Who even cares about water? It's a problem for the future.

A mixed methods study on reusing greywater to reduce Sweden's residential water consumption. The Case of Sörsjön.

Asfa Kashif Dodhy

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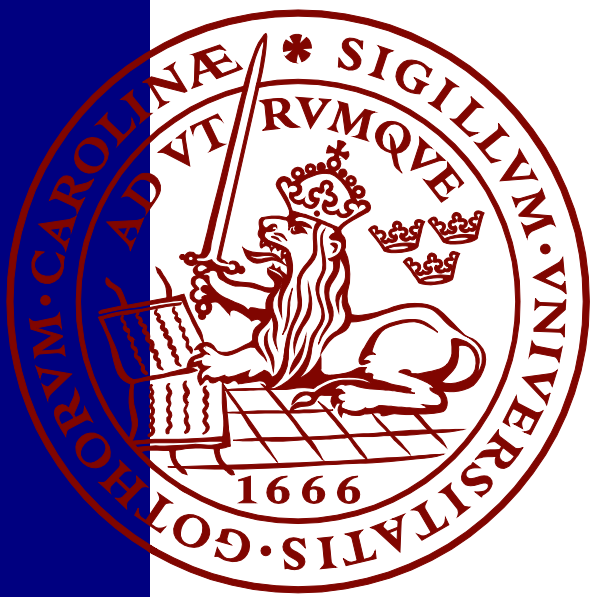

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Lund University Centre for Sustainability Studies

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Submitted May 12th 2024

Supervisor: Henner Busch, LUCSUS, Lund University

Note to Reader

This thesis is written in collaboration with the Sweden Water Research (SWR) and with close cooperation with Junehem. The thesis was co-supervised by Ellen Edefell from SWR, while Junehem was used as the case study for the thesis.

Abstract

Freshwater demand is expected to rise while supplies decline, putting pressure on water systems. Water conservation and determining potential alternative sources is imperative. The thesis aims to determine the effectiveness of greywater recycling as an alternative source in Sweden. Sörsjön was used as a case study and the roles of property owners and water utilities explored. The theory of planned behaviour and rebound effect were used. Data collection included field research questionnaires, quantitative documents, and unstructured interviews. Key findings comprised the need for awareness and knowledge on water alternative sources. There was high environmental concern among consumers but low willingness to change their consumption behaviours. There were varying opinions with greywater reuse for different purposes. It is crucial for an entity to take responsibility over decisions regarding alternative water sources (e.g., greywater). Property owners have a key role in the scalability of greywater integration. It may be problem for the future but why not take advantage of that and determine alternatives before issues arise.

Keywords: Circular wastewater, Water recycling, Household, Water alternatives, Consumer behaviour, Sustainable Consumption

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List of Abbreviations:

SWR	Sweden Water Research
RE	Rebound Effect
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
L/p/d	Litres per person per day
m^3/p/m	Cubic metre per person per month
UN SDG/SDG	United Nation's Sustainable Development Goals
RQ	Research Question
NSVA	Northwest Skåne Water and Wastewater/Nordvästra Skånes Vatten och Avlopp
PO1/PO2	Property Owner 1/Property Owner 2
WU1	Water Utility 1

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1 Introduction

1.1 The Problem

Climate change and water are interconnected, global water sources are impacted by climate change in various ways. Many consequences of climate change mainly impact water with the rising sea levels, droughts, floods, retreating ice sheets, unpredictable rainfall patterns (UN Water, 2024b). Climate change is disrupting water cycles and precipitation patterns, which is causing water related hazards and water scarcity to worsen, making it difficult to acquire safe drinking water (UNICEF, 2024). Furthermore, freshwater is only 3% of Earth's total water, and climate change is considerably decreasing its availability (Smart City Sweden, 2024). Over the last 20 years, terrestrial water storage is decreasing at a rate of 1 centimetre every year, significantly impacting water security (UN, 2023; WMO, 2021). Climate change is not the only problem as rapid population growth, urbanisation, and increased freshwater pollution have increased the pressure on water sources and limited freshwater availability (Ajit, 2016; Chen et al., 2013; Fielding et al., 2019; Tortajada & Nambiar, 2019). In other words, there is increasing demand for water but limited availability of clean drinking water due to water pollution and scarcity (Tortajada & Nambiar, 2019).

In the Swedish context, due to the abundance of freshwater sources, focus has been on improving water quality instead of the quantity, as historically water scarcity or the need for conserving water has not been a concern and therefore been overlooked (RISE, 2024; Smart City Sweden, 2024; UN Water, 2024a). Consumers residing in apartments have been found to overconsume water with an average of 140 litres/day, as they lack the knowledge of their consumption and the incentive to reduce their consumption to conserve water (Ejeklint, 2022; RISE, 2022). Since in most residential buildings their water bills are included in their rent and that they can only see their consumption once a year (RISE, 2022). Moreover, existing laws restrict water tariffs from increasing, which has resulted in the belief that water costs should remain low.

However, in recent years, Sweden has experienced prolonged periods of dry spells from minimal precipitation due to climate change resulting in unusually low availability of freshwater that particularly impacts southern and central Sweden (RISE, 2024; Smart City Sweden, 2024). These drought periods are also the only time water utilities or government entities can impose water consumption limits and prohibitions to conserve water (Krisinformation, 2024). Sweden's infrastructure for freshwater and wastewater is aging with its maintenance overdue, as the cost are much higher than what is being invested into the sector (Svenskt Vatten, 2023). Which is why there is

a need for Sweden to be better prepared for the future and determine alternative water sources for when water shortage increase and water quality declines (RISE, 2024).

1.2 Aim & Research Question

Therefore, the aim for this thesis is to determine the effectiveness of wastewater recycling as a solution to water overconsumption and an alternative water source. Accordingly, the overarching research question and three sub-research questions are as follows:

> ***RQ 1. How effective is integrating greywater recycling in reducing residential water consumption?***
>
> RQ 1.1. What knowledge do consumers have about their water consumption behaviours?
>
> RQ 1.2. What is the role of property owners and water utility companies in encouraging sustainable water consumption?
>
> RQ 1.3. How can greywater integration be a scalable solution to reducing residential water consumption?

1.3 Relevance to Sustainability Science

The thesis positions itself in sustainability science, a field that intends to observe and understand the complex interactions between nature and society (Clark & Dickson, 2003; Kates et al., 2001). Additionally, sustainability science is solution-focused, often using interdisciplinary approaches for tackling challenging problems. As this thesis will explore the interactions between consumer behaviour, water, and the use of alternative water sources to overcome water issues makes it applicable to sustainability science (Jerneck et al., 2011; Kates et al., 2001; Wiek & Iwaniec, 2014). Moreover, proper water management is crucial in sustainability science, as it not only concerns public health but also impacts the level and quality of ecosystem services, education, food security, and human rights (Spencer, 2021; Van de Walle et al., 2023). In several countries, strengthening the resilience of water management is part of many key development goals. Most importantly, on an international level, improving water management is part of the United Nations Sustainable Development Goal's (UN SDG), particularly SDG 6: Clean water and Sanitation (Spencer, 2021; UN SDG, 2024; Van de Walle et al., 2023). SDG 6 is crucial in achieving several of the other goals (i.e., the rest cannot be accomplished if the goal of water and sanitation is not accomplished first) (Sydvatten, 2020). Through this thesis I will be contributing to SDG target 6.3 (improve water quality, wastewater

treatment and safe reuse) and target 6.4 (increase water-use efficiency and ensure freshwater supplies). In Sweden there has been a need to adopt sustainable water practices with utility companies like Sydvatten which has developed a strategy to reduce 2% of freshwater consumption every year by 2040, with the intention of reducing household water consumption from 140 L/p/d to 100 L/p/d by 2040 (Sydvatten, 2024).

2 Background

In the following chapter I will introduce greywater as an alternative water source (2.1. and 2.1.1.) and its relation to consumption behaviour (2.1.2.), and the description of the case used for this thesis (2.2.).

2.1 Greywater

In the last decades as a result of improvements to living standards, rapid population growth, agricultural expansion, industrialisation, and rising pollution of water resources, greywater reuse has gained global attention (Al-Ghazawi et al., 2018; Fielding et al., 2019; Mahmoudi et al., 2021; Van de Walle et al., 2023). Greywater is referred to the wastewater produced from domestic and public consumption (i.e., showers, bathroom and kitchen sinks, and laundry) but excludes blackwater (i.e., toilet wastewater) (Jabornig & Favero, 2013; Khanam & Patidar, 2022; Mohamed et al., 2016, 2019; Noutsopoulos et al., 2018). Greywater is considered a resource as its generated by every household as compared to the freshwater supplies that are dependent on weather conditions (Mohamed et al., 2013). Through greywater treatment systems the reused greywater can be used to combat global water scarcity (Khanam & Patidar, 2022; Oteng-Peprah et al., 2020). The average volume of residential greywater ranges from 90 to 120 litres per person per day (L/p/d), which depends on factors like living standards, lifestyle and habits, demographics (age/gender), water installations and the extent of water abundance (Morel & Diener, 2006; Noutsopoulos et al., 2018).

Residential greywater production is thought to be around 50-80% of total residential wastewater generated (around 135 L/p/d) (Gyapong-Korsah et al., 2023; Li et al., 2009; Noutsopoulos et al., 2018). Therefore, it is a potential solution to water overconsumption or scarcity as greywater reuse would result in improved resilience and adaptability for local water systems and significantly reduce domestic water consumption (Bakare et al., 2016; Van de Walle et al., 2023). This can be achieved through separating blackwater and greywater and treating the greywater on-site in order to encourage its reuse for toilet flushing and/or garden irrigation, as respectively they make up 30 to 40% of daily water needs (Bakare et al., 2016; Khanam & Patidar, 2022; Noutsopoulos et al., 2018).

2.1.1 Challenges and Opportunities for Greywater

Generally, some challenges in implementing greywater reuse in residential buildings include the need for separate piping systems in construction projects with higher investment costs, the public's perception related to the "yuck factor" for greywater, and lack of advancements and research in the water sector (particularly due to technology lock-in effects) (Mankad & Tapsuwan, 2011; Rabaey et al., 2020; Van de Walle et al., 2023). Furthermore, treatment plans for greywater are case specific as

greywater characteristics differ, being determined by seasonal shifts, living standards, and demographics (Van de Walle et al., 2023). The absence and/or limited legislative framework in several countries have inhibited with the development and integration of wastewater reuse systems (Van de Walle et al., 2023). It is often necessary to make direct in-person assessments of water quality when considering greywater reuse for specific household applications in urban reuse purposes (Van de Walle et al., 2023). There is also a shortage of international greywater reuse guidelines, existing ones tend to not coincide with the other nations and organisations guidelines hindering the effective comparison of the two policies (Capodaglio, 2021; Van de Walle et al., 2023).

Additionally, there is concern if greywater is not managed or treated correctly, it may contain contaminants that could possibly cause health and environmental issues (Gyapong-Korsah et al., 2023; Li et al., 2009; Yu et al., 2013). Lastly, the main market for greywater treatment systems are building developers but they are greatly influenced by their end customers (i.e., the tenants) and due to the lack of legislations or regulations on recycled water they prefer to avoid integrating recycled water (Van de Walle et al., 2023). Consumer acceptance towards reused greywater varies depending on a range of factors (Van de Walle et al., 2023), which will be discussed in further detail in the thesis. Despite the challenges, Juan et al. (2016) and Mahmoudi et al. (2021) state that in respect to public acceptance, reusing greywater as a method of water reclamation is less stigmatised as compared to other forms of recycled water (e.g. blackwater), and is more economically and technically sound. Greywater reuse is still a feasible solution for reducing residential freshwater consumption, it has been implemented and/or researched in places such as South Africa, Australia, Jordan, Oman, Sweden United Arab Emirates, and Ghana (Bakare et al., 2016; Brown & Davies, 2007; Jamrah et al., 2006, 2008; Junehem, 2024; Maraqa & Ghoudi, 2015; Oteng-Peprah et al., 2020). A recent study found that from the average Swedish consumption of 140 L/p/d, greywater had amounted to 90 L/p/d and 30 L/p/d were used only for flushing toilets (Ejeklint, 2022). Therefore, Sweden could save up to an average of 10,950 litres per person per year of freshwater, just through flushing toilets using greywater.

2.1.2 Greywater and Behaviour

There have been several studies conducted on greywater reuse many of which focused on the natural sciences or technological side of it (e.g., determining greywater quality based on organic and chemical compounds) (Jabornig & Favero, 2013; Khanam & Patidar, 2022; Mohamed et al., 2016, 2019; Noutsopoulos et al., 2018; Van de Walle et al., 2023). On the other hand, Fielding et al. (2019); Gyapong-Korsah et al. (2023); Oteng-Peprah et al. (2020); Van de Walle et al. (2023) and Bakare et al. (2016) are some who have conducted research assessing the role of behaviour in the consumption of reused greywater. Gyapong-Korsah et al. (2023) and Oteng-Peprah et al. (2020) looked into greywater

reuse and consumer willingness in Ghana, similarly, Bakare et al. (2016) researched public attitudes on greywater reuse in low-cost housing in South Africa, Van de Walle et al. (2023) explored greywater reuse in managing wastewater in the urban context, and Fielding et al. (2019) examined public acceptance of reusing water.

It was found that people had higher intentions to adopt a greywater treatment system if they perceived the system would minimise environmental hazards and pollution and provide financial relief (water bills) (Bakare et al., 2016; Fielding et al., 2019; Oteng-Peprah et al., 2020; Van de Walle et al., 2023). Some main findings highlight the need for awareness and knowledge on the treatment systems, to overcome the initial financial commitment, the necessity for water quality assurance and clearer legal guidelines (Fielding et al., 2019; Oteng-Peprah et al., 2020; Van de Walle et al., 2023). The acceptance rate of greywater reuse was higher, if consumers had more general knowledge and awareness of water treatment systems (Fielding et al., 2019). Demographics, particularly age, was found to be a significant determinant on the likelihood of accepting of greywater reuse. Compared to other age groups, those between the ages of 20-29 demonstrated higher willingness for greywater reuse (Bakare et al., 2016; Gyapong-Korsah et al., 2023). There has not been any research specifically done in the context of Sweden that focused on the correlation between greywater reuse and consumer perception while exploring the perspectives of different actors involved (i.e., property owners/developers and water utility companies), like I will attempt with this thesis.

