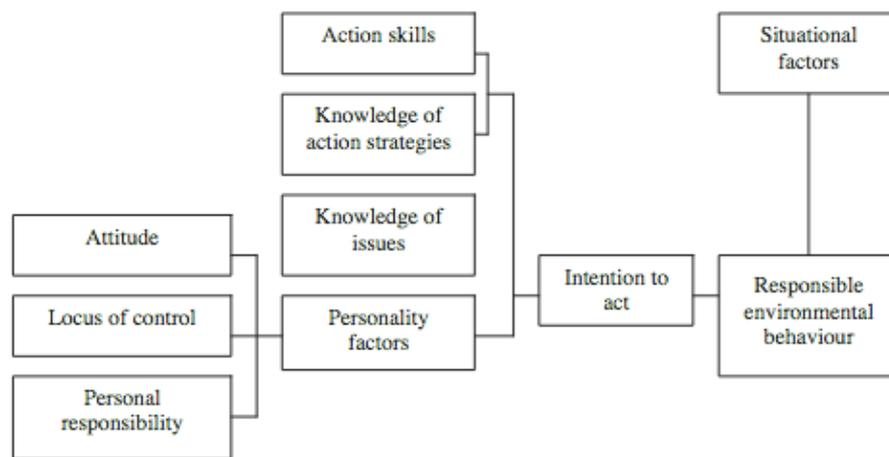


Figure 1: Model of pro-environmental behaviour.

Source: Kollmuss and Agyeman (2002).

They explain that environmental problems are not tangible for people, making them less aware of it. Thus, environmental problems need to be translated into understandable situations in order for people to be more aware. Another factor which influences environmental awareness is the slow

pace of environmental change. Humans are not good at perceiving slow changes (Kollmuss and Agyeman (2002), and therefore will not feel the direct urge to be more environmentally aware. This suggests that people who are aware of problems relating to water usage also show more water saving behaviour. An explanation for this is, according to Macovei (2015), that awareness of the problems' consequences and the need to act pro-environmental, which in turn can be accomplished by more information, results in stronger intentions to adopt pro-environmental behaviour. Chao (2012), explains that someone's intention to act pro-environmental depends, among other things, on knowledge of environmental issues (see figure 2). Thus, awareness and knowledge can create stronger intentions to behave environmentally conscious.



**Figure 2: Model of Responsible environmental behaviour.**

Source: Chao (2012).

However, according to Kaiser and Gutscher (2003), the link between people's intentions and their actual behaviour is weak. This is supported by Clark and Finley (2007), as they state that more research is needed to find out what people need in order to bridge the gap between their intention to be water conscious, and them actually adopting water saving behaviour. This would suggest that the link between awareness and behaviour in this case is also weak, because awareness of water related problems is present before the intention to consume less water. As Pelletier et al. (1998) explains, those who carry out environmental conscious behaviour usually do possess environmental knowledge, but knowledge itself does not always result in environmental conscious behaviour.

When looking at a specific group of people, namely students, research shows that this is the case. According to Yazici and Babalik (2016), students are in general aware of environmental problems and know what could be done in order to improve these, however this is often not translated into their daily habits. Or in other words, students do possess the knowledge and awareness but it does not result in environmental conscious behaviour. This shows that students might also be aware of their water consumption, but for some reason do not yet translate this knowledge into a more water conscious lifestyle. For student cities, like Groningen, this is an important group which needs to be stimulated to adapt a more water conscious lifestyle.

Furthermore, it is also important to know which variables influence people's water consumption. Knowing these can help to design successful water awareness methods, which in turn can result in a reduction of water usage among residents.

There are different factors influencing people's water consumption behaviour. Examples of this are income, household size and home ownership (Renwick and Archibald, 1998, Gregory and Di Leo, 2003, Syme et al., 2004). Moreover, other socio-demographic variables such as type of dwelling, and number of residents living in a household influence how people manage their water (Dolnicar et al., 2012).

## ***2.2 Personal factors***

Fan et al. (2014), explain that people who estimate their water consumption accurately have more water awareness and behave more water sustainable than people who underestimate their water consumption. Consumers with high incomes and education levels tend to overestimate their water consumption, while female's and people of a higher age estimate their water consumption accurately (Fan et al., 2014). Clark & Finley (2007), also confirm that older people are more likely to participate in water saving behaviour. But on the contrary to Fan et al. (2014), they explain that the role of gender on pro-environmental behaviour is not clear (Clark & Finley, 2007). When focusing on education, the same inconsistency is found within the literature. Fan et al. (2014), state that people with higher education levels are less likely to behave water conscious than people with lower education levels, because they tend to underestimate their water consumption, resulting in an increase of their water consumption. However, research done by Lam (2006) contradicts this, as this research shows that higher educated people had more intentions to be water conscious which can result in less water consumption. Thus, the influence of education on water consumption is not yet clear.

Ferdous Hoque (2014), determined multiple factors which influence domestic water consumption. Among these factors are personal factors such as household income and household size/ age composition. To begin with household income: ideas about the relationship between income and water consumption varies per research. Rubin (2003), explains that people with a higher income tend to use more water. Reasons for this being that rich people consume more goods and services related to water, while also living in bigger houses. However, Mainieri (1997), argues that rich people live in newer homes, including water saving technologies and so consume less water. With an increase in household size, an increase in total water consumption is expected. However, the water usage per capita will decrease when the household size increases (Ferdous Hoque, 2014). Thus, bigger households are more aware of their water consumption than smaller households.

