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Consumer Attitude and Awareness of Göteborg Water Supply, Sweden

Bachelor Thesis in Chemical Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

Water management in Sweden is going through fundamental change as a result of the adoption of the EU Water Framework Directive in 2000. According to article 14 of the Directive, public involvement is crucial for the goals to be achieved. If a dialogue between the water authorities and the public is to be meaningful a shared base of knowledge is required. A consumer survey is presented here. It was carried out in Göteborg (Sweden) with the overall aim to identify and evaluate consumer issues related to urban water supply in Göteborg.

The identified issues include public awareness, perception, attitude and willingness to pay for improvements. The willingness to pay for improvements amongst all groups is high. At the same time the public awareness of the urban water cycle, water supply management and levels of consumption is low; 45% of the respondents did not know the source of raw water, only 23% knew that the sewage is treated at the water purification plant of Rya and 54% did not know who is responsible for the drinking water delivery. Young people were more unaware than older people.

Visits to treatment plants, signs/information boards and having water bills separated from the rent, seem to be efficient ways of increasing the public awareness. There is also need to target such campaigns to different age groups as the level of awareness differs. Overall, it is found that there is a need for an increased public awareness of the urban water system and water issues in order to achieve the goals of the Directive.

Key words:

public awareness, willingness to pay, public attitude, public participation, EU Water Framework Directive, sustainable water management, urban water system

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1. Introduction

Water is essential for all life forms. 70% of the earth's surface is covered with water but only about 3% of this is fresh water. Many areas in the world suffer from water scarcity. It could be a natural state but is likely to be influenced by anthropogenic activity. Irrigation systems have changed the hydrological conditions in areas and infrastructure has had effects on watercourses. Today, one in every five people does not have access to safe drinking water. The problem is worsening due to the growing populations and the effects of climate change. There is currently a call for improved and sustainable water management in basically all regions of the world. (McKinney, 1998)

As for Europe, shortage of water is not the main threat to water supply, even if it is a growing problem in the south and in some of the larger cities. The central problem is water quality deterioration. The European Commission (web ref.1) reports 20% of the European waters being badly polluted and nearly 60 % of the cities in Europe overexploiting its groundwater resources. According to a report released by the United Nations World Health Organisation (web ref.2), 16% or 100 million of the people living in Europe do not have access to safe drinking water in their homes. 170 000 Europeans fall ill every year due to outbreaks of waterborne diseases. The report also warns that global warming will lead to more intensive rain, causing flooding and leading to additional water quality deterioration.

In Göteborg (Sweden) and other areas of Europe extreme weather has been experienced lately. For example, heavy rains have caused flooding and land slides affecting the transport system and putting additional stress on the urban water system and its management. The EU Water Framework Directive was created to shift toward a more sustainable water management with the ultimate goal of achieving "good status" for all waters by 2015. In the Directive, consumer and stakeholder involvement is pointed out as one of the success factors for its implementation at local level. (Web ref.3)

2. Aim and Objectives

The overall aim of this study is to identify and evaluate consumer issues related to Göteborg urban water supply through a consumer survey addressing the following key questions:

- What is the public knowledge about, and attitudes toward, Göteborg urban water cycle, drinking water supply management and levels of consumption?
- What are the attitudes towards possible future scenarios?
- What is called for in terms of consumer involvement from policy documents and what are the implementation gaps for the water sector to consider?

3. Background

3.1 Overview of Göteborg water system

Göteborg uses surface water from the Göta River for drinking water production. 2000 litres/sek of raw water is taken in at Lärjeån. This represents 0.5 % of the total flow in the river. Half of the water is pumped to the water purification plant of Alelyckan. The rest is transported to the Lakes Delsjöarna through an underground tunnel. The lakes serve as water reservoir for the other water purification plant of Göteborg, Lackarebäck. (web ref. 4). Göteborg Water and Wastewater Works are responsible for the operation and maintenance of the plants.

In order to test the river water quality, seven monitoring stations are located along the river. At these points, properties of the water such as pH, conductivity and cloudiness is measured.

These monitoring points serve as a warning system. When the quality of the river water is insufficient, the intake at Lärjeån is closed and water from the Lakes Delsjöarna is used. Water from the reservoirs, Lake Delsjöarna and Lake Rådasjön can be pumped back to Alelyckan through the same underground tunnel that supplied the lakes. This way, both purification plants can operate at full capacity during the times when the intake at Lärjeån is closed. The lake reservoirs store sufficient water supply for an approximate one-month period.