2.2 Case Description: Sörsjön

I will be using Sörsjön as the case study for this thesis. Located in the locality of Taberg and situated in Jönköping Municipality, Sörsjön are the apartment buildings built with a focus on sustainability by the property developers Junehem that have integrated greywater reuse systems into the construction. The construction began in Autumn 2020 with the first stage (Etapp 1) and construction for the project is expected to end with stage 2 (Etapp 2) in Summer 2024 (see figure 2.1) (Junehem, 2024). Upon completion there will be a total of 11 buildings (of which 6 were complete at the time this research was conducted) with 143 apartments, with stage 1 consisting of 62 apartments and 81 in stage 2. At the time I conducted this research, buildings 12, 10, 9, 7, 6, and 5 were occupied. The apartments range from 1 to 5 rooms and the tenants move in as construction for each building is completed (Junehem, 2024). There are greywater treatment tanks installed for each building, the tanks treat the greywater coming from the tenants' showers and bathroom sinks. The treated water is then pumped back into the apartments and used to flush toilets (Junehem, 2024). There are also individual water metering systems in each apartment, measuring treated greywater, hot-, and cold-water consumption. The tenants are billed for their hot and cold-water consumption and not for greywater. Tenants living at

Sörsjön could also see their consumption of electricity, hot and cold water through Mina Sidor (My Page) on Junehem's website. Mina Sidor also indicates the percentage difference in the tenant's consumption compared to the previous month, the tenant can also observe their consumption patterns by being able to compare their consumption data from the previous year.

Figure 2.1. Plan of Sörsjön (Junehem, 2024)

3 Theory

The theoretical framework of this thesis is based on the Theory of Planned Behaviour (TPB) and the Rebound Effect (RE). As I was interested in determining behaviour of consumers living in residential buildings, I therefore looked for a behavioural theory and decided to use the TPB for this thesis. Afterwards, to supplement the TPB I made use of RE despite it being an energy theory.

3.1 Theory of Planned Behaviour (TPB)

3.1.1 Definition, Origins, & Variables

TPB is a social cognitive model that is interested in understanding an individual's intentions behind behaving in a particular way (Oteng-Peprah et al., 2020; Raudkivi, 2020). As the theory implies that behaviour is predetermined, it assesses any intentional behaviour (Ajzen, 1991). TPB is where intentions are regarded when acquiring motivational influences that impact behaviour and illustrate an individual's willingness and effort which they plan on using for a behavioural action (Raudkivi, 2020). The theory states that an individual's 1. attitude towards a behaviour, 2. their interpretation of subjective norms of society surrounding the behaviour, and 3. the degree to which they perceive themselves to have control over the behaviour, are the factors that directly shape their intentions to engage in a behaviour or action (Ajzen, 1991; Arafat & Ibrahim, 2018; Fishbein, 2000). Which therefore form the three main variables of the TPB: Attitude, Subjective Norms, and Perceived Behavioural Control, that together guide a person's behavioural Intentions (Figure 3.1.) (Ajzen, 1991). The strongest predictor of behaviour is thought to be Behavioural Intentions (Arafat & Ibrahim, 2018; Gibson et al., 2023). Behavioural intentions are not directly impacted by a person's demographics, but it could indirectly influence behavioural intentions through attitude and subjective norms (Ajzen, 1991). TPB is based on the Theory of Reasoned Action (TRA) model (Fishbein & Ajzen, 1977), compared to the TRA the TPB had the addition of perceived behavioural control, as it became apparent that behaviour was not always voluntary and controllable (Arafat & Ibrahim, 2018).

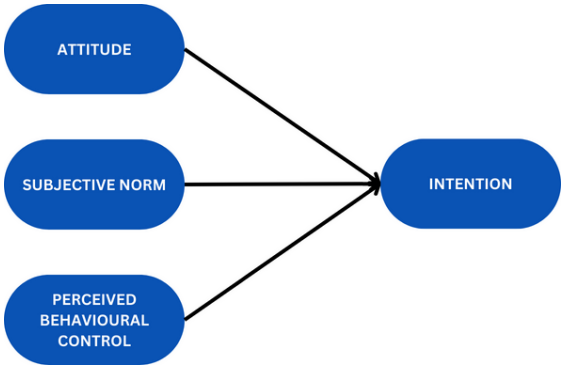

Figure 3.1. Theory of Planned Behaviour Model (Ajzen, 1991)

In the theory, attitude is described as a person's negative or positive feelings related to conducting a particular behaviour (Ajzen, 1991; Oteng-Peprah et al., 2020). Furthermore, if a person believes that engaging in a behaviour would lead to generally favourable results, only then would they hold a positive attitude towards the behaviour. Thus, one's attitude regarding a behaviour represents their positive or negative evaluation on conducting that behaviour (Ajzen, 1991; Oteng-Peprah et al., 2020). Meanwhile, subjective norm is described as the perceived social pressure to perform or not to perform a behaviour. It is the result of a behaviour or intention being approved or disapproved of by significant peers (Ajzen, 1991; Oteng-Peprah et al., 2020). Lastly, perceived behavioural control involves one's belief in their capacity to execute a specific behaviour (Ajzen, 1991; Oteng-Peprah et al., 2020). In this thesis the behaviour in question is the resident's willingness and consumption behaviour in reusing greywater and reducing their water consumption.

3.1.2 Criticisms

There have been plenty of criticism for the TPB. It has been criticised for solely focusing on rational reasoning and disregarding the underlying factors influencing behaviour, along with the function of emotions beyond the expected affective consequences (Botetzagias et al., 2015; Conner et al., 2013; Sheeran et al., 2013). McEachan et al. (2011), criticise that the theory's static explanatory characteristic makes it difficult to comprehend how behaviour is shown to impact cognitions and future behaviour. Similarly, the theory undermines the impacts and explanatory power of social norms (Gao et al., 2017; Zhang et al., 2014). Ajzen (1991), states that social norm could be divided into subjective and descriptive norm. However, the TPB often considers social norm as subjective norm, which is why, the impact of subjective norms on one's behavioural intentions is rather limited in TPB (Gao et al., 2017; Zhang et al., 2014). Another shortcoming is the restricted predictive validity of TPB, as it has been discovered that most of the variability in observed behaviour cannot be explained by the TPB variables

(Sniehotta et al., 2014). Specifically, TPB fails to address the issue of 'inclined abstainers' or people who have the intention but choose not to act on it (Orbell & Sheeran, 1998). Lastly, Sniehotta et al., (2014) considers TPB an outdated model as a majority of researchers tend to use extended versions of the theory (i.e., adding variables) since the TPB on its own provides insufficient explanation on human behaviour. To address these criticisms, I will also be extending the TPB to better fit the purpose of this thesis.

3.1.3 Extended TPB

According to Ajzen (1991), additional explanatory variables could potentially be integrated to the theory as long as it can be demonstrated that they make a significant and discernible contribution, while referring to the 'sufficiency' of the theory. Several researchers have also theoretically endorsed the addition of more variables to the TPB, as it was seen to increase explanatory power (Botetzagias et al., 2015; Christian et al., 2007; Gao et al., 2017; Oteng-Peprah et al., 2020; Thøgersen & Ölander, 2006). However, Sniehotta et al. (2014) have advised against including additional variables as it prevents any progress in the development of the model. Nevertheless, additional variables have been included in many studies using TPB (Botetzagias et al., 2015). Furthermore, Oteng-Peprah et al. (2020) had found the extended TPB to be better at anticipating people's willingness to adopt a household greywater treatment system. Therefore, I will be using TPB by extending it to incorporate the additional variables of Perceived Personal Norm, Descriptive Norm, Intervening Factors (Figure 3.2.).

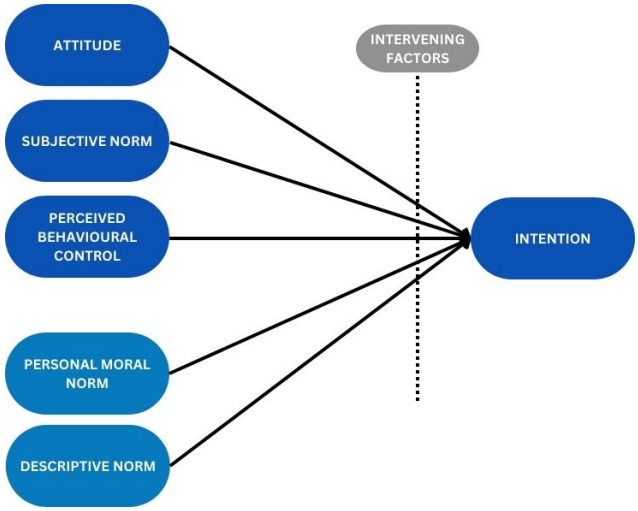

Figure 3.2. Extended TPB [Own Figure- adapted from Gao et al. (2017)]

Previous studies have found that integrating the personal moral norm variable allowed for improved explanatory power, especially as one's intention to engage in environmentally conscious behaviour is notably influenced by personal moral norm (Chen & Tung, 2014; Kaiser & Scheuthle, 2003). Personal moral norm is described as the individualist belief that determines the extent of one's intent to carry out a certain behavioural action that reflects their personal responsibility or duty (Kaiser & Scheuthle, 2003; Manstead, 1999). Similarly, descriptive norm is where in a certain situation what others do essentially determines or influences your decision on whether to engage in that behaviour or not (Gao et al., 2017; Graham-Rowe et al., 2015; Jun & Arendt, 2016). The explanatory power of the TPB has been seen to improve with the inclusion of descriptive norms (Gao et al., 2017; Manning, 2009; Rivis & Sheeran, 2003). Suggesting that the more social pressure an individual experiences, the higher their behavioural intention (Kim et al., 2003; Rah et al., 2004). An interesting variable to the extended TPB found was intervening factors which act as a form of external barrier to a person engaging in a behaviour despite having high behavioural intentions (Ajzen, 1991; Gibson et al., 2023; Stern, 2018). For instance, due to financial constraints people may be unable to have water saving technologies like low flow shower heads or simply lack the knowledge for water conserving behaviours (Gibson et al., 2023). Intervening factors will be looked at through the perspective of water utilities and property owners (RQ 1.2.), while the rest of the variables will be applied on consumers (RQ 1.1.).

3.2 Rebound Effect (RE)

3.2.1 Definition

The rebound effect is a theory developed for the impact of energy efficient technology on energy consumption (Brookes, 1990; Jevons, 1866; Khazzoom, 1980). Jevons (1866) first coined the concept of the RE by discovering efficient steam engines to reduce coal consumption along with its price, leading to a rise in demand for coal. REs are the unintentional outcomes of increased resource efficiency (Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008). York & McGee (2016, p.76) define the rebound effect as "any circumstance where efficiency improves by X%, but resource consumption declines by something less than X% or increases". In other words, it is when advancements from resource efficient technologies partially offset the amount of resource conserved, which is a result of behavioural and systemic responses (Song et al., 2018; Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008; Vivanco et al., 2018).

3.2.2 Role of RE in Other Fields and in This Thesis

Despite the RE being a concept mainly used in energy research, I will apply it in the context of water consumption as the thesis aims to explore the relation between greywater reuse and water

consumption. The energy efficient technology would be the greywater treatment and reuse systems and the energy consumption would be the water consumption in this thesis's context. The RE could be expanded on to other resources but unlike energy use there is limited empirical evidence (Freire-González, 2019). There have been studies conducted in the context of water with the focus on the direct RE. Furthermore, most previous research analysed impacts on agriculture and irrigation systems from water productivity improvements (Berbel et al., 2015; Berbel & Mateos, 2014; Freire-González, 2019; Pfeiffer & Lin, 2014; Song et al., 2018).

3.2.3 Types of Rebound Effects

There are three types of rebound effects: 1. Direct, 2. Indirect, and 3. Economy-wide (Sonnberger & Gross, 2018). The first two observe behavioural and systemic responses to the resource efficiency on a micro-level (household or consumer), meanwhile the third type is on a macro-level (whole economy) (Sonnberger & Gross, 2018). Direct REs are when there is a rise in demand for a good/service after a resource efficient advancement is developed of the *same* good/service, causing the offset of prospective resource savings (Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008). For instance, travelling longer distances or taking frequent drives on an electric car as it is more sustainable (Sonnberger & Gross, 2018). Similarly, indirect REs is where there is an increased demand for goods/services paid for through monetary savings from costs reductions by an improvement in resource efficiency in *another* good/service (Freire-González, 2019; Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008). For example, cost savings from a more energy efficient heating system are then invested in extra car rides (Sonnberger & Gross, 2018). Finally, economy-wide is where resource-efficient advancements stimulate economic growth, which in turn increases consumption (Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008).

Micro-level rebounds have economic and psychological triggering factors, with the former referring to time and monetary savings, and the latter referring to moral licensing (Azevedo, 2014; Binswanger, 2004; Santarius & Soland, 2018; Sonnberger & Gross, 2018). Moral licensing is when consumers feel the right to consume more of a resource as they believe they have done enough for the environment through having increased resource efficiency in their homes or appliances (Vivanco et al., 2022). Therefore, I will be focusing on the direct rebound effect while investigating the moral licensing of consumers as a trigger for direct rebounds of greywater reuse on freshwater consumption. Direct rebounds and moral licensing will be examined by combining it with the Attitude variable in the extended TPB (Figure 3.2.).

3.2.4 Criticisms & Support

Vivanco et al. (2022) identified two key problems with the rebound effect theory: 1. The lack of regard for the multidimensional nature of rebound effects, which can have positive and negative effects simultaneously, and 2. An overall failure to address behavioural effects. There has also been criticism on moral-licensing's sole focus on the individual consumer, disregarding the social structural restraints that pushes individuals to engage in rebound behaviours (Labanca & Bertoldi, 2018; Ruzzenenti & Wagner, 2018; Vivanco et al., 2022). Furthermore, to assess a combined effect it was found that the different types of rebound effects cannot be merged, as the existence of one would undermine the other. For instance, in the situation that both direct and indirect REs apply, the outcome is less than the total as any direct RE reduces the amount of available money to be spent elsewhere (Gillingham et al., 2013). Gillingham et al. (2013), also note that the impacts from REs are limited and should not be a justification for inaction. Even though consumers would, for example, drive longer distances on fuel-efficient vehicles, overall, those vehicles would still save energy (Gillingham et al., 2013). However, there is support for future research on the rebound effect as it may be able to shed light on why strategies such as the circular economy, are not as successful as anticipated, and why major goals like the SDGs have a high probability of not being accomplished entirely (Vivanco et al., 2022).