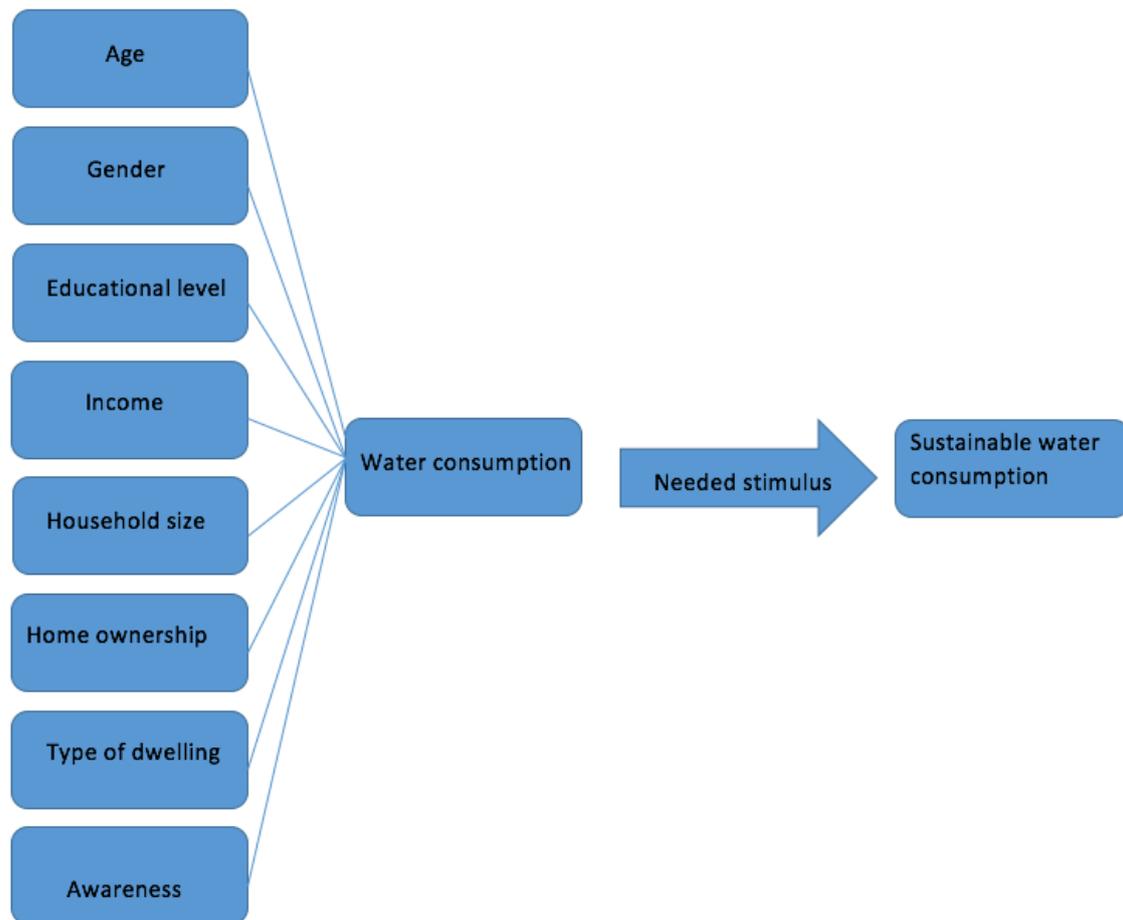
## ***2.3 External factors***

According to Ferdous Hoque (2014), not only personal factors influence domestic water consumption, external factors are also important. two of which are dwelling type and dwelling ownership. According to research done by Clark & Finley (2007), people living in detached houses have more intentions of conserving water. This is because they are in full control of their own water consumption and the benefits from saving water will result in benefits for them personally. Moreover, home owners have more control over their houses and thus are more likely to install water saving devices compared to tenants.

In addition to this, tenants do not receive a water bill like home owners do, making it a hidden part of their total rental costs. So, creating a situation in which tenants are less aware of their water consumption than home owners. This is also confirmed by Randolph and Troy (2008), who explain that home owners tend to engage in more water-efficient behaviour than tenants.

However, it is not enough to only know which factors influence a person's water consumption behaviour. As stated earlier, according to Kaiser and Gutscher (2003), the link between people's intention and their actual behaviour is weak. Thus, more research is needed in finding out what people need in order to bridge the gap between their intention to be water conscious, and them actually adopting water saving behaviour (Clark and Finley, 2007).

## 2.4 Conceptual model



*Figure 3: Conceptual model.*

*Source: This paper*

The conceptual model needs to be read from left to right. On the left side the factors are mentioned which are expected, as found and explained in the sections above, to have an influence on people's water consumption. These factors are: age, gender, educational level, income, household size, home ownership, type of dwelling, and awareness (Kollmuss and Agyeman, 2002; Fan et. Al, 2014; Clark and Finley, 2007; Lam, 2006; Ferdous Hoque, 2014). These factors will lead to people already engaging in water conscious behaviour or not. If this is not the case, there might be certain stimuli a person needs in order for them to start behaving more water conscious (Clark & Finley, 2007). These stimuli will become clear by analysing the gathered data.