Wastewater is collected and transported to the Wastewater Treatment Plant (WTP) of Rya, situated on the island of Hisingen. Sewage from the municipalities of Ale, Härryda, Kungälv, Mölndal and Partille is also treated here. The wastewater undergoes both mechanical and chemical treatment. The processed water is discharged into the sea. Gryaab is responsible for the operation and maintenance of the WTP.

The Eco-cycle committee is responsible for the overarching planning of water and sewage management in Göteborg. They order operational services from Göteborg Water and Wastewater Works and Gryaab. The Eco-cycle Office implements the water management plan formulated by the committee including making recommendations on water and sewage tariffs.

No profits should be made and the water tariffs should cover the following expenses;

- Operational costs of the two water purification plants, Alelyckan and Lackarebäck and the WTP of Rya.
- Maintenance costs of pipelines and tunnels for the transport of drinking water and wastewater.
- Administrational costs and expenses for informing customers of operational disturbances etc.

The people of Göteborg pay less than 1 öre per litre of water used. The cost of sewage treatment is included in this price. A family living in a private house pays around 3600 SEK for water and

sewage each year (web ref 5). The water tariff was raised by 4% on the 1st of January 2007. An average household will pay around 40 öre more for water per day as a result. A deficit in the water and wastewater sector funds during the last years was the cause. The maintenance costs and operational costs have risen in the past years. (web ref 5)

The water system in Göteborg is designed for an average consumption of 600 litres per person a day, based on calculations made in the 1960's of future water consumption. This is much higher than 185 litres that the average person in Göteborg is using today. Water saving equipment, such as washing machines and toilets using less water is becoming more common. But a shift towards a decreased consumption should not be realised until the system is ready for it since a low flow in the pipes leads to higher risks of microorganism outbreaks. The development towards using less water would have to go hand in hand with the change of the water pipe systems according to stakeholders interviewed.

3.1.1 Challenges to future water supply in Göteborg

Due to high demands on the Göta River from shipping, industry and wastewater, the management and the monitoring of pollutants flowing into the river is essential. Even though the overall quality of the raw water in the Göta River is relatively good, high levels of faecal pollution are occasionally detected. These raised levels of bacteria are caused either by operational malfunctions in sewage treatment plants upstream or run-offs from agricultural land and sewer overflows during heavy rainfalls. The intake at Lärjeån needs to be closed for one-third to one-fourth of the time due to poor river quality. Water is then taken from the water reservoirs of Lake Delsjöarna. If the intake would need to be closed for a longer time, for example in the case of a large landslide, 100.000- 200.000 consumers could be out of water within a number of weeks. This makes the system according to stakeholders, quite vulnerable. The cost of maintaining today's water quality is rising. Göteborg Water and Wastewater Works estimates that the annual increase of costs will be around 75 million.

To offset this trend three types of measures need to be applied;

- Protection of raw water.
- Improvement of the water purification process with the installation of more efficient microbiological barriers.
- Use of an alternative raw water source i.e. artificially produced groundwater.

Climate change might have some impact on the water quality in the Göta River. The amount of rain is expected to increase during the winter months according to predictions. Flooding, like the one in the Göteborg area in December 2006 is likely to occur more frequently. Two negative

effects of heavy rainfalls mentioned above are increased risk of sewer overflow and increased run-off from agricultural land. Intensive rainfalls could lead to decreased water quality in two additional ways;

- Increased risk of landslides caused by fluctuating water levels; landslides occur when river banks collapse. Heavy rainfalls reduce the stability of the riverbanks causing landslides to occur with greater frequency. Sediments released during landslides reduce water quality. Pollutants bound to particles in the sediments are introduced to the water. The increase of suspended material in the water makes it unsuitable for drinking water production. This effect could be long-term depending on the magnitude of the landslides.
- Surface pollutants; Heavy rainfall washes surface pollutants from roads and land into the river system e.g. car exhausts residues and chemicals from industries and households. This leads to higher concentrations of pollutants in rivers and lakes.

3.1.2 One future water supply scenario

Today, water with the same high quality as drinking water is used for purposes such as flushing the toilets, washing clothes, washing the car, irrigation and in the industry. In the context of sustainable development the use of water with a lower quality would be of great benefit for these purposes (Nordström, 2005). A possible future supply scenario, defined through stakeholder interviews, is that we would have two taps at home with different qualities. The attitudes amongst the public towards this scenario were then assessed through the consumer survey. It is important to seek the opinions of the end-users before new technology is introduced. Critical issues of concern amongst the consumers could be identified this way (Friedler, 2006). Information campaigns following the survey could then focus on these issues. This would increase the chances for a successful implementation.