4 Methodology

This thesis applied a critical realist ontological and epistemological position which acknowledges that the observed reality of the social world can only be understood and changed if the underlying structures that form reality are identified and studied (Bryman, 2012). As a result, it's crucial to examine the background of an observed phenomenon to understand these structures (Bryman, 2012). Accordingly, this thesis studies the underlying structures that shape the extent of knowledge people have on their water consumption behaviour. A critical realist perspective is applied as the role of property owners and water utility companies will be studied.

4.1 Methodological Approach

As this thesis required different aspects and perspectives to be understood a mixed methods approach was used which comprises of a study that gathers and analyses both qualitative and quantitative data separately and then concurrently or sequentially merging them to draw findings to answer the research questions (Creswell & Plano Clark, 2011; Creswell & Creswell, 2023). An exploratory sequential mixed methods research design was selected to broadly explore and understand water consumption practices and behaviours towards greywater (Figure 4.1). Table 4.1 below indicates the RQ, and which method (qualitative, quantitative, or both) was used.

Table 4.1. RQ and Method Used

RQ	Data Collection Type:
1. How effective is integrating greywater recycling in reducing residential water consumption?	**Qualitative & Quantitative**
1.1. What knowledge do consumers have about their water consumption behaviours?	Quantitative
1.2. What is the role of property owners and water utility companies in encouraging sustainable water consumption?	Qualitative
1.3. How can greywater integration be a scalable solution to reducing residential water consumption?	Qualitative & Quantitative

The intent of the design is to explore how qualitative data can improve quantitative measures, scales, or instruments (Creswell & Creswell, 2023). The research design is where qualitative data is collected

and analysed first, the themes found are used to form/develop the quantitative research to further investigate the research question (Figure 4.1) (Berman, 2017; Creswell & Plano Clark, 2011). This research design leads to three stages of analyses: the primary qualitative phase, the secondary quantitative phase, and finally the integration phase which links the two sets of data and expands the primary qualitative exploratory results (Creswell & Plano Clark, 2011). This research however added a tertiary qualitative phase before the integration. In other words, I have taken an iterative approach with the data collection.

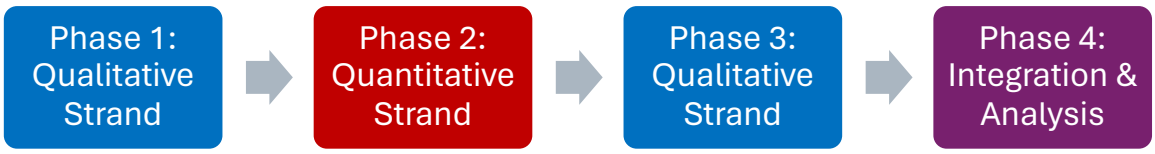

Figure 4.1. Exploratory Sequential Mixed Methods Research

4.2 Data Collection & Analysis

There are a total of 4 sets of data collected in this thesis: 1. Informal interviews and observation notes from fieldwork, 2. Questionnaire results, 3. Quantitative Documents: Consumption data from Sörsjön, 4. Interview with an employee from the water utility company. The results from each data set were used as a basis to develop the other data sets and later all the data was integrated together to draw the discussions for this thesis. The Figure 4.2. below provides a visualisation of the data collection timeline.

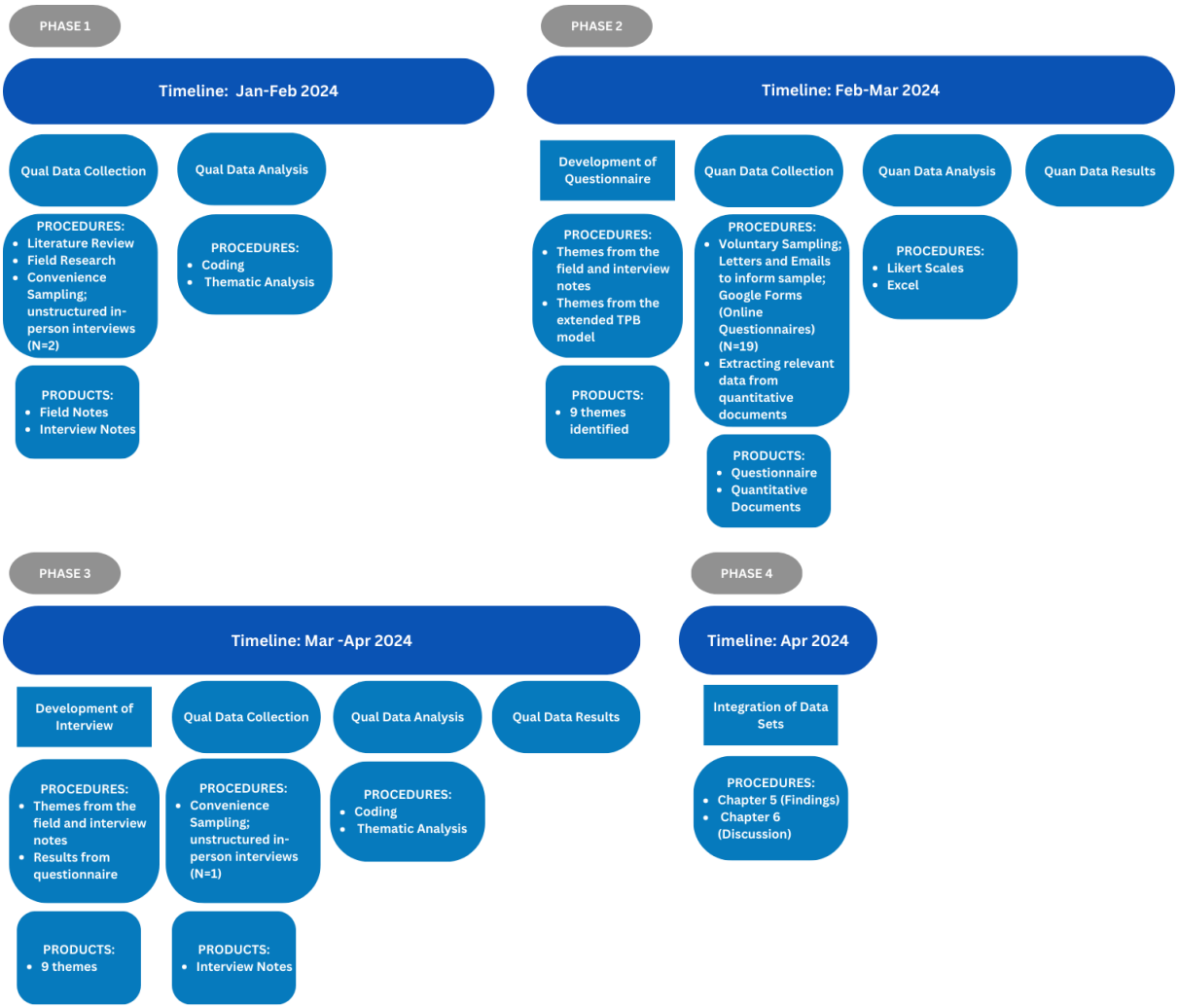

Figure 4.2. Data Collection & Analysis Timeline

4.2.1 Phase 1 (Qualitative)

I first conducted field research by visiting Junehem and the site of Sörsjön. Field research is defined as involving "acquiring information, using any set of appropriate data collection techniques, for qualitative, quantitative, or experimental analysis through embedded research whose location and duration is dependent on the project" (Irgil et al., 2021, p.1500). The purpose of the field research was to gather data through observation and unstructured interviews to answer RQ 1.2. and to build a basis for RQ 1.3. Prior to the field visit I had noted some specific aspects that needed to be researched. For instance, gain insights and form an understanding on how the greywater treatment system works, and see how water consumption is measured at the apartments (Figure 4.3). Findings from observation were recorded through field notes, which were then refined and recorded on to Google Docs.

Figure 4.3. Individual Water Meters (Left: Cold and Greywater; Right: Hot)

I conducted two unstructured interviews with employees at Junehem. Unstructured interviews are where a list of topics to be discussed are prepared beforehand and the questioning style is informal (Bryman, 2012). The topics discussed in the interviews were how communication occurs between them (as the landlords) and the tenants, the role of Junehem as a property owner in developing and constructing housing with greywater reuse, challenges they experienced with Sörsjön, and to clarify any questions I had during the site visit. I used unstructured interviews as they entailed a conversational style interview that was flexible and free flowing and allowed for adapting the interview based on what seemed relevant to the thesis (Bryman, 2012). I used thematic analysis to code the interview, and field notes to identify 9 themes.

4.2.2 Phase 2 (Quantitative)

The findings from the field research and theory were used to formulate the self-administered questionnaire. The questionnaire was designed and targeted for tenants living in Sörsjön, to explore the extent of their knowledge on their water consumption patterns and insights on their views on greywater reuse (RQ 1.1.). The structure of the questionnaire was based on the TPB, however, before distributing the questionnaire the structure was adapted to be more respondent friendly (Appendix 9.1.)

Questionnaires are easy to administer, allow for flexible analysis, and are convenient for the respondents; however, they are prone to bias, rely on the respondent's memory, and the respondents cannot be probed or prompted (Bryman, 2012; Nordfält & Ahlbom, 2024). Due to the nature of the sample a questionnaire was used as it would be more accessible and prone to responses as compared

to a qualitative method. The questionnaire used voluntary sampling and was conducted through Google Forms. For inclusivity, the questionnaire was conducted in English and Swedish, the English version was made first and later translated into Swedish. The translation was reviewed by Ellen Edefell from SWR, a native Swedish speaker, to ensure that it matched the English version.

A week before the questionnaire was distributed a letter was sent to the tenants informing them of the research and it purpose. The tenants then received a second letter containing further information and QR codes to the questionnaires. A week later a reminder email was also sent. Around 60 responses were contacted out of which 19 responded (31.6% response rate), with the Swedish version observing the most responses. As both versions are the same the results from the Swedish and English versions were combined to allow for smoother analysis. The analysis was done through the results summaries automatically generated by Google Forms.

During the field visit, I was also able to collect quantitative documents on the water consumption data of the tenants at Sörsjön. Such quantitative data was needed to compare the tenant's perceived consumption (derived from the questionnaire results) to their actual consumption contributing to RQ 1.1. Monthly consumption averages from April 2023 to April 2024 were extracted first by segregating the cold, hot, and greywater consumption data based on apartment size (i.e., number of rooms) in each building on Excel. The consumption averages were then divided with the average number of people living in apartments to determine the average consumption m^3/p/m. The data was taken from buildings in Stage 1, as they were occupied for longer compared to buildings in Stage 2.

4.2.3 Phase 3 (Qualitative)

After the questionnaire was completed, to get a perspective of water utility companies on water consumption and greywater reuse, I conducted an unstructured interview with Amanda Widén from Northwest Skåne Water and Wastewater (NSVA). Some of the themes and questions for the interview were more general while others were based on the results of the questionnaire. Themes included the overconsumption of water in Sweden, barriers, and motivations with integrating alternative water sources, consumers perceptions on greywater reuse for other purposes, etc. The purpose of this interview was to contribute to answering RQ 1.2. I used thematic analysis to analyse the interview.

4.2.4 Phase 4 (Integration & Analysis of Data Sets)

As part of the exploratory sequential mixed methods research design, the last phase is where I combined and compared all the data sets gathered and analysed them with the theory in Section 5 Findings (Creswell & Plano Clark, 2011). To allow for easier analysis, the interviews from Junehem will

be referred to as PO1 and PO2 (Property Owner 1,2), while the interview with Amanda from NSVA will be referred to as WU1 (Water Utility 1) throughout the findings (Chapter 5) and discussion (Chapter 6) sections.

4.3 Limitations

A limitation to this thesis is that as I had only gathered one interview from the perspective of the water utility companies, this means that insights from the interview are mainly focused on Skåne. Therefore, it cannot be generalized that it is the perspectives of all water utilities in Sweden. The same goes for the two interviews conducted for a property owner perspective, as both interviews were from one company, it cannot be assumed to be the opinion of all property owners in Sweden. Furthermore, a limitation for the questionnaire is that it was conducted on a very specific sample, with limited responses and with some respondents not answering all questions. A limitation with the Sörsjön quantitative documents is that as tenants moved into the buildings at different times depending on when the building was completed, therefore the averages or consumptions level differ depending on when the buildings were occupied. Which is why, I decided to analyse the consumption data of buildings from stage 1 (that were occupied within 2022), that were recorded between April 2023 to April 2024. Additionally, there are some discrepancies in the data that taken into consideration and omitted from the analyses.

5 Findings

This chapter will be combining and analysing the results from the mixed methods data collected, the chapter is divided into the role of consumers (RQ 1.1.), and the role of property owners and water utility companies (RQ 1.2.). The sub sections are based on the TPB and Rebound Effect (RE) discussed in Chapter 3 Theory. The interviews from the water utility will be referred to as WU1 and the ones with the property owners as PO1 and PO2. The findings presented in this section are rounded to the nearest whole number, other than for demographics. The visual representation of the questionnaire results not presented in this chapter can be found in Appendix 9.2.

5.1 Consumer (RQ 1.1.)

5.1.1 Demographics & Knowledge

Nearly a third of the respondents of the questionnaire were aged over 71 (31.6%), followed by an equal number of responses (26.3%) from people aged between 20-30 and 31-40. With most responses coming from single (36.8%) or 2-person households (47.4%). The respondents were slightly overrepresented by men with 52.6% of the total responses. Most respondents believed to have above average knowledge of their water consumption, with 42.1% responding to 4 on the scale of 1 to 5, followed by average amount of knowledge with 26.3% answering to 3 on the scale. All the tenants knew about Mina Sidor, however 15.8% were unaware that they could access their water consumption data on it. A majority of the respondents (55.6%) of the respondents stated to monitoring their water consumption on a monthly basis, while almost a third (27.8%) has never checked their water consumption.