## 2.5 Hypothesis

Multiple different researches have shown that personal characteristics such as age, gender, education level and income, together with external factors such as household size, home ownership, type of dwelling and awareness influence people's water consumption (Ferdous Hoque, 2014., Clark & Finley, 2007., Fan et al., 2014). Thus, the following hypothesis will be tested in this research:

- (i) Personal and external factors such as age, gender, education level, income, household size, home ownership, type of dwelling and awareness have influence on the water consumption of residents living in Groningen.
- (ii) Awareness alone is not enough for people to consume less water based on the fact that the link between awareness, intentions, and actual behaviour is weak.

### 3. Methodology

#### 3.1 Method and population

For this research it was chosen to collect primary data through the use of a questionnaire (see appendix). A total of 68 respondents filled in the questionnaire of whom 61 were complete. These questionnaires will give insight in the factors influencing people’s water consumption by asking the respondent multiple questions. By asking an open question, the second sub question was tried to be answered. The questionnaires were first spread within four different neighbourhoods in Groningen. These neighbourhoods were: Lewenborg Zuid, Reitdiep, Schildersbuurt, and Vinkhuizen Zuid. They are selected based on data available via CBS (2017). They are chosen because of their different residential and neighbourhood characteristics in order to get a wide variety of respondents (See table 1). Because it was known through the data what the average amount of income per neighbourhood is, questions related to income were initially not part of this questionnaire. Reason for this being that people might feel uncomfortable answering this question, and thus decide to leave it blank. However, after encountering some difficulties during the data collection process it was decided to also use the researchers own network in order to reach a sufficient amount of respondents. In section 3.3 these difficulties will be elaborated on further. This decision resulted in an extra question within the questionnaire; ‘What is your income (on a yearly basis)?’. This was necessary because for the people outside of the four selected neighbourhoods filling in the questionnaire the average income was not known.

*Table 1: Neighbourhood characteristics.*

*Source: CBS (2017).*

| Neighbourhood                    | Lewenborg Zuid | Vinkhuizen Zuid | Schildersbuurt | Reitdiep |
|----------------------------------|----------------|-----------------|----------------|----------|
| <b>Age</b>                       |                |                 |                |          |
| <15                              | 21%            | 17%             | 4%             | 30%      |
| 15-25                            | 11%            | 14%             | 46%            | 7%       |
| 25-45                            | 30%            | 21%             | 28%            | 33%      |
| 45-65                            | 25%            | 24%             | 14%            | 25%      |
| >65                              | 12%            | 24%             | 8%             | 5%       |
| <b>Type of dwelling</b>          |                |                 |                |          |
| Private property                 | 56%            | 22%             | 38%            | 88%      |
| Rental                           | 44%            | 78%             | 60%            | 12%      |
| <b>Income (x1000)</b>            |                |                 |                |          |
| Average income                   | 18             | 17              | 23             | 30       |
| Around or beneath social minimum | 14%            | 19%             | 9%             | 2%       |
| Low income                       | 14%            | 19%             | 12%            | 2%       |
| High income                      | 7%             | 6%              | 10%            | 46%      |

### ***3.2 Questionnaire***

Within the questionnaire, all factors that influence a person's water consumption according to the literature are present. These factors are; gender, age, education level, income, household size, home ownership, and type of dwelling. The respondents' water consumption is being questioned through questions 13, 14, 15, 16, 17, 18 and 19. It was chosen to not directly ask the respondents what their exact water consumption is, because it is expected that not many people know these exact numbers. The questions related to water consumption are based on an online water consumption simulator which was later on used in order to calculate the respondents water consumption on a yearly basis (Swde, 2020).

The last question; '*What do you need in order to start living (more) water conscious?*' (question 23) gives the respondents' the opportunity to explain what they need in order to start living water conscious. This question adds a small qualitative aspect to the research and results in a deeper understanding of the respondents' ideas about water consumption. By analysing the answers to this question, a distinction can be made between three different types of answers. This resulted in three categories; answers related to more information/awareness, financial related answers, and circumstance related answers. This makes it easier to analyse and interpret the data (Clifford et., 2016).

In all four neighbourhoods, Lewenborg zuid, Vinkhuizen zuid, Schildersbuurt, and Reitdiep the questionnaires were distributed. This was done by spreading pieces of paper with a QR code, which will lead to the online questionnaire, in the inhabitant's mailbox. The houses were chosen randomly. This method was chosen since it is not responsible to approach people on the streets within the current Covid-19 circumstances. By spreading the questionnaires like this, people could fill in the questionnaires in the safe space of their own home without me being in contact with them. Another advantage of this strategy is that this part of the data collection was entirely random, apart from selecting the neighbourhoods, due to the fact that the researcher has no information about the residents living in the houses. However, the second data collection method, using the researchers own network, was not random. This was taken into account when analysing the data.

With the use of a multiple linear regression the impact of the variables (age, gender, education level, income, household size, home ownership, type of dwelling and awareness) on water consumption was analysed. This test provides insight into whether there is a relationship between the different variables on the one hand and water consumption on the other hand. Water consumption being the dependent variable in this case, and the other factors being the independent variables. In order to calculate the respondents water consumption, the answers of questions 13, 14, 15, 16, 17, 18 and 19 were used to fill in an online water consumption simulator resulting in the amount of water (in m<sup>3</sup>) on a yearly basis. These results were then used to create a new ratio variable for water consumption. By using a Mann-Whitney and Kruskal-Wallis test, the difference in water consumption between groups based on age, gender, income and currently studying or currently not studying was being analysed.