It is unlikely that the water supply in a city the size of Göteborg will be converted to this system within the next 50 years. However, it might be realised in parts of the city and in new areas. The factors that might have an impact on the development in this direction are the price of chemicals and energy used in the water purification process. If they would rise dramatically then these types of solutions would become more interesting. Globally, it is likely that systems like these will become more and more interesting due to the rising scarcity of water.

3.2 The importance of “public involvement” and “public participation”

Public participation is a prerequisite for sustainable development. There are four main benefits and reasons why it is so important that the public participates in watershed management. These are:

- The quality of decisions is improved
- Credibility and public support is improved
- Decision-making processes are facilitated
- Implementation and monitoring is improved (Bruch, 2005.)
- Can promote social learning if everyone involved in the process; members of the public, government and experts can have a constructive dialogue. Then they could learn how to manage a river basin, which is a complex natural resource and handle conflicting views and interests collectively. The “water awareness” may increase as a result of this work, and real innovations could be the result. (Bruch, 2005.)

Even though the work with involving the public is costly, time-consuming and has significant labour costs, the price of not involving members of the public is often higher. This fact has been acknowledged for decades in the environmental policy making on international-, EU- and national level.(Bruch, 2005).

Previous studies indicate (E.F van der Schraft, 2006) a lack in understanding amongst the general public in Göteborg, on the importance of public awareness on water issues. As about 250 water consumers were asked to rank a number of criteria based on what was most important for the future, the criterion “Public awareness on water related issues” ended up last. The study illustrates a great difference in perception between water authorities and the general public and according to EU, public- and stakeholder involvement is believed to be one of the most crucial parts for the implementation of the Water Framework Directive.

3.2.1 Sustainable development and public dialogue – a historical background

The United Nation Conference on Human Environment in Stockholm 1972 was held as a result of growing concerns of environmental problems around the world. The United Nations Environment Programme (UNEP) was formed later that year as a product of the summit. Differences of opinion regarding the scientific bases of environmental concerns and disagreements about how to combine the goals of environmental protection and development arose during the discussions. Developed and Developing countries agreed on the importance of

preserving natural resources, but the developing countries often claimed, that the negative environmental effects has been caused by the advanced industrial states. Now the environmental consciousness is obstructing the development for the rest of the world. Fear was also been raised that the environmental standards will impede economic growth and erode the standard of living in the developing countries. (Encyclopædia Britannica,2006).

UNEP established the World Commission on Environment and Development (WCED) through the General Assembly. It was this organisation that popularised the concept of Sustainable Development in 1987 in the Brundtland report, "*Our common future*". They define Sustainable Development as "development that meets the needs of present without compromising the ability of future generations to meet their own". (Encyclopædia Britannica, 2006).

The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 further focused attention on environmental issues. This intergovernmental global conference was by far larger than any preceding one and input of numerous NGOs was integrated into the resulting report. The Rio Declaration on Environment and Development was presented as a result of the conference and it constitutes a number of principles. The document is "a plan for the sustainable development of the Earth's resources into the 21st century (Agenda 21)" (Encyclopædia Britannica,2006).

A number of conferences on sustainable development have since then been held. One was organized by the United Nations Economic Commission for Europe (UNECE) in the Danish city of Aarhus in 1998. The conference focused specially on the importance of public participation on the path towards sustainable development. The resulting Aarhus convention entered into force on 30th of October 2001. 40 countries have signed the treaty including all EU member States (Web ref7.) EU has applied Aarhus-type principles in its legislation, including the water framework directive (Directive 2000/60/EC).The major principles of the Aarhus convention are as follows(Eco-Accord, 2006) :

1. Ensuring active public access to information;
2. Public participation in environmental decision-making, in development of environmental policy, programs, plans;
3. Consideration of public opinion in environmental decision-making, during the development of environmental policy, programs and plans;
4. Ensuring public access to justice in environmental matters;
5. Support to non-governmental environmental organisations, transforming national legislation to correspond to this principle;
6. Parties should ensure the application of Aarhus principles in international environmental decision-making.

3.2.2 The EU Water Framework Directive and public participation

In December 2000 the EU adopted the Water Framework Directive. The Directive legislated on water quality management and replaces 7 previous EU Directives for different aspects of water protection and conservation. The goal of the Directive is an ambitious one. The Directive aims at sustainable water management and calls for the attainment for all EU waters to reach “good status” by 2015. “Good status” is defined as a state that shows only minor differences compared to the natural state in respect to chemical/or biological characteristics. (Web ref.9)

In the EU Commission legislation (article 249 ex.159), the following definition is found: “ *A directive shall be binding, as to the result to be achieved, upon each member states to which is addressed, but shall leave to the national authorities the choice of form and methods*”. It is up to the member states to find a way to incorporate the principles of the directive into the national legislation in a way that suits the cultural and political structure of the country. The WFD has been implemented into the Swedish Environmental Code.