Table 5.1. Questionnaire Results: Perceived Water Consumption

L/p/d	% of respondents	m^3/p/m	% of respondents
0-50	27.8%	**1-1.9**	33.3%
51-100	16.7%	**2-2.9**	11.1%
101-150	16.7%	**3-3.9**	22.2%
151-200	22.2%	**4-4.9**	22.2%
		5+	11.1%

Regarding the tenant's perception on how much water they consider themselves to be consuming, I had provided them with the option of answering the question in average litre consumption per person per **day** (L/p/d) or average cubic metre consumption per person per **month** (m^3/p/m). The different units used are not directly convertible, but somewhat comparable as 50 L/p/d equals 1.5 m^3/p/m. Table 5.1 below indicates their answers. A study by RISE (2022) also found that the majority of consumers living in apartments tended to underestimate their consumption, believing to consume an average of 0-60 L/p/d while their actual consumption averaged between 140 to 200 L/p/d. However, in the case of Sörsjön, average consumption (Table 5.2) was similar to their perceived consumption (Table 5.1). A third perceived their consumption to be between 1-1.9 m^3/p/m which is within the range of the average consumption calculated in Table 5.2.

Table 5.2. Average Cold and Hot Consumption m^3/p/m.

Room Type	Number of Apartments	Consumption Average	Average number of people living in apartments	Average consumption (m^3/p/m)
5	2	4.97	3.7	1.3
4	3	5.56	3.3	1.7
3 (80 sqm)	9	3.51	2.4	1.5
3 (73 sqm)	9	4.20	2.4	1.8
2	7	2.39	1.5	1.6
Total	**30**	**20.63**	**13.3**	**7.8**

Note: The data for "Average number of people living in apartments" is taken from Statistics Sweden (2017).

Furthermore, the calculations indicated 30% of freshwater being saved annually at Sörsjön by reusing greywater. The average greywater consumption m^3/p/m can be found in Appendix 9.3. The results from the questionnaire indicated that 74% were already aware of what greywater was and nearly 90% of all respondents knew that treated greywater was being used to flush their toilets, suggesting a high level of awareness for wastewater reuse among the residents. This is likely because the greywater reuse has been explicitly promoted and communicated by Junehem. Two thirds (67%) of respondents said that they learnt about the reuse through a brochure for Sörsjön.

5.1.2 Attitude (Direct RE & Moral Licensing)

In terms of consumer attitude towards the environment, the results from the questionnaire revealed that there was an elevated interest and concern for the state of the environment. With most of respondents strongly agreeing (58%), a quarter agreeing (26%), and only 5% strongly disagreeing to the importance of the environments state (Question 3.8. in Figure 5.1). When asked about the importance of reducing one's water consumption to protect the environment 37% strongly agreed, 32% neither agreed or disagreed, and 21% agreed (Question 3.9. in Figure 5.1). WU1 also noted that that there has been increased interest and awareness in both property owners and the general public on the reuse of water, signifying the rise in environmental awareness. Over half (53%) of respondents strongly agreeing with greywater reuse having a positive impact on the environment (Question 3.10. in Figure 5.1). Interestingly, there were a range of responses on whether the tenants thought it would

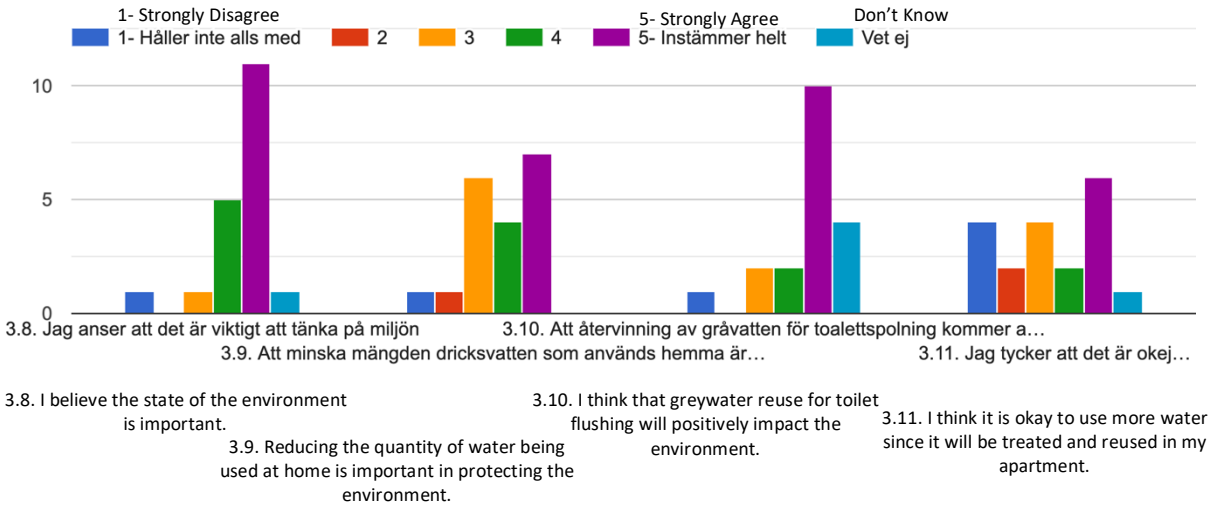

Figure 5.1. Questionnaire Results: Attitude

be okay to consume more freshwater since it would anyways be treated and reused (Question 3.11. in Figure 5.1). With around a third strongly agreeing (32%), followed by those that strongly disagreed and remained neutral both at 21%, 10% agreed while another 10% disagreed, and 5% did not know. This is an example of direct rebound effect, which suggests that there would be a rise in demand for resource after a resource efficient technology is introduced (Sonnberger & Gross, 2018; Sorrell & Dimitropoulos, 2008). In this case, consumption of freshwater would rise due to the tenants knowing that it would be reused (i.e., majority of tenants consider it to be okay to consume more freshwater without it having a negative impact on the environment). This is also an example of moral licensing which suggests that consumers feel the right to consume more freshwater as they consider themselves to have done enough for the environment by having a greywater reuse system (Vivanco et al., 2022).

When asked whether reusing greywater has enabled them to reduce the amount of freshwater consumed, 27% said that they strongly agreed and 11% strongly disagreed, while another quarter (27%) said they were not sure (Question 3.4. in Figure 5.2). There were mixed responses or rather inconclusive results on the role of greywater reuse in making them more conscious of their water consumption, with about a fifth (21%) of respondents are unsure and another fifth (21%) simply agreed with the statement. 16% strongly agreed while another 16% strongly disagreed with reusing greywater making them more conscious of their water consumption (Question 3.5. in Figure 5.2). This suggests that one's attitude on greywater influencing their water consumption greatly depends on the person. Interestingly, with considering greywater reuse as unnecessary in reducing their water consumption (Question 3.6. in figure 5.2), a little over a third (37%) stated that they strongly disagree and less than half (42%) answered that did not know. This indicates that the respondents see greywater reuse as important in reducing their water consumption, but there are varying opinions on whether it has helped them reduce their consumption. The demographics of the respondents may have influenced the response, as Ajzen (1991) mentions that demographics could influence behavioural intentions through attitude and subjective norm. As mentioned before, regarding greywater reuse, Bakare et al. (2016) and Gyapong-Korsah et al. (2023) found age demographics to greatly influence the level of greywater reuse acceptance, with younger individuals having higher acceptance. The results of this study, however showed that nearly a third of the responds were over 71 and only around a fifth were aged 20-30.

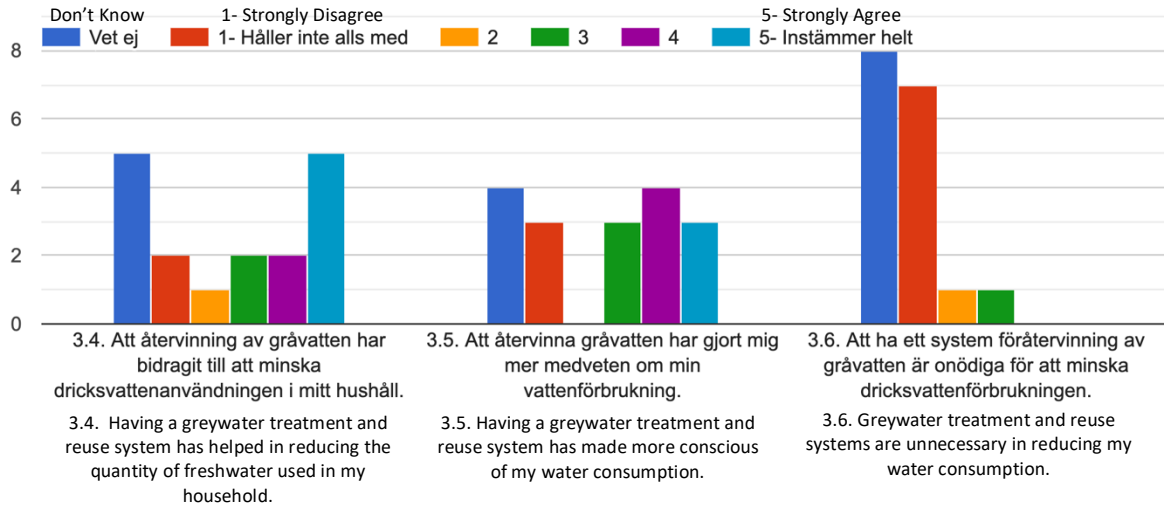

Figure 5.2. Questionnaire Results: Attitude

To summarise, the results show that consumer attitude is influenced by the level of environmental awareness or concern a person has. This is because the responses overall were rather positive on how

they believed their consumption would impact the environment. This is further supported by consumers feeling that having a sustainable water system is helping the environment, with greywater reuse being seen as essential in reducing freshwater consumption. Therefore, if a consumer's environmental concern is high, their attitude towards their intention to conserve water or adopt sustainable water systems (e.g. greywater reuse) would be positive. Consumers would have a positive attitude towards greywater reuse or reducing water consumption if they see it to positively impact the environment.

5.1.3 Perceived Behavioural Control

One fourth of respondents neither agreed nor disagreed (26%) to feeling capable and in control of reducing their water consumption. Meanwhile, respondents equally disagreed, strongly disagreed, and the opposite strongly agreed with feeling capable in reducing their water consumption (each at 21%). However, nearly half (47%) agreed to the statement of knowing how to lower their own water consumption, and a fifth (21%) strongly agreeing, while 11% were strongly disagreeing and 5% disagreeing. Additionally, nearly half (47%) strongly agreed to perceiving themselves as the sole person responsible for lowering their consumption. This implies that the tenants perceive themselves to have the knowledge and believe themselves to be entirely responsible to reduce their water consumption but do not feel capable or in control of managing their water consumption. Indicating a divide between consumers knowledge and responsibility with their actions (Wells et al., 2011).

In a monetary aspect, two fifths (42%) of the tenants strongly agreed that having to pay monthly bills for their hot and cold-water consumption impacted their water consumption. However, PO1 mentioned that there was a general trend of the tenants initially reducing their consumption but eventually going back to consuming more or the same amount of water as they originally used. WU1 also stated that there is always a risk of people reducing their consumption only for a short while. This suggests that monetary aspects have a higher impact or influence on people's consumption, as consumers have higher intentions to adopt greywater reuse if provided monetary relief as compared to other factors influencing their consumption (Bakare et al., 2016; Fielding et al., 2019; Oteng-Peprah et al., 2020; Van de Walle et al., 2023). About one fourth (26%) of tenants strongly disagreed and nearly a third (32%) disagreed with the notion of having to pay for their hot, cold, ***and*** reused greywater consumption, while 21% agreed and 11% strongly agreed. Signifying that consumers' willingness to pay for recycled water is low while the willingness to pay for freshwater consumption is higher. Consumers are interested in adopting greywater reuse as long as they are not required to pay for it.

There were an interesting range of responses on possibly using treated greywater for purposes other than flushing toilets. The prospect of reusing greywater for drinking water was met with significant opposition (Question 3.7.3. in Figure 5.3.), with the majority (58%) of respondents strongly disagreeing, 16% disagreeing, about a fifth (21%) remaining neutral, and only 5% agreeing. Meanwhile, there were differing responses with using reused greywater for showering; with 16% strongly disagreeing, nearly two fifths (37%) disagreeing, while another 16% agreeing and over a quarter (26%) strongly agreeing (Question 3.7.1. in Figure 5.3.). Comparatively, there is more support for reusing greywater for doing laundry, as around a quarter (26%) strongly agreed and 16% agreed, in addition, another quarter (26%) neither agreed nor disagreed (Question 3.7.2. in Figure 5.3.). This indicates that people are more open to trying reused water for other purposes but perhaps more awareness on greywater (quality, safety, treatment process, etc) is needed. WU1 highlighted the importance of communication between consumers, water utilities and property owners in finding ways to make consumers understand and feel safe, while property owners and water utilities ensure they have safe treatment systems as well.

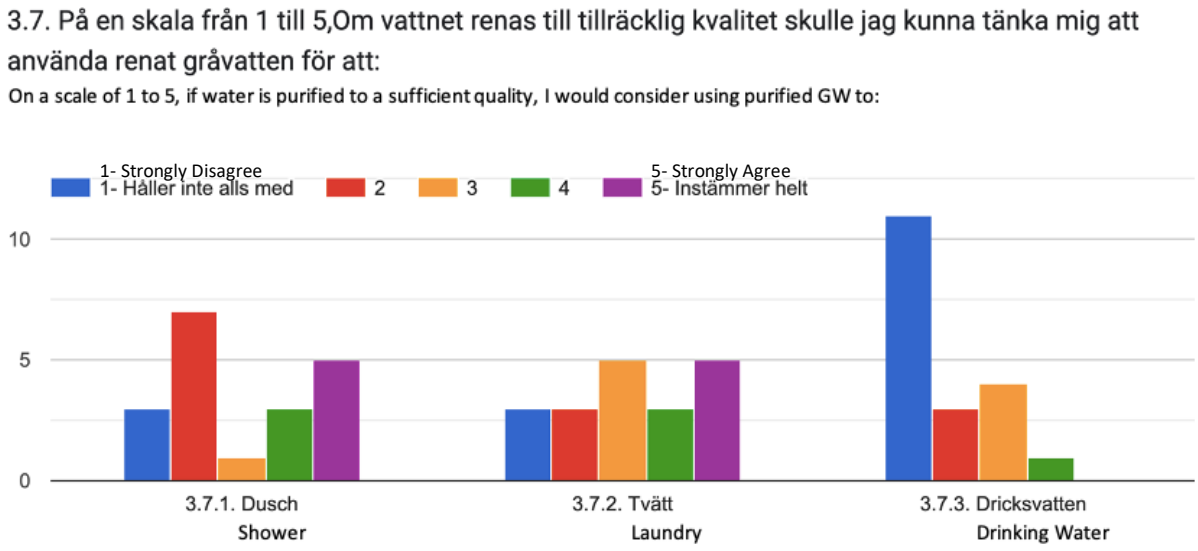

Figure 5.3. Questionnaire Results: Perceived Behavioural Control

There is a relation between the level of acceptance and the level of awareness for greywater reuse, as the higher the awareness consumers had the higher the acceptance was according to a study by Fielding et al. (2019). PO2 pointed out that Junehem puts all relevant information on their website for the tenants to see (i.e., the structure for their bills, information on greywater being used at Sörsjön) before they moved in. Using reused greywater for drinking water would most likely take the longest to implement as that would require for people to really change their mindsets. WU1 stated how Sweden is known to have an abundance of clean water, therefore it would be difficult to change people's behaviour and opinions. A solution would be to be transparent and providing consumers with

water quality assurance (Fielding et al. 2019; Oteng-Peprah et al. 2020; Van de Walle et al. 2023). WU1 also mentioned the importance of communication and transparency on how the treatment processes work must be conveyed to consumers to make them understand and feel safe with using any alternative water sources. However, knowledge and awareness of using greywater could eventually fade if the system is implemented for an extended period as it would become the norm (Fielding et al., 2019). Boucher et al. (2011) discovered in a case in Namibia that while most respondents were satisfied with their drinking water, very few were aware that it was generated from recycled water. In other words, a system with treated water will eventually be considered the norm if it is implemented for long enough.