### ***3.3 Ethics and reflection***

When conducting the research, through the use of questionnaires, it was tried to work as ethically responsible as possible. The anonymity of the respondents is ensured and their data is used in a confidential way (Clifford et al., 2016). All the respondents are processed anonymously within this research. Furthermore, at the start of the questionnaire it was explicitly stated that while filling in the questionnaire the respondent could, at any point, decide to stop participating. Additionally, the questionnaire could only be handed in if consent was given to use the data for this research. During the data collection process the researcher encountered some difficulties. First of all, it appeared to

be challenging to find enough respondents within the four initially chosen neighbourhoods. It turned out that spreading the questionnaire by putting it in people's mailbox did not result in enough respondents. This forced the researcher to change the data collection method. By spreading the questionnaire within the researchers own network a sufficient amount of respondents was established. Both strategies combined led to a number of 68 respondents in total. Moreover, letting go of the four neighbourhoods also meant adding the question '*What is your income (on a yearly basis)?*' to the questionnaire. Luckily, all respondents filled in this question. However, choosing to change the strategy does effect the data because the researcher's network tends to consist of more young people who attend higher levels of education. This could result in a less representative sample and needs to be taken into account while analysing the data.

## 4. Results and discussion

In this chapter it will be analysed if the factors as found in the literature; age, gender, education, income, household size, home ownership, type of dwelling and awareness, could potentially influence someone's water consumption. Furthermore, the answers to the question: 'What do you need in order to start living (more) water conscious?' will be analysed in order to see if any connections to the literature can be made.

*Table 2: Descriptive statistics respondents' questionnaire*

|                                     |              |
|-------------------------------------|--------------|
| Total amount of respondents         | 61 (100%)    |
| Amount of males                     | 14 (23%)     |
| Amount of females                   | 47 (77%)     |
| Mean age                            | 37 years old |
| Minimum age                         | 18 years old |
| Maximum age                         | 76 years old |
| Mean water consumption(per year)    | 50,20 m3     |
| Minimum water consumption(per year) | 23 m3        |
| Maximum water consumption(per year) | 74 m3        |

When looking at table 2, the mean water consumption of respondents in the dataset is 50,20 m3. This is almost the same as the yearly average from a person living in the Netherlands, which is 52 m3 (Waternet, 2016) This indicates that the dataset is an accurate reflection of the whole population. Within the dataset, more than 50% of the respondents (34 respondents) has a yearly water consumption between the 40m3 and 60m3. The maximum amount is 74m3 and the minimum is 23m3. This already illustrates that most people within the dataset do not use extremely much or extremely little water per year.

When comparing the average water consumption between different groups of people, there are some general outcomes that become visible. First of all, a small difference in mean water consumption between men and women can be found in the dataset (52 m3 for men and 49,66 m3 for women). This difference shows that women tend to use less water on a yearly basis (on average), than men. According to Fan et al. (2014), an explanation for this is that women tend to estimate their water consumption accurately, leading to more water conscious behaviour while men underestimate their their water consumption resulting in more water usage. To find out whether there is a statistical difference in water consumption between men en women a Mann-Whitney test was carried out in SPSS. The outcome shows that there is no statistical difference between men and women regarding their water consumption ( $P=0,630$ ) (see table 3). The same applies for currently studying or not. No statistical difference can be found between people who are currently attending HBO or WO, and people who are not ( $P=0,783$ ) (See table 4).

*Table 3: SPSS results Mann-Whitney; gender*

|                   | Z      | Sig.  |
|-------------------|--------|-------|
| Mann-Whitney test | -0,482 | 0,630 |

a. Grouping variable: Gender

*Table 4: SPSS results Mann-Whitney; studying*

|                   | Z      | Sig.  |
|-------------------|--------|-------|
| Mann-Whitney test | -0,275 | 0,783 |

a. Grouping variable: Currently studying

By using the Kruskal-Wallis Test, no statistical difference is found in water consumption between age groups (10-25 years old, 26-40 years old, 41-55 years old, 56-70 years old, and 71-85 years old) (see table 5). This is also the case for income groups (<€10.000, €10.000-€20.000, €20.000-30.000, €30.000-40.000, €40.000-€50.000, €50.000-€60.000, >€60.000) (see table 6). Between these groups, no difference can be found in water consumption.

These results show that there is no difference in water consumption between groups based on gender, age, income, and students and non students.

*Table 5: SPSS results Kruskal-Wallis; income*

|                     | Sig.  |
|---------------------|-------|
| Kruskal-Wallis test | 0,285 |

a. Grouping variable: Income

*Table 6: SPSS results Kruskal-Wallis; age*

|                     | Sig.  |
|---------------------|-------|
| Kruskal-Wallis test | 0,702 |

a. Grouping variable: Age

When dividing the respondents into two groups based on the question whether they made a conscious choice in the past week related to their water consumption, the difference is surprising. The average yearly water consumption of the group who declared to having made a conscious choice is higher than the group who did not made a conscious choice. Even though this difference is only small (52,39 m3 against 49,29 m3) it is an unusual outcome. It would be expected that the group whom made a conscious choice, and thus showing to be consciously behaving water sustainable in one way or the other, would also have lower water consumption rates per year compared to the group who did not make a conscious water related choice in the past week.