Furthermore, in response to whether they had any concerns about greywater reuse, several tenants stated they had none, while a few mentioned the smell of it. The removal of smell when reusing water usually requires an extra step for the treated water to go through and is something that needs to be investigated when treating any kind of water (WU1). This suggests that there is nothing major that concerns people about greywater reuse, but it could also be due to underlying prejudice (the yuck factor), uncertainty of trying something new and the lack of knowledge with greywater reuse (Fielding et al., 2019; Rabaey et al., 2020; Van de Walle et al., 2023).

In essence, the findings indicate that in general consumers perceived behavioural control as rather neutral. Since the responses to feeling capable and in control of reducing their water consumption are overall neither positive nor negative. However, it was evident that perceived behavioural control is greatly affected by financial aspects. This is due to the strong opposition over the possibility of having to pay for their greywater consumption. This means that consumers' intention to reuse greywater will be higher if they only pay for their freshwater consumption. Moreover, the results demonstrated that intentions to adopt greywater reuse would be lower if the recycled water was used for other purposes, as the consumer's perception of having to possibly use recycled greywater for showering, for instance, is quite negative. Therefore, it is important to have more transparent communication with consumers to increase awareness and reduce prejudice of the safety and treatment processes of greywater.

5.1.4 Perceived Moral Norm

Over a third of respondents strongly agreed (37%) with considering themselves to have a moral obligation to use water wisely as well as around a quarter (26%) agreeing and another quarter (26%) neither agreeing nor disagreeing (Question 4.6. in Figure 5.4.). In terms of whether tenants feel happy to reduce their water consumption, more people had agreed with the statement (Question 4.7. in Figure 5.4.), 11% had agreed, and about a third (32%) strongly agreed, meanwhile another third were

neutral, 11% disagreed. Similarly, there were positive views when asked if reusing greywater lowered their water consumption, with over a third (37%) strongly agreeing to the statement (Question 4.8. in Figure 5.4.). Ultimately, this shows that the consumer's moral norm is on the positive side, as most of the responses indicated positive and high intentions towards the conservation of water and the adoption of reusing greywater.

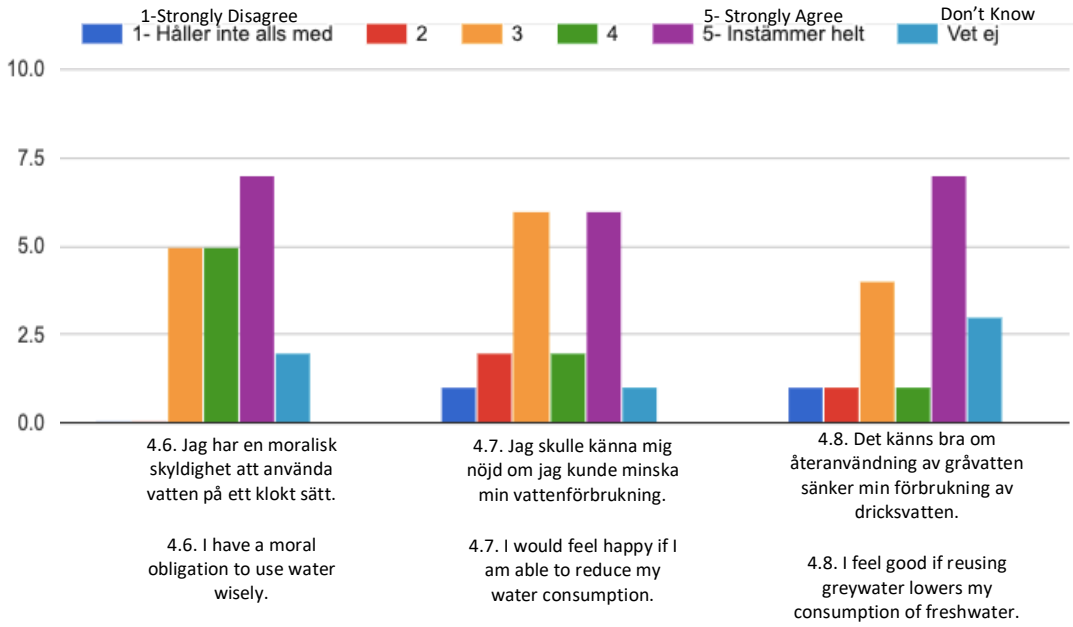

Figure 5.4. Questionnaire Results: Perceived Moral Norm

5.1.5 Subjective Norm & Descriptive Norm

When it comes to subjective norm, it was evident that the respondents were more influenced by what their friends or family would think over what the neighbours thought. This is likely a result of Sweden being an individualist society, where one is more likely to care for oneself and one's immediate family (Hofstede Insights, 2024). As seen in Figure 5.5. where Questions 5.2., 5.3., and 5.5. indicate how there is a stark difference in answers between the questions that were on family and friends (Questions 5.2. and 5.3.) and the ones on neighbours (Question 5.5.). The tenants' opinion on whether their friends and family approve of greywater reuse at home, nearly a third (32%) them strongly agreed while another 32% neither agreed nor disagreed (Question 5.2.). Meanwhile, for whether the tenants believed their friends and family to consider water conservation to be important (Question 5.3.), about a quarter (26%) strongly agreed, the same number also answered to not knowing. 16% seemed to strongly disagree and another 16% said that they neither agreed nor disagreed. This suggests that the greywater reuse is perceived as something positive whereas water conservation appears to not be as

important. Whereas a majority (74%) of responders were unaware of their neighbours' opinions regarding household water consumption reduction (Question 5.5.).

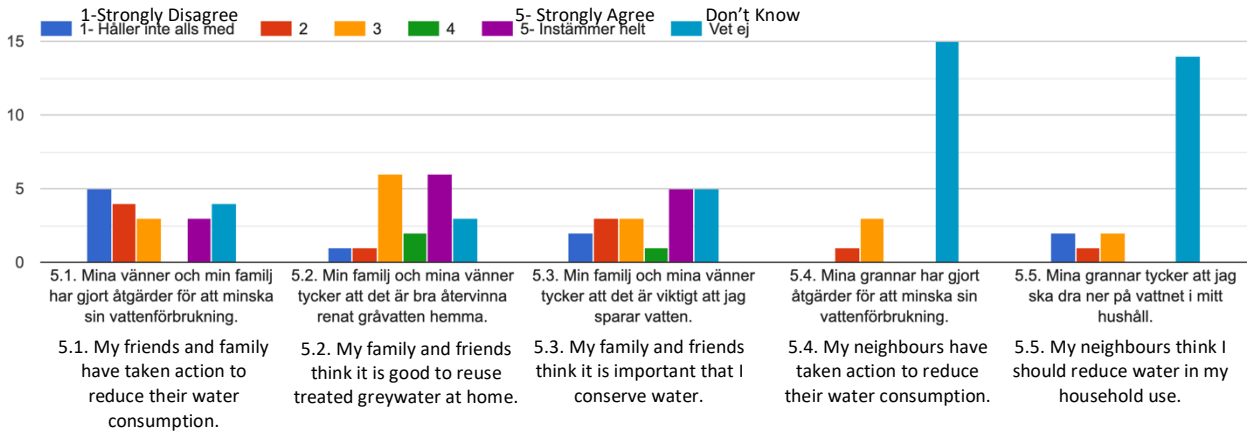

Figure 5.5. Questionnaire Results: Subjective Norm and Descriptive Norm

In terms of descriptive norm, which suggests that people perform a certain act if the majority of people around them actually do the same act or not; the results indicated that many of the respondents do not believe that people around them are doing something to conserve water. As seen in Question 5.1. (Figure 5.5.), where around a quarter (26%) strongly disagreed, and a fifth (21%) disagreed that their friends and family have done something to reduce their water consumption, while only 16% strongly agreed. However, just like with subjective norm, more than three quarters (79%) said that they didn't know if their neighbour had taken any action to reduce their water consumption (Question 5.4. in Figure 5.5.).

In summary, this indicates that consumer's subjective and descriptive norms do not have much influence on their behavioural intentions as much as the other variables. This was found to be because of Swedish individualistic culture where other's opinions do not influence whether they do something or not. However, to an extent, descriptive norm may have an influence of their behaviour as it seems that those close to them (family and friends) have similar intentions as them.

5.1.6 Intention

Lastly, in relation to the tenant's intentions, there were a range of responses on if they would try to reduce their own water consumption. As about a quarter (26%) strongly agreed and the same amount agreed to their intention to reduce their consumption (Question 6.1. in Figure 5.6.). However, nearly a third (32%), which is the biggest group, neither agreed nor disagreed with the statement.

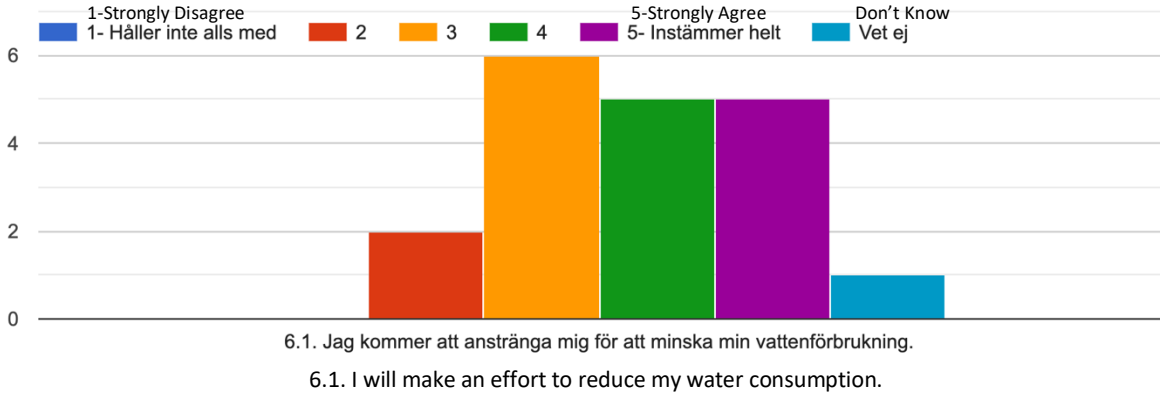

Figure 5.6. Questionnaire Results: Intention

As a follow up to the last question, the tenants were to explain why they would not or would change their water consumption behaviour (Question 6.1.1. in Figure 5.7.). Several reasoned that they use as little as they need and could not possibly lower it any further. Another common response was the environment and the monetary aspect of water consumption. Indicating that there is high environmental concern among consumers. This also supports Bakare et al. (2016), Fielding et al. (2019), Oteng-Peprah et al. (2020), Van de Walle et al. (2023) findings on higher intentions to adopt greywater reuse if consumers saw it to have a lower environmental impact and provide monetary relief. A response worth noting was, "Vet inte vad jag ska göra (Don't know what I should do)", which implies and emphasises the need for further awareness for consumers.

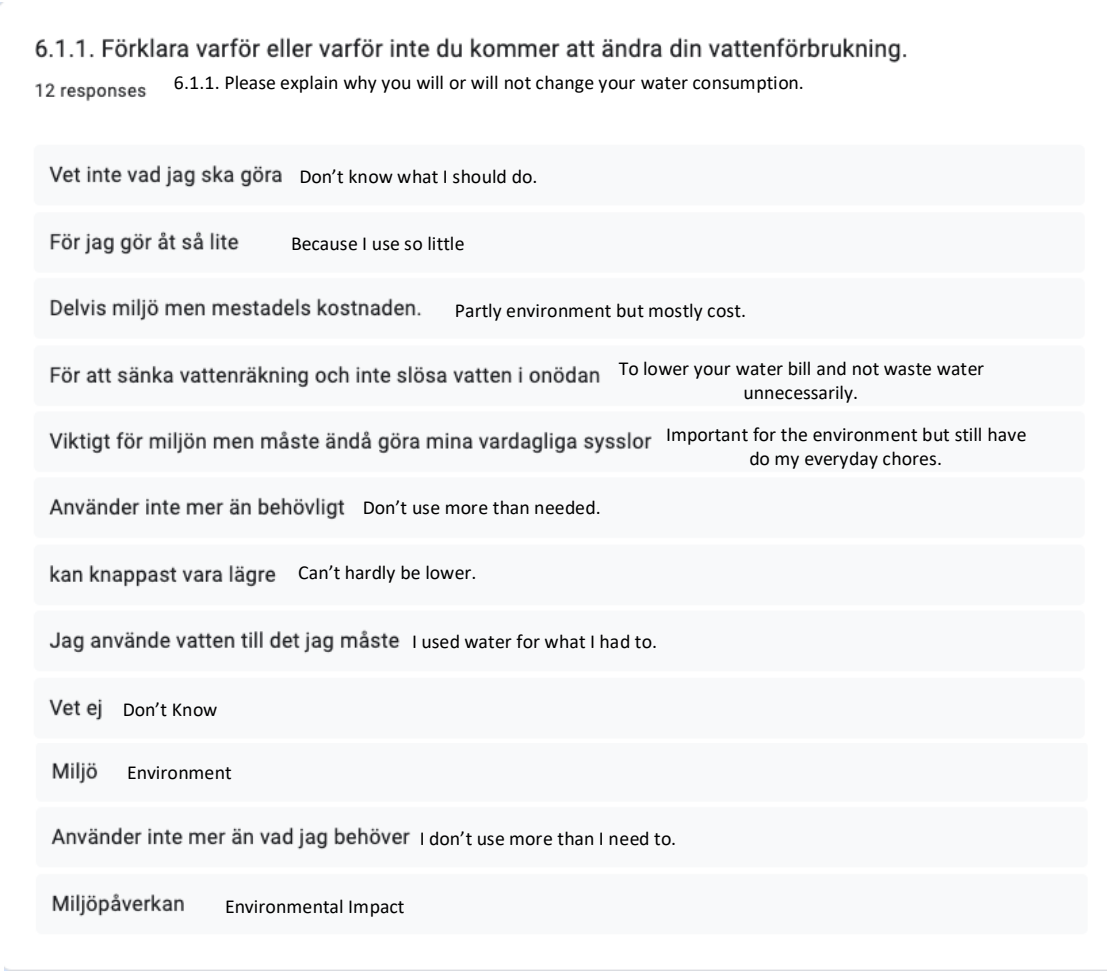

Figure 5.7. Questionnaire Results: Intention

When asked if they intended to engage in taking steps that would reduce their water consumption, the biggest group of respondents appeared to neither agree nor disagree (32%). While around a fifth (21%) agreed, 16% strongly agreed, while 21% disagreed, and 5% strongly disagreed to intending to partake in activities that would lower their water consumption. From a list of options, the respondents were also asked to specify which changes they were willing to make to reduce water consumption (they could chose multiple answers) (Question 6.2.1. in Appendix 9.2.). The majority (83%) of the respondents said they would use the dishwasher only its full, 78% would do the laundry on a full load, and 78% also answered to closing the tap when brushing their teeth, shaving, etc.

Finally, from a list, the respondents were asked what external factors would make them change their behaviour (Question 6.3. in Figure 5.8.). Nearly half, (47%) expected more water efficient machines and equipment, and 47% said that incentives on reducing water consumption would encourage them to change their behaviour. An interesting observation is of over a third (37%) saying that improving their knowledge of water conservation would make them change their behaviour.

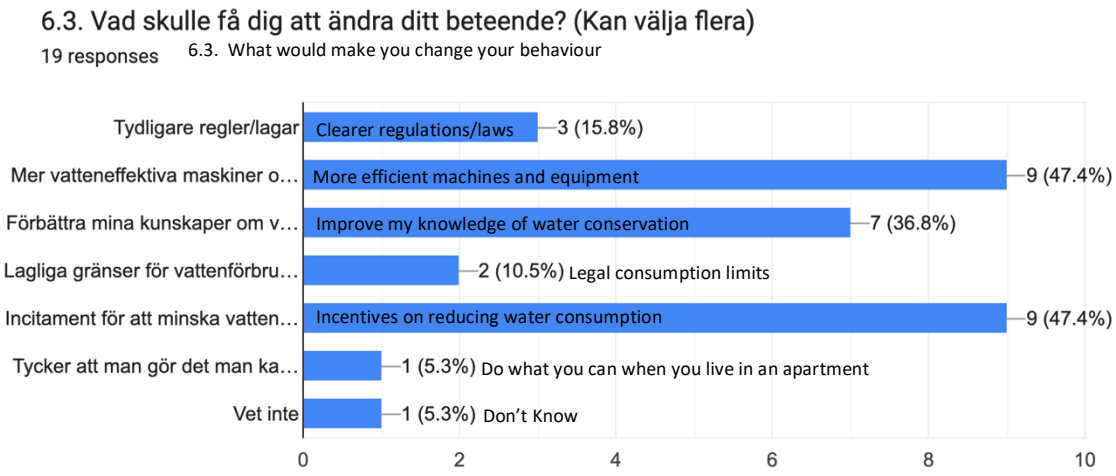

Figure 5.8. Questionnaire Result: Intention

Since 2022, it is mandatory to install individual metering systems for hot water in any new constructions (Boverket, 2022), Junehem had also installed meters for greywater, hot, and cold water at Sörsjön and the data from meters could be seen by tenants on Mina Sidor. Through the questionnaire it was found that the majority of the tenants were monitoring their consumption (Section 5.1.1.). This indicates that individual metering systems could help consumers become aware of their consumption. A project done by RISE, (2022) in Halmstad and Laholm, Sweden had found consumers to have high intention to change their behaviour if they had access to information on their water consumption and better communication between the water utility company and consumers. WU1 suggested the use of smart meters, as that would enable consumers to see where and how much water they are consuming. Hence, helping tenants know exactly where they could make changes in their consumption.

In short, the respondent's intention to change their consumption is high, but the willingness to act is low. In other words, they have high intentions to do something about their consumption but their intention to carry out that behaviour themselves is low. Which is in line with the opinions/norms of the family and friends of the consumers (Section 5.1.5.). The results had revealed that they would make changes for the environment, but they also feel a lack of control or the capability to make a change themselves (Section 5.1.3). In this case, reusing greywater to reduce their water consumption was not something they actively decided to do themselves, since it was Junehem that had integrated such a system.

5.2 Property Owners & Water Utilities (RQ 1.2.)

Looking into the role of property owners and water utilities, I have structured this section based on the themes I had based my interview questions on, which where motivations and drivers for adopting water alternative sources. Meanwhile, the second part of this section (5.2.2. Intervening Factors and Challenges) is also based on a variable from the Extended TPB (Figure 3.2.) that is used for this thesis.

5.2.1 Motivations, Drivers, & Opportunities

Through the interviews with PO1 and WU1, a common motivation for both entities were sustainability. PO1 mentions how they had a vision from the beginning to integrate more sustainable processes in their properties. Junehem had a long list of sustainable changes they wanted to implement but decided to prioritise reducing the wastage of freshwater in flushing toilets through the use of recycled water. WU1 also noted that there has been rising interest among property owners in thinking about water sustainability but are not aware on how to incorporate sustainable solutions. As there was a case of a property developer contacting NSVA on advice and guidance on reusing stormwater or greywater. Thus, WU1 emphasised the need for water utilities to prepare for when a situation like this emerges and be ready to provide guidance to interested parties when needed. Property owners like Junehem are also considering using greywater reuse systems in their older projects through renovation and integrating it into the common laundry rooms.

WU1 commented on how water is not a huge problem for Sweden now but that gives them the opportunity to try out different alternative solutions before the issues surface and become urgent in the future. Therefore, water utilities like NSVA have highlighted the importance of preparing for future water related issues, such as decline in water quality, high demand but low water supply, and fixing existing infrastructures for leaks to prevent wastage. Along with, determining whether the investments for new water production sites could instead be used for something else (e.g., water reuse projects).

As previously mentioned, it is difficult for consumers to change their behaviour, therefore transparency would be necessary (Fielding et al., 2019; Oteng-Peprah et al., 2020; Van de Walle et al., 2023). WU1 said that communication with consumers is key in raising awareness and to encourage consumers to change their behaviours. Communications that send a message on how and what NSVA (or other water utilities) are doing to reduce water wastage, highlighting that they are doing what they can and therefore the consumer should also play their part to reduce water usage. However, increasing consumer awareness is effective to an extent, for instance, it improves consumers environmental responsibility but its influence on behaviour is limited (Wells et al., 2011).

5.2.2 Intervening Factors/Challenges

Sweden is known to have an abundance of water and laws in place that have enabled water tariffs to remain low, resulting in the concerns for water issues to be unurgent (RISE, 2024; Smart City Sweden, 2024; UN Water, 2024a). As compared to energy, where consumer awareness and concern is higher, which is why changes in electricity prices influences consumers behaviour (WU1). Another challenge faced by water utility companies and property owners are the unclear legislations and laws. WU1 said how it is uncertain what the legislation is since there are differing opinions and how it is interpreted is up for discussions between the different governmental entities. Due to the numerous governing bodies that are currently involved, there is a no clear direction and inconsistent interpretation of legislations. WU1 added how the current legislation does not need to change for projects to be implemented but rather somebody (i.e., a governmental entity) needs to take charge and assess how the legislation could be implemented and for that to be the interpretation to be standardised.

Junehem's experience from developing Sörsjön showed that installation would cost around 500,000 SEK/house. In Stage 1 treatment tanks were installed outside buildings while in Stage 2 treatment tanks were installed inside the buildings. This is because the maintenance of the treatment tanks outside was found to be more costly and difficult than initially anticipated. It is estimated to cost around 20-25,000 SEK/house/year while the maintenance of the indoor tanks in Stage 2 is estimated to cost around 10,000 SEK/house/year and allow for Junehem to conduct the maintenance themselves. Furthermore, for future projects PO1 recommended having self-flowing pipes instead of electrical pumps (which are currently used at Sörsjön) to pump water into the treatment tanks. Electrical pumps require a lot of energy and maintenance therefore more resources and space are used compared to self-flowing pipes. However, if self-flowing pipes are used, the treatment tanks would need to be installed lower to allow for water to flow into the tank on its own. Having an extra meter that measures the amount of freshwater being used in the instance the greywater treatment fails or during maintenance periods, as currently, it is unclear how much freshwater is used during such times (PO1).

Ultimately, the intervening factors mentioned here are the factors that have acted as a barrier for property owners and water utility companies in implementing greywater reuse and on improving current systems to become more sustainable. Which in turn prevent consumers from being able to consume water more sustainably, since the results show that consumer willingness to act was low, therefore, consumers need an external force for them to act on their intention (i.e., property owners integrating greywater reuse).

6 Discussion

In this chapter, I will be discussing the key findings derived from Chapter 5 Findings. This chapter will also assess the effectiveness of wastewater recycling as solution to water overconsumption in Sweden and determining if it's a scalable solution (RQ. 1.3.). The discussion will be divided into the key findings for Consumers (6.1.), Property Owners and Water Utilities (6.2.). Followed by policy recommendations (6.3.) and ending with a reflection on the theories used in this thesis (6.4.).

6.1 Consumers

The results indicate that there is high environmental concern among consumers, but they have low willingness to change their water consumption behaviour and opinions. To an extent this contradicts Oteng-Peprah et al. (2020) which stated consumers' willingness and intentions being higher if environmental concern was higher. However, in this case, consumers are aware of environmental issues in general, but water related issues are not of great concern. This is likely a result of water being considered as an inexpensive resource with many consumers having water bills included in their rent and the general perception and belief of Sweden having an abundance of water (RISE, 2022, 2024; UN Water, 2024a). It may also be due to existing stigma and mindsets consumers have towards greywater. The questionnaire results indicated consumers reluctance towards using greywater for drinking water and showering (Figure 5.3.). Such reluctance could be overcome through improved communication and awareness in consumers (Fielding et al., 2019). Over a third of the respondents believed that improving their knowledge of water conservation would make them change their behaviour. However, Wells et al. (2011) found that more knowledge is only useful to a certain extent, as it encouraged minimal changes in consumers lifestyle and no major behavioural changes.

Consumers tend to use a lot more water than they perceive themselves to (RISE, 2022). However, the respondent's consumption data showed that they used an average of 1.3-1.6 m^3/p/m (Table 5.2.) which matches their perceived consumption of 1-1.9 m^3/p/m (Table 5.1.). This suggests that having individual metering systems, and monthly bills at Sörsjön, and tenants monitoring their consumption effectively enable them to be more aware of their actual consumption, compared to the usual metering system where consumers would only find out about their consumption once a year (RISE, 2022). But, both PO1 and WU1 mentioned how monthly billings are only temporary as consumption would only go down for a short while and would then go back up. RISE (2022) had found that individual metering with communication between residents and water utilities proved to be more effective in lowering consumption levels as compared to having no communication at all.

In previous studies, monetary aspects were found to have more influence on consumers than anything else in this research (Bakare et al., 2016; Fielding et al., 2019; Oteng-Peprah et al., 2020; Van de Walle et al., 2023). This is due to water traditionally being an inexpensive resource due to abundance of water in Sweden (RISE, 2024; Smart City Sweden, 2024; UN Water, 2024a). It was also seen consumers' willingness for greywater reuse would significantly decline if they were required to pay for their usage. Compared to electricity, where prices greatly vary resulting in consumers' adjusting their consumption (WU1). This therefore suggests that it is possible for consumers to change their behaviour but there is a need for external influences that push them due to their lower willingness (i.e., having reuse system in place or making it mandatory to integrate reuse systems), or through having water reuse in place long enough that it eventually is considered a norm (Boucher et al., 2011; Fielding et al., 2019). However, it should be noted that consumers stated external factors, such as efficient machines and equipment (Figure 5.8.), would help them reduce their consumption, but it was also found that they believe it to be okay to use more water if they are saving some. Which indicates a direct rebound effect since total savings from installing a water efficient device or system would be offset from their belief that it's okay to use more water.

6.2 Property Owners & Water Utilities

My findings show that property owners have an important role in Sweden's transition towards reusing wastewater. As they have the power to enable consumers to accept water alternatives by integrating it into their constructions. Especially, since current laws restrict water utilities from enforcing any water limits or to integrate sustainable water methods, unless there is a need for it (e.g., during drought periods), (Krisinformation, 2024), all water utilities can do is push and advise them (WU1). Water utilities can also improve their knowledge so they can better advice interested property owners, since there is increased interest from both property owners and water utilities as well to reuse wastewater (WU1).