A multiple linear regression analysis was carried out in SPSS, testing whether there is a linear relationship between on the one hand water consumption and on the other hand the independent variables as found in the literature (age, gender, education, income, household size, home ownership, type of dwelling and awareness). The outcome of the overall test was not significant ( $P^{**}=0,994$ ) (see table 7). Meaning that in the population, no linear relationship was found between water consumption and the variables as mentioned above. When looking at the individual variables the same outcome is visible. None of the variables (age, gender, education, income, household size, home ownership, type of dwelling, and awareness) show a significant result. In other words, there is no linear relationship in the population between water consumption and age, water consumption and gender, water consumption and education, water consumption and income, water consumption and household size, water consumption and home ownership, water consumption and type of dwelling, and water consumption and awareness (see table 8).

This result contradicts the literature, as the literature did show a relationship between age, gender, education, income, household size, home ownership, type of dwelling, and awareness with water consumption. A possible explanation for the difference in outcome of this research compared to the literature could be the fact that this research is carried out in the city of Groningen. For example, research done by Fan et al. (2014), showing a relationship between water consumption and age, gender, and education, was performed in 16 rural villages. As this research targets urban residents instead of rural residents, this could be a possible explanation for the difference in results. Research done by Clark & Finley (2007), showing a relationship between water consumption and home ownership, type of dwelling, age, and gender, was carried out in a city almost 3 times less the size of Groningen. Again, this difference in city size could explain the different outcomes.

**Table 7: SPSS results multiple linear regression**

| Model        | Sum of Squares | df | Mean Square | F     | Sig.              |
|--------------|----------------|----|-------------|-------|-------------------|
| 1 Regression | 254,518        | 8  | 31,815      | 0,168 | .994 <sup>b</sup> |
| Residual     | 9833,121       | 52 | 189,098     |       |                   |
| Total        | 10087,639      | 60 |             |       |                   |

a. Dependent Variable: Water consumption

b. Predictors: (Constant), Awareness, Education, Gender, Income, Household size, Home ownership, Age, Type of dwelling

Note: p < 0,1, \*\*p < 0,05, \*\*\*p < 0,01

**Table 8: Significance levels multiple linear regression**

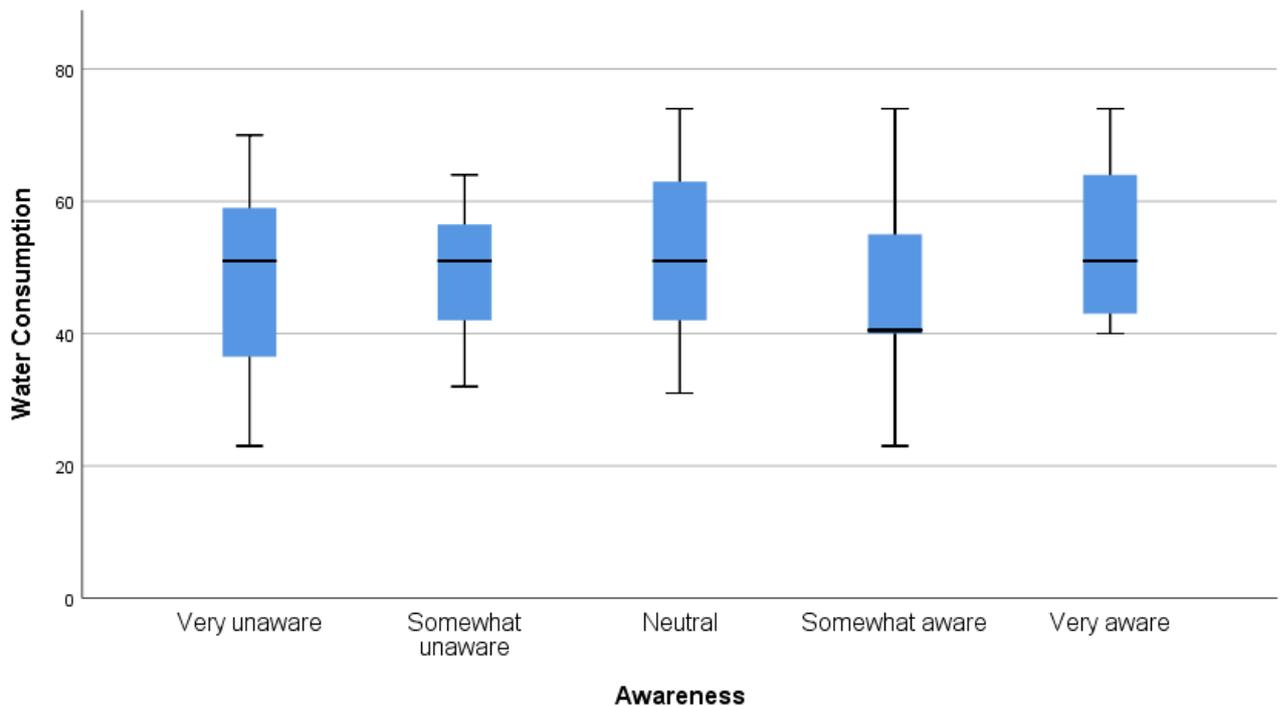
|                  | Sig.  |
|------------------|-------|
| (Constant)       | 0,000 |
| Gender           | 0,677 |
| Age              | 0,458 |
| Income           | 0,834 |
| Education        | 0,999 |
| Type of dwelling | 0,707 |
| Home ownership   | 0,960 |
| Household size   | 0,716 |
| Awareness        | 0,673 |

a. Dependent variable; Water Consumption.