There is a need for more pilot projects, such as Junehem's Sörsjön, where alternative water sources are integrated. Such pilot projects are important as it enables water utility companies in being better prepared to answer questions for those interested in integrating reuse systems. As well as encourage uninterested property owners as it would help to eliminate any concerns or uncertainty they would have. As many property owners are hesitant to do pilot projects due to the financial cost associated with it and the risk factor (WU1). Therefore, lessons learnt from such projects can allow for improved application and implementation for future projects on water alternatives, encouraging scalability. As the first project is always the most expensive ones but as more projects are implemented investment costs and maintenance costs would decline, technology would also improve (WU1). Taking Sörsjön for

example, it was found that treatment tanks should be indoors instead of outdoors to save on costs. Sörsjön also shows how greywater reuse can be an effective solution to reduce residential water consumption. The results had shown that an average of 30.9 m^3/m of greywater was generated, resulting in reduced freshwater consumption

6.3 Policy Recommendations

It is imperative for a single entity (stakeholder) to take responsibility and guide the legislations related to the reuse of wastewater that would result in consistent interpretation. Since currently, there are multiple governing bodies involved, which results in no clear direction and conflicting interpretation of legislations. As WU1 highlighted that there is no need for newer legislations as it is not a barrier for them in implementing projects but it's the lack of a single governing entity or guideline for those involved to follow. Van de Walle et al. (2023) had also emphasised how limited legislative framework and guidelines have inhibited the development of the reuse of wastewater. Moreover, Sweden needs to take advantage of this time they have and find alternative sources of water, as it may not be an issue currently, but it is expected to be a larger issue in the future. Therefore, more standardisation in guidelines and flexibility on decision making should be put on the development of water solutions, while ensuring the safety of water quality. Along with increasing and improving communication, transparency, and awareness between property owners and water utilities.

6.4 Reflection on Theory

The TPB's static explanatory characteristics undermines the impacts social characteristics have on behaviour (Gao et al., 2017; Zhang et al., 2014), this was seen through how the theory failed to see the cultural aspects present in Swedish society (i.e., individualism). Furthermore, the findings indicated how the respondents were inclined abstainers, as they were people who have the intention but choose not to act on it, which is a something that the theory fails to address (Orbell & Sheeran, 1998). The TPB is indeed flawed and dated and there is a need for a more updated theory, but it also allows for flexibility, since the theory can be adapted and made relevant to specific research through extending it. Regarding rebound effect, Vivanco et al. (2022), mentioned how the RE can shed light on why strategies or goals are not met. This research had found how the RE with water consumption was hindering the success of SDG 6 since it is one of the barriers behind the effectiveness of GW reuse.

7 Conclusion

In this thesis, I aimed to determine the effectiveness of wastewater recycling as a solution to water overconsumption and an alternative water source in Sweden. This was done through exploring consumers knowledge on water consumption (RQ 1.1.) and the role of property owners and water utility companies on encouraging sustainable water consumption (RQ 1.2.) and determining it to be a scalable solution (RQ 1.3.). Mixed methods were used to allow for better analyses of the different perspectives. The findings revealed that consumers did not underestimate their water consumption and were aware of their consumption levels. Furthermore, an average of 30% of freshwater was saved through greywater reuse systems at Sörsjön yearly.

Consumers also have high levels of environmental concern, but their willingness to change their consumption behaviour is low. Willingness to change is only to the extent that does not require much effort and is not too different from how things are done traditionally. This is due to long-existing laws in Sweden that have restricted water tariffs from rising has shaped people's interest and concern for water related problems to remain low. Changing people's behaviour and opinions would be difficult but it would be possible through external forces that would push them to change. Reuse systems such as greywater are a solution for water overconsumption and an alternative water source, however the rebound effect should also be taken into consideration. Property Owners play a key role in Sweden's move toward alternative water sources. Water issues may be a problem for the future, but Sweden needs to advantage of this time and invest in alternative water sources and renovate existing water systems before it's too late.

Based on this, further research could be done on studying the perspective of one actor in more detail and perhaps on a larger scale to include actors from around Sweden instead of one area. Since, this thesis focused on different perspectives and had a limited view of both property owners and water utilities. Further research on current legislations and the different stakeholders related to it could be conducted to determine how a standardised interpretation of the legislations and a guideline could be formed. Different forms of communications between property owners, water utilities, and consumers could also be further researched to establish which form of communication works best. An interesting point to further research would be a comparison between the consumptions of residents in a building without greywater reuse and those with, to see the extent of the rebound effect and to determine the difference between their behaviours and perceptions.

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9 Appendix

9.1 Questionnaire

Denna enkät är frivillig och ditt svar kommer att vara helt anonymt. Du har rätt att inte svara på alla frågor eller välja att lämna enkäten när som helst. Du behöver inte förbereda något i förväg. Syftet med enkäten är att bättre förstå kunskap, medvetenhet och beteende när det gäller vattenförbrukning. Resultaten har inte för avsikt att användas för några affärsändamål. Data som samlas in från enkäten kommer att anonymiseras och publiceras i ett examensarbete vid Lunds Universitet i samarbete med Sweden Water Research och Junehem.

This questionnaire is voluntary and that your response will be completely anonymised. You also have the right to not answer questions and the right to withdraw from the questionnaire at any given time. You do not need to prepare anything beforehand. The purpose and aim of the questionnaire are to better understand knowledge, awareness, and behaviour regarding water consumption and have no intention of being used for any business purposes. The data collected from the questionnaire will be anonymised and published in a master's thesis done at Lund University, and will also be used by Sweden Water Research and Junehem.

1. **DEMOGRAFI:** DEMOGRAPHICS:
   - 1.1. Ålder? Age? *(<20, 20-30, 31-40, 41-50, 51-60, 61-70, 71+)*
   - 1.2. Kön? Gender? *(Kvinna, Man, Ickebinär, Föredrar att inte säga)* (*Female, Male, Non-binary, Prefer not to say)*
   - 1.3. Hur många bor i ditt hushåll (inklusive du själv)? *(1-5)* How many live in your household (including you)?

2. **DIN VATTENFÖRBRUKNING:** YOUR CONSUMPTION AWARENESS:
   - 2.1. Hur myket vet du om din vattenförbrukning? *(5-point Likert scale; 1 = Ingenting; 5 = Allt).* How much do you know about your water consumption? *(1 = Nothing; 5 = Everything)*
   - 2.2. Vet du vad Junehems Mina Sidor är? *(JA/NEJ)* Do you know what Junehem's Mina Sidor is? *(YES/NO)*
   - 2.3. Vet du att du kan se din vattenförbrukning på Mina sidor? *(JA/NEJ).* Do you know you can access your water consumption data on Mina Sidor? *(YES/NO)*
     - 2.3.1. *(JA)* Hur ofta läser du av din förbrukning? *(ALTERNATIV- 1. Dagligen, 2. Varje vecka, 3. En gång i månaden, 4. Årligen, 5. Aldrig, 6. Varannan månad kanske 7. Har nyligen flyttat in)* (*YES)* How often do you monitor your consumption? *(OPTIONS-1. Daily 2. Weekly 3. Monthly 4. Yearly 5. Never 6. Every other month 7. Newly moved in)*

2.4. Hur mycket vatten tror du att du förbrukar i genomsnitt per dag? *(INTERVALL- 1. Föredrar att svara i genomsnitt per månad - gå till fråga 2.5., 2. 0-50 liter/dag, 3. 51-100 liter/dag, 4. 101-150 liter/dag, 5. 151-200 liter/dag, 7. 201-250 liter/dag, 6. 300+ liter/dag).* How much water do you think is consumed per person on average per day? *(RANGES- 1. Prefer to answer on average per month -go to question 2. 51. 0-50 litres/day 3. 51-100 litres/day 4. 101-150 litres/day 5. 151-200 litres/day 6. 201-250 litre/day 7. 300+ litres/day)*

2.5. Hur mycket vatten tror du att du förbrukar i genomsnitt per *månad*? *(INTERVALL- 1. < 0.1 m³/månad, 2. < 0.1 m³/månad, 3. 2-2.9 m³/månad, 4. 3-3.9 m³/månad, 5. 4-4.9 m³/månad, 6. 4-4.9 m³/månad).* How much water do you think is consumed per person on average per day? *(RANGES-1. < 0.1 m³/month, 2. < 0.1 m³/month, 3. 2-2.9 m³/month, 4. 3-3.9 m³/month, 5. 4-4.9 m³/month, 6. 4-4.9 m³/month)*

3. <u>GRÅVATTEN</u>: GREYWATER:

3.1. Vet du vad gråvatten är? *(JA/NEJ).* Do you know what greywater is? *(YES/NO)*

"Gråvatten är vatten från duschar och handfat."

"Greywater refers to the water from the showers and sinks "

3.2. Är du medveten om att renat gråvatten används för att spola toaletten i din lägenhet? *(JA/NEJ)*. Are you aware that treated greywater is being used to flush the toilet in your apartment? *(YES/NO)*

3.2.1. *(JA)* Hur fick du reda på det? *(OLIKA ALTERNATIV- 1. Sörsjön Broschyr, 2. Junehems webbplats, 3. Familj och vänner, 4. Nyheter, 5. Övrigt:).* *(YES)* How did you find out about it? *(DIFFERENT OPTIONS- 1. Sörsjön Broschyr, 2. Junehem Website, 3. Family and Friends, 4. News)*

3.3. Är det något som oroar dig när det gäller återvinning av gråvatten? *(OPEN ENDED)* Is there something that concerns you about greywater reuse? *(OPEN ENDED)*

(5-point Likert scale) (1 = Håller inte alls med; 5 = Instämmer helt; Vet ej) *(1 = Strongly Disagree; 5 = Strongly Agree; Don't Know)*

3.4. Att återvinning av gråvatten har bidragit till att minska dricksvattenanvändningen i mitt hushåll. I think having a greywater treatment and reuse system has helped in reducing the quantity of freshwater used in my household.

3.5. Att återvinna gråvatten har gjort mig mer medveten om min vattenförbrukning. Having a greywater treatment and reuse system has made me more conscious of my water consumption.

3.6. Att ha ett system föråtervinning av gråvatten är onödiga för att minska dricksvattenförbrukningen. Greywater treatment and reuse systems are unnecessary in reducing freshwater consumption.

3.7. Om vattnet renas till tillräcklig kvalitet skulle jag kunna tänka mig att använda renat gråvatten för att: If the water is purified to a sufficient quality, I would consider using purified greywater to:

3.7.1. Duscha Showering

3.7.2. Tvätt Laundry

3.7.3. Dricksvatten Drinking Water

3.8. Jag anser att det är viktigt att tänka på miljön. I believe the state of the environment is important.

3.9. Att minska mängden dricksvatten som används hemma är viktigt för att skydda miljön. Reducing the quantity of freshwater being used at home is important in protecting the environment.

3.10. Att återvinning av gråvatten för toalettspolning kommer att påverka miljön positivt. I think that greywater reuse for toilet flushing will positively impact the environment.

3.11. Jag tycker att det är okej att använda mer vatten eftersom det kommer att behandlas och återvinnas i min lägenhet. I think it is okay to use more water since it will be treated and reused in my apartment.

4. **MIN INSTÄLLNING TILL VATTENFÖRBRUKNING:** MY ATTITUDE ON WATER CONSUMPTION: *(5-point Likert scale) (1 = Håller inte alls med; 5 = Instämmer helt; Vet ej) (1 = Strongly Disagree; 5 = Strongly Agree; Don't Know)*

4.1. Att betala för min förbrukning av varm- och kallvatten påverkar mitt använding. To pay for my hot and cold-water consumption impacts my water use.

4.2. Jag tycker att jag ska betala för hela min vattenförbrukning, inklusive dricksvatten och återvunnet gråvatten. I think I should pay for my water consumption, including fresh water and reused greywater.

4.3. Jag kan minska vattenförbrukningen i min lägenhet. I am capable of reducing water consumption in my apartment.

4.4. Jag vet vad jag kan göra för att minska min förbrukning av vatten. I know what I can do to lower my water consumption.

4.5. Jag tycker att det är mitt eget ansvar att minska min vattenförbrukning. I think reducing my household water consumption is solely my responsibility.

4.6. Jag har en moralisk skyldighet att använda vatten på ett klokt sätt. I have a moral obligation to use water wisely.

4.7. Jag skulle känna mig nöjd om jag kunde minska min vattenförbrukning. I would feel happy if I am able to reduce my water consumption.

4.8. Det känns bra om återanvändning av gråvatten sänker min förbrukning av dricksvatten. I feel good if reusing greywater lowers my consumption of freshwater.

5. **VAD TYCKER PERSONER I DIN OMGIVNING:** WHAT PEOPLE AROUND YOU THINK?: *(5-point Likert scale) (1 = Håller inte alls med; 5 = Instämmer helt; Vet ej) (1 = Strongly Disagree; 5 = Strongly Agree; Don't Know)*

5.1. Mina vänner och min familj har gjort åtgärder för att minska sin vattenförbrukning. My friends and family have taken action to reduce their water consumption.

5.2. Min familj och mina vänner tycker att det är bra återvinna renat gråvatten hemma. My family and friends think it is good to reuse treated greywater at home.

5.3. Min familj och mina vänner tycker att det är viktigt att jag sparar vatten. My family and friends think it is important that I conserve water.

5.4. Mina grannar har gjort åtgärder för att minska sin vattenförbrukning. My neighbours have taken action to reduce their water consumption.

5.5. Mina grannar tycker att jag ska dra ner på vattnet i mitt hushåll. My neighbours think I should reduce water in my household use.

6. **AVSIKTER FÖR FRAMTIDEN:** INTENTIONS FOR THE FUTURE: *(5-point Likert scale) (1 = Håller inte alls med; 5 = Instämmer helt; Vet ej) (1 = Strongly Disagree; 5 = Strongly Agree; Don't Know)*

6.1. Jag kommer att anstränga mig för att minska min vattenförbrukning. I will make an effort to reduce my water consumption.

6.1.1. Förklara varför eller varför inte du kommer att ändra din vattenförbrukning. *(OPEN ENDED).* Please explain why you will/will not change your water consumption *(OPEN ENDED)*

6.2. Jag har för avsikt att göra förändringar för att minska min vattenförbrukning. I intend to engage in activities to reduce my water consumption.