Within the literature, awareness is seen as one of the most important aspects as to whether people live water conscious. According to Kollmuss and Agyeman (2002), awareness can lead to pro-environmental behaviour. This would suggest that people who are aware of problems with regards to water, also show more water saving behaviour. 42 respondents chose either neutral, somewhat aware or aware on the question if they are aware of the problems arising regarding the fresh water availability. Showing that these people do have some sort of awareness as to these problems. However, when analyzing if these people actually use less water compared to people who are not aware of these problems, the data shows that this is not the case. On the contrary, people who stated to be very aware of water related problems consumed more water on average than people who said to be very unaware of these problems (see table 9).

**Table 9: Results questionnaire awareness**

|                  | Mean water consumption (per year) |
|------------------|-----------------------------------|
| Very unaware     | 48,25 m3                          |
| Somewhat unaware | 49,36 m3                          |
| Neutral          | 52,26 m3                          |
| Somewhat aware   | 45,71 m3                          |
| Very aware       | 55,56 m3                          |



**Figure 4: Boxplot awareness**

When creating box plots to see whether there are any outliers pushing these values up (or down), no outliers are visible (see figure 4). Meaning that the mean water consumption for groups based on awareness is not influenced by outliers. The boxplots even show that the minimum water consumption of the group who are very aware is the highest out of all the groups. This outcome supports the theory of Kaiser and Gutscher, 2003; Clark & Finley, 2007; Chao, 2012, that people might be aware of the problems and have the intention to implement behaviour related to these problems, but this does not automatically mean they actually adopt this behaviour in their daily life's. Thus, it is even more important to know what people need in order to bridge this gap between intention and actual behaviour. Therefore, the last question asked in the questionnaire was 'What would you need in order to start living (more) water conscious?' The answers to this question can mostly be divided into three categories, namely answers related to more information/awareness, financial related answers, and circumstance related answers. Most answers are related to more information/awareness. 38 respondents argue that they need more information/awareness about the problem itself. According to the respondents, this can be established through governmental campaigns, more information about the problem on the news, and information on how they themselves can actually save water. 8 answers were related to finances. Most of these claimed that higher water costs would make them start living more water conscious, and others explained that if water saving techniques were cheaper they were more likely

to buy and implement these. A few (4) respondents indicated that when owning their own house, they would start living more water conscious. This shows that even though no statistical relationship between home ownership and water consumption can be found within this research, for some people owning their own house might in fact be a reason to adopt more water saving behaviour. One person even explained that when owning their own home, they would be more aware of their water consumption because this meant paying their own water bill instead of it being included into the rental price. The remaining 11 respondents left this question blank.

## 5. Conclusions and recommendations

This research attempted to find an answer to the following question: *'What factors influence people's water consumption in the city of Groningen and what is needed to stimulate them to live more water conscious'*. In order to do this, a quantitative research has been conducted through the use of a questionnaire. According to the statistical tests (multiple linear regression, Mann-Whitney, and Kruskal-Wallis) there is no linear relationship between on the one hand water consumption and on the other hand gender, age, income, education, dwelling type, home ownership, household size, and awareness.

Within this research, there is also no statistical difference in water consumption between age groups, income groups, groups based on gender, and groups based on students and non students. A possible explanation for the difference in results between this study and the literature could be the fact that this study is specifically focussed on a city. Research showing a relationship between water consumption and age, gender, education, home ownership, and type of dwelling, is focused on rural areas or cities smaller than Groningen (Fan et. al, 2014; Clark & Finley, 2007). However, more research in bigger and smaller cities is needed in order to confirm this difference.

An important outcome of this research is the fact that awareness does not always lead to lower water consumption levels. Table 9 even shows that the respondents who indicated to be very aware of the problems arising with regards to fresh water availability use more water on average than respondents who indicated to be very unaware of these problems. This confirms the outcomes of research done by Kaiser and Gutscher, (2003); Clark & Finley (2007); Chao (2012). They explain that the link between people's intentions to behave water conscious, and them actually adapting a water conscious lifestyle is weak. Showing that there is a gap between awareness, intentions, and actual behaviour that needs to be filled in order for people to start living (more) water conscious. Adding to this the outcome of no linear relationships between water consumption and age, gender, education level, income, household size, home ownership, type of dwelling and awareness, it appears that people are not consciously taking action to consume less water. This does not differ between gender, age groups, income groups, or people who are currently studying or not. These outcomes only underline the scope of the problem and the need for more awareness amongst individuals. The majority of the respondents mentioned more information or more awareness as a stimulus for them to start behaving more water conscious. In other words, people do not have enough knowledge about these problems or about what they themselves can do to help solve this problem. This conclusion is supported by Kollmuss and Agyman (2002). According to them, environmental problems are not tangible for people, making them less aware of them. By translating environmental problems into understandable situations, more awareness is created amongst people. These understandable situations will be even more effective in creating more awareness and knowledge, if they are translated into personal and tangible situations. Various respondents mentioned information about how they themselves can save more water as an important factor in behaving more water conscious. This will also create a more direct urge for people to be more water aware, which is important to create because humans are not good at perceiving slow changes and need to feel a direct urge to start living environmentally aware (Kollmuss and Agyeman, 2002). Creating this awareness, translating the problem regarding fresh water into a more personal situation, and showing people what they can do in order to save water, can be done through the use of the news, and governmental campaigns. Drinking water companies (drinkwaterbedrijven) like Vitens and water boards can also help with informing Dutch citizens about fresh water problems and possible solutions.