6.2.1. Vilka förändringar är du villig att göra för att minska din dricksvattenförbrukning? *(ALTERNATIV- 1. Duscha kortare, 2. Tvätta fulla maskiner, 3. Diska fulla diskmaskiner, 4. Diska för hand utan rinnande vatten, 5. Stänga kranen medan du borstar tänderna, rakar dig etc., 6. Gör redan det jag kan)* What changes are you willing to make to lower your freshwater consumption? *(OPTIONS- 1. Reducing time spent showering, 2. Doing laundry when it's a full load, 3. Using the dishwasher when its full, 4. Wash the dishes by hand with the tap off, 5. Closing the tap when brushing teeth, shaving etc., 6. Already doing what I can)*

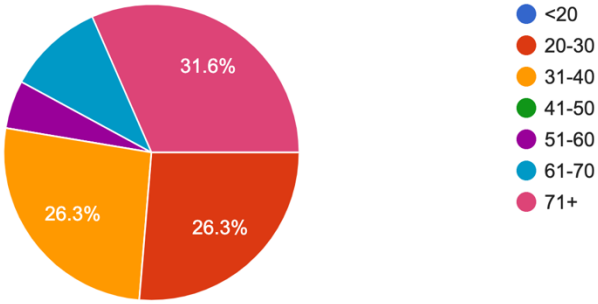
6.3. Vad skulle få dig att ändra ditt beteende? *(ALTERNATIV- 1. Tydligare regler/lagar, 2. Mer vatteneffektiva maskiner och utrustning, 3. Förbättra mina kunskaper om vattenvård, 4. Lagliga gränser för vattenförbrukning, 5. Incitament för att minska vattenförbrukningen, 6. Tycker att man gör det man kan när man bor i lägenhet, 7. Vet inte).* What would make you change your behaviour? *(OPTIONS- 1. Clearer regulations/laws, 2. More water efficient machines and equipment, 3. Improve my knowledge of water conservation, 4. Legal water consumption limits, 5. Incentives on reducing water consumption, 6. Do what you can when you live in an apartment 7. Don't know)*

7. **Övriga kommentarer:** Any other comments:

9.2 Questionnaire Results

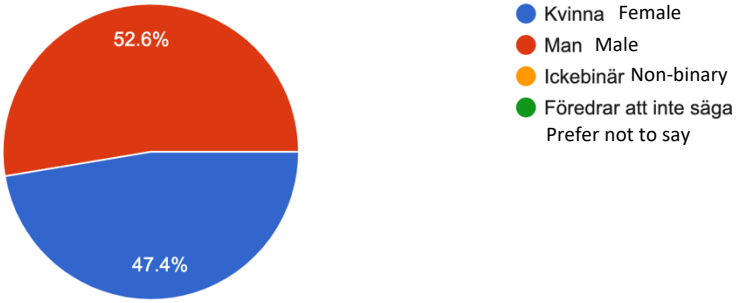
1.1. Ålder 1.1. Age

19 responses



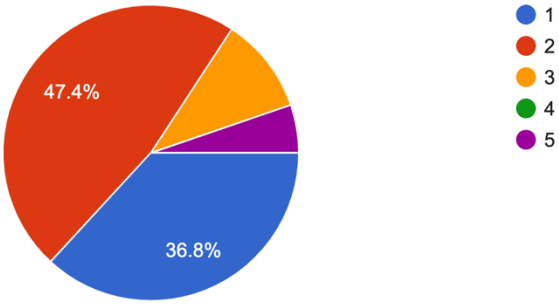
1.2. Kön 1.2. Gender

19 responses



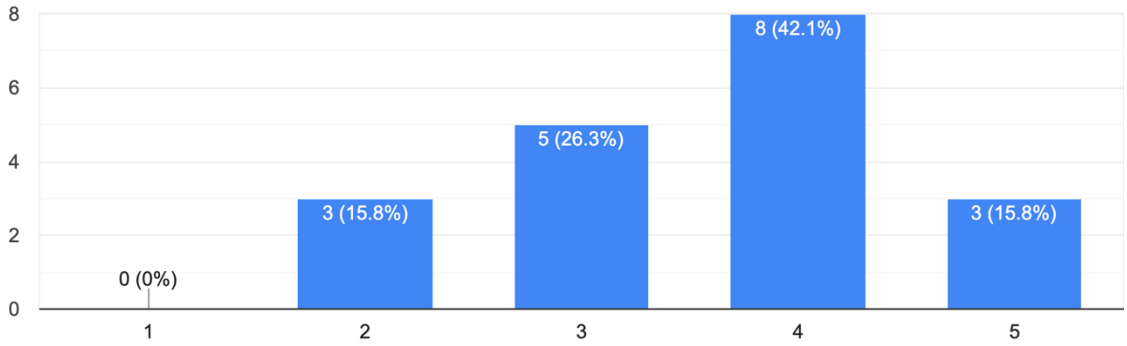
1.3. Hur många bor i ditt hushåll (inklusive du själv)?

19 responses 1.3. How many live in your household (including you)?



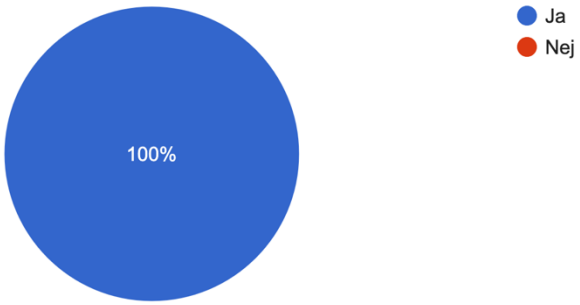
2.1. Hur mycket vet du om din vattenförbrukning? (På en skala från 1 till 5)

19 responses 2.1. How much do you know about your water consumption? (on a scale of 1 to 5)



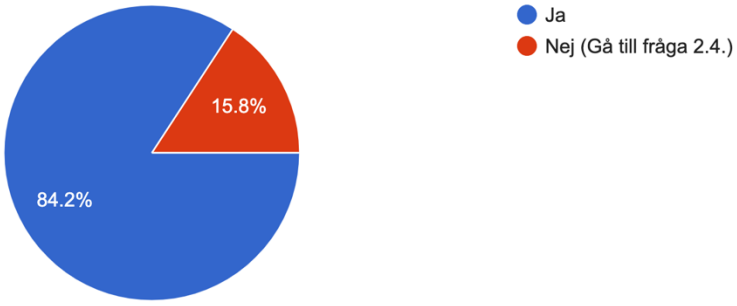
2.2. Vet du vad Junehems Mina Sidor är?

19 responses 2.2. Do you know what Junehem's Mina Sidor is?



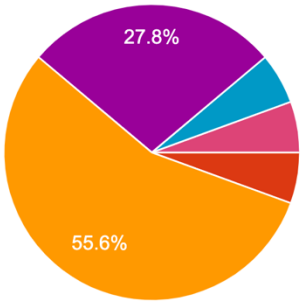
2.3. Vet du att du kan se din vattenförbrukning på Mina sidor?

19 responses 2.3. Do you know you can access your water consumption data on Mina Sidor?



2.3.1. Hur ofta läser du av din förbrukning?

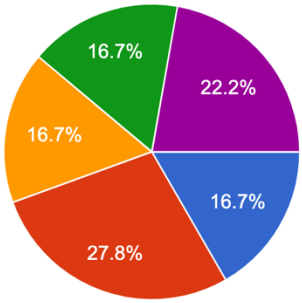
18 responses 2.3.1. How often do you monitor your consumption?



- Dagligen Daily
- Varje vecka Weekly
- En gång i månaden Monthly
- Årligen Yearly
- Aldrig Never
- Varannan månad kanske Every other month
- Har nyligen flyttat in Newly moved in

2.4. Hur mycket vatten tror du att du förbrukar i genomsnitt per dag?

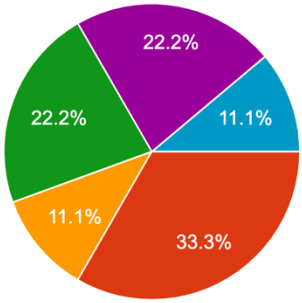
18 responses 2.4. How much water do you think is consumed per person on average per day?



- Prefer to answer on average per month- (go to Question 2.5)
- Föredrar att svara i genomsnitt per månad - gå till fråga 2.5.
- 0-50 liter/dag Litre/day
- 51-100 liter/dag
- 101-150 liter/dag
- 151-200 liter/dag
- 201-250 liter/dag
- 300+ liter/dag

2.5. Hur mycket vatten tror du att du förbrukar i genomsnitt per månad? (Hoppa över om du svarade 2.4.) 2.5. How much water do you think is consumed per person on average per day?

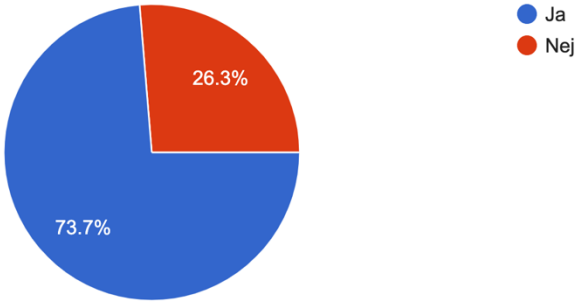
9 responses



- < 0.1 m³/månad m³/month
- 1-1.9 m³/månad
- 2-2.9 m³/månad
- 3-3.9 m³/månad
- 4-4.9 m³/månad
- 5+ m³/månad

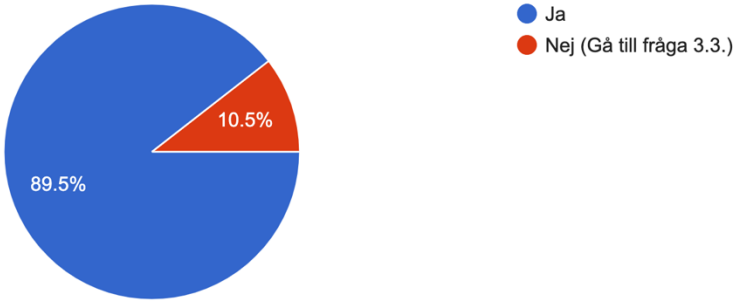
3.1. Vet du vad gråvatten är?

19 responses 3.1. Do you know what greywater is?



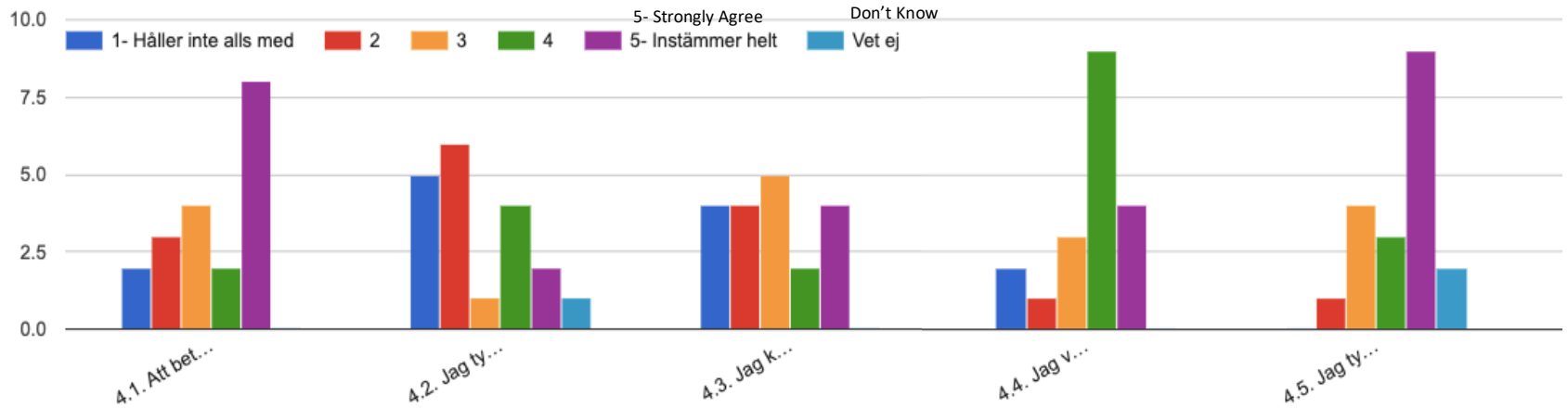
3.2. Är du medveten om att renat gråvatten används för att spola toaletten i din lägenhet?

19 responses 3.2. Are you aware that treated greywater is being used to flush the toilet in your apartment?



3.2.1. Hur fick du reda på det?

18 responses 3.2.1. How did you find out about it?



4.1. To pay for my hot & cold-water consumption impacts my water use

4.2. I think I should pay for my water consumption, including drinking water, and reused greywater

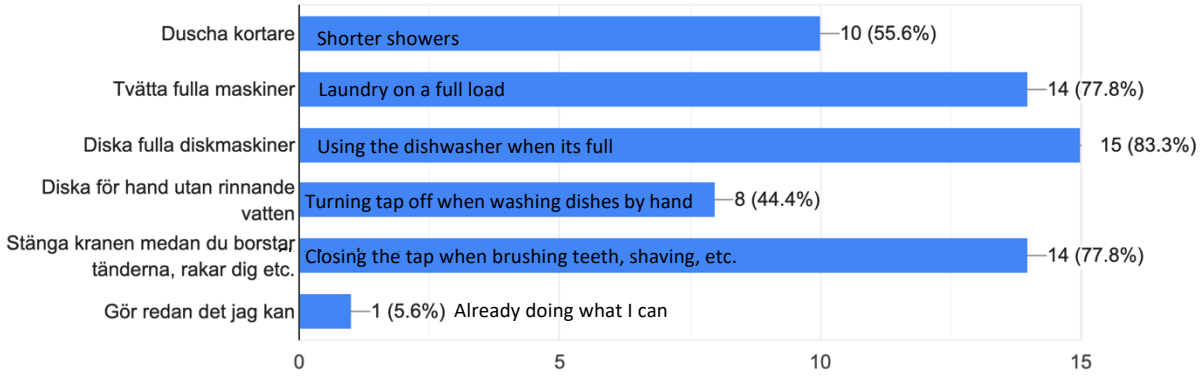
4.3. I am capable of reducing water consumption in my apartment

4.4. I know what I can do to lower my water consumption

4.5. I think reducing my household water consumption is solely my responsibility

6.2.1. Vilka förändringar är du villig att göra för att minska din dricksvattenförbrukning? (Kan välja flera) 6.2.1. What changes are you willing to make to lower your freshwater consumption?

18 responses



9.3 Average Greywater Consumption $m^3/p/m$

Room Type	Number of Apartments	Consumption Average	Average number of people living in apartments	Average consumption $m^3/p/m$
5	2	1.75	3.7	0.5
4	3	3.62	3.3	1.1
3 (80 sqm)	9	1.92	2.4	0.8
3 (73 sqm)	9	1.53	2.4	0.6
2	7	1.31	1.5	0.9
Total	**30**	**10.13**	**13.3**	**3.9**
Note:				