A weakness of this study is the way of data collection via the researchers own network and thus only reaching a small part of the research population. There are a lot more women and people with a higher education level who responded to the questionnaire than men and people with a lower

education level. This is important to keep in mind when looking at the results of this research. For future research it is advised to also use other ways of data collection to get a more representative and reliable data set.

In order to get even more insight into what can help people to live more water conscious, further research needs to be done. Through the use of in depth interviews more understanding of people's motivations, or lack there of, to live water conscious can be established. This information can then be used by policy makers in order to establish a fitting strategy aiming for people to consume less water resulting in a more resilient and sustainable way of water usage.

## References

- Abdulrazzak, M. and Khan, M., (1990). Domestic Water Conservation Potential in Saudi Arabia. *Environmental Management*, 14(2), pp.167-178.
- Aprile, M. and Fiorillo, D., (2017). Water conservation behavior and environmental concerns: Evidence from a representative sample of Italian individuals. *Journal of Cleaner Production*, 159, pp.119-129.
- Bates BC, Kundzewicz ZW, Wu S, Palutikof JP Eds. (2008). Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva,
- Brundtland, H., (1987). *Report Of The World Commission On Environment And development: Our Common Future*. [online] Available at: <<https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>> [Accessed 23 September 2020].
- Bryx, D. and Bromberg, G., (2009). Best practices in domestic water demand management. Tel Aviv, Israel: Friends of the Earth Middle East.
- CBS. (2019). *Forecast: 19 Million Inhabitants In 2039*. [online] Available at: <<https://www.cbs.nl/en-gb/news/2019/51/forecast-19-million-inhabitants-in-2039>> [Accessed 19 September 2020].
- Chao, Y., (2012). Predicting people's environmental behaviour: theory of planned behaviour and model of responsible environmental behaviour. *Environmental Education Research*, 18(4), pp.437-461.
- Clark, W. and Finley, J., (2007). Determinants of Water Conservation Intention in Blagoevgrad, Bulgaria. *Society & Natural Resources*, 20(7), pp.613-627.
- Clifford, N., French, S. and Valentine, G., (2016). *Key Methods In Geography*. London: SAGE Publications Ltd.
- De Oreo, W., Mayer, P., Dziegielewska, B., Kiefer, J., (2016). *Residential end uses of water, version 2*. Water Research Foundation, Denver.
- Dolnicar, S., Hurlimann, A. and Grün, B., (2012). Water conservation behavior in Australia. *Journal of Environmental Management*, 105, pp.44-52.
- Fan, L., Wang, F., Liu, G., Yang, X. and Qin, W., (2014). Public Perception of Water Consumption and Its Effects on Water Conservation Behavior. *Water*, 6(6), pp.1771-1784.
- Ferdous Hoque, S., (2014). *Water Conservation In Urban Households: Roles Of Prices, Policies And Technologies*. London: IWA Publishing.
- Gregory, G. and Leo, M., (2003). Repeated Behavior and Environmental Psychology: The Role of Personal Involvement and Habit Formation in Explaining Water Consumption. *Journal of Applied Social Psychology*, 33(6), pp.1261-1296.
- Kaiser, F. and Gutscher, H., (2003). The Proposition of a General Version of the Theory of Planned Behavior: Predicting Ecological Behavior. *Journal of Applied Social Psychology*, 33(3), pp.586-603.

Kemmelmeier, M., Król, G. and Kim, Y., (2002). Values, Economics, and Proenvironmental attitudes in 22 Societies. *Cross-Cultural Research*, 36(3).

Kollmuss, A. and Agyeman, J., (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), pp.239-260.

Kourtis, I., Kotsifakis, K., Feloni, E. and Baltas, E., (2019). Sustainable Water Resources Management in Small Greek Islands under Changing Climate. *Water*, 11(8), p.1694.

Lam, S., (2006). Predicting Intention to Save Water: Theory of Planned Behavior, Response Efficacy, Vulnerability, and Perceived Efficiency of Alternative Solutions. *Journal of Applied Social Psychology*, 36(11), pp.2803-2824.

Macovei, O., (2015). Applying the Theory of Planned Behavior in Predicting Pro-environmental Behaviour: The Case of Energy Conservation. *Journal of Danubian studies and research*, 5(2), pp.261 – 275.

Mainieri T., Barnett E. G., Valdero T. R., Unipan J. B. and Oskamp S. (1997). Green buying: The influence of environmental concern on consumer behavior. *The Journal of Social Psychology*, 137, 189– 204.

Memon, F. and Ward, S., (2015). *Alternative Water Supply Systems*. IWA Publishing.

Philip, S., Kew, S., van der Wiel, K., Wanders, N. and Jan van Oldenborgh, G., (2020). Regional differentiation in climate change induced drought trends in the Netherlands. *Environmental Research Letters*, [online] 15(9), p.094081. Available at: <<https://iopscience.iop.org/article/10.1088/1748-9326/ab97ca/pdf>> [Accessed 18 September 2020].

Randolph, B. and Troy, P., (2008). Attitudes to conservation and water consumption. *Environmental Science & Policy*, 11(5), pp.441-455.

Renwick, M. and Archibald, S., (1998). Demand Side Management Policies for Residential Water Use: Who Bears the Conservation Burden? *Land Economics*, 74(3), p.343.

RIVM, (2010). *Impact Of Climate Change On Water Quality In The Netherlands*. [online] Available at: <<https://www.rivm.nl/bibliotheek/rapporten/607800007.pdf>> [Accessed 21 September 2020].

Rubin S. J. (2003). The Cost of Water and Wastewater Service in the United States. *National Rural Association*, Duncan.

Statline. (2020). *Watergebruik Bedrijven En Particuliere Huishoudens; Nationale Rekeningen*. [online] Available at: <<https://www.cbs.nl/nl-nl/cijfers/detail/82883NED?dl=34A99>> [Accessed 22 September 2020].

Syme, G., Shao, Q., Po, M. and Campbell, E., (2004). Predicting and understanding home garden water use. *Landscape and Urban Planning*, 68(1), pp.121-128.

UN, (2019). *Population*. [online] Available at: <<https://www.un.org/en/sections/issues-depth/population/>> [Accessed 20 September 2020].

Waternet.nl. 2020. *Gemiddeld Waterverbruik*. [online] Available at: <<https://www.waternet.nl/service-en-contact/drinkwater/gemiddeld-waterverbruik/>> [Accessed 6 December 2020].

Yazici, N. and Babalik, A., (2016). Determination of environmental awareness of university students: the case of Suleyman Demirel University (SDU). *Environmental Earth Sciences*, 75(3).

## Appendix

### *Questionnaire: Water consumption*

---

Dear participant,

The researcher requests your consent for participating in a bachelor project study about water consumption at a domestic level. This bachelor project is part of the study programme 'Human Geography and Planning' at the University of Groningen. This consent form asks your permission to use the given answers in this questionnaire as data for this study. Participation in this study is completely voluntary and anonymous. If you decide not to participate there will be no negative consequences. Please be aware that if you do decide to participate, you may stop participating at any time. The researcher will maintain the confidentiality of the research records or data, and all data will be destroyed in 12 months. By agreeing with this form, you are indicating that you have read the description of the study, are over the age of 18, and that you agree to the terms as described. If you have any questions, or would like a copy of this consent letter, please contact me at [j.l.mijnheer@student.rug.nl](mailto:j.l.mijnheer@student.rug.nl). The questionnaire consists of a maximum of 23 multiple-choice and open questions and will take no longer than 5 minutes to complete. Thank you in advance for your participation!

Lieke Mijnheer

- Yes, I consent
- No, I do not consent

Q2 What is your gender?

- Male
- Female
- Other

-----

Q3 What is your age?

---

-----

Q4 In which neighbourhood do you live?

- Reitdiep
  - Lewenborg Zuid
  - Schildersbuurt
  - Vinkhuizen Zuid
  - Other, namely: \_\_\_\_\_
- 

Q5 What is your income (on a yearly basis)?

- <€10.000
  - €10.000 - €20.000
  - €20.000 - €30.000
  - €30.000 - €40.000
  - €40.000 - €50.000
  - €50.000 - €60.000
  - >€60.000
- 

Q5 What is the highest level of education you have attended?

- High school
  - MBO
  - HBO
  - University
  - Other, namely: \_\_\_\_\_
-

Q6 Are you currently attending HBO or WO education?

No

Yes

---

Q7 In what type of dwelling do you live?

Student room

Studio

Apartment

Terraced house

Semi-detached house

Detached house

Other, namely: \_\_\_\_\_

---

Q8 Do you rent or own your current dwelling?

Rent

Own

---

Q9 How many individuals live within your household (including yourself)?

\_\_\_\_\_

---

Q10 To what extent are you aware of the problems arising with regards to fresh water availability?  
(1= not at all aware, 5= very aware).

1

2

3

4

5

---

Q11 Where did you learn about this problem? (Multiple answers possible).

Social media

The news

Through others

Through my education

Other, namely: \_\_\_\_\_

---

Q12 Are there already ways in which you try to consume less water? If so, which? (Multiple answers possible)

- Using rainwater
- Showering as short as possible
- Turning off the tap while brushing your teeth
- Only using the washing machine when assembled enough dirty laundry
- Using a water saving shower head
- Using an eco-toilet button
- Other, namely: \_\_\_\_\_
- I do not yet try to consume less water in any way

-----

Q13 How many times per week (on average) do you take a shower or bath?

\_\_\_\_\_

-----

Q14 Does your shower have a water saving shower head?

- No
  - Yes
  - I do not know
- 

Q15 How many times per day (on average) do you flush the toilet?

\_\_\_\_\_

-----

Q16 Does your toilet have an eco-button?

- No
  - Yes
  - I do not know
- 

Q17 How many times a week (on average) do you use the washing machine?

\_\_\_\_\_

---

Q18 How do you do your dishes?

- By hand
  - I use a dishwasher
- 

Q19 How many times a week (on average) do you do the dishes?

\_\_\_\_\_

---

Q20 Do you use water saving techniques (Such as rain water harvesting or shower timer)?

- No
  - Yes, namely: \_\_\_\_\_
- 

Q21 What is your reason for using this technique(s)?

\_\_\_\_\_

---

Q22 Have you, in the last week, made a conscious choice related to your water consumption?

No

Yes, namely: \_\_\_\_\_

-----

Q23 What would you need in order to start living (more) water conscious

\_\_\_\_\_