The implementation of the Directive will create changes in the organisational structures. Two parallel water management-planning systems exist, that of the Water Authority and the municipality. This could mean significant problems ahead with accountability and legitimacy, since formal relationships are unclear. For this to work, forms of effective collaborations between the Water Authorities and the municipalities need to be developed. Methods for involving the public and other stakeholders in this process need to be applied. (Hedelin, 2005)

There are a number of tools in the Directive that will help the member states to achieve the objective “good status”. Perhaps the most significant is that water management should be organised within the natural geographical and hydrological unit of the river basin. This promotes according to the Directive a holistic approach to watercourse management. Within these hydrological units called river basin districts, all groundwater, rivers, lakes and coastal waters will be taken into consideration. Groups of nearby catchments within a region could form larger unit called main water district. Sweden is divided into five main water districts, figure 3.1. The municipality of Göteborg is part of the water district of Västerhavet. One of the County Administrational Boards in each of the five water districts is responsible for the implementation of the WFD. These are named Water Authorities. The County Management Board of



Figure 3.1 Water Districts of Sweden (web ref 10)

Västra Götaland situated in Göteborg serves as the Water Authorities for the Water District of Västerhavet.

An economical analysis of each of the River Water Districts is carried out in the initial phase of the implementation. The natural characteristics of the River Basin District are also analysed. The human activities in the area e.g. farming, industry or wastewater treatment plants and the resulting effects are included in the economic analysis. Based on this study a series of recommendations are formed so as the district can fully comply with the WFD. Monitoring of river courses and coastal water bodies are put in place. Finally, for each River Basin District a River Basin Management Plan (RBMP) is created, in which the work is catalogued. To fulfil the reporting aspect of the directive the results of the monitoring programme is submitted to the EU periodically and published so as the general public and stakeholders are informed. This work follows a six-year cycle with the first programme of measures set for the end of 2009. Following this a review period is planned and an amended plan is set for 2015 and again in 2021. Although the EU has legislated that the objectives of WFD should be implemented by 2015 the directive provides for the possibility that under certain circumstances, they may be postponed. (Hedelin, 2005)

The polluters' pays principle is another important aspect of the Directive. The users of water including consumers, industry and agriculture should pay the cost of water services, protection and restoration. It is not yet clear how these so called "water charges" will be designed but it will result in a higher price for water. The purpose of these "water charges" will lead to a more efficient use of the water resources.

Table 3.1. Timetable for consultation with the public, linked to the 6-year cycle of the directive

<i>December 2006</i>	Timetable and work programme for the production of the river basin management plan completed
<i>July 2007</i>	Written comments
<i>December 2007</i>	A provisional summary of the most important water management issues within the water basin district completed
<i>July 2008</i>	Written comments
<i>December 2008</i>	A draft of the river basin management plan available for the public to read
<i>July 2009</i>	Written comments
<i>December 2009</i>	The river basin management plan is completed and programs of measures established

Public participation is important throughout the whole implementation process according to the

WFD.

How the public will be involved is described in Article 14. of the Directive. For example, the governments in the member states should ensure that the relevant documents are readily available and arrange public meetings where these documents and related issues can be discussed. They could also carry out surveys and interview in order to gauge the opinions of the public. Public involvement is especially important during the production of River Basin Management Plan. The timetable for the Water Basin Management Plan is presented in the table 3.1.

To make the goals given in article 14 concrete and to give further support to the authorities responsible for planning public involvement measures, an informal working group was formed. The members of the groups are technical experts, policymakers and stakeholders from different countries in the EU. The group was formed in 2001. A guidance document was produced. The guidance document is not legally binding. Because of the difference in the member state's political and cultural structures as well as physical conditions there exist no set code for how this public participation should be organised; it is up to the member states to decide what measures to take. The availability of information, consultation and active participation with the public are among the main issues considered in the WFD. The first two are to be ensured while the last one should be encouraged.

Each member state need to report the results of active participation, information supplied to the public and consultation measures to the European Commission. When presenting the measures taken, two purposes are served; it first gives the E.C. an indication of how Sweden is fulfilling the requirement of public participation. It could also help the authorities responsible for the implementation of the WFD to improve the public participation in the following planning cycle (Web ref 11)).

4. Methodology

The method used is illustrated in Figure 4.1. Interviews with selected stakeholders were carried out in the initial step. From the result of these, consumer issues were identified for evaluation and a questionnaire was formulated. The literature review of scientific articles, legislation and policy documents was made in parallel throughout the study. The information gathered during the literature review was used both in the describing phase and in the result analysis and discussion. Implementation gaps were identified and methods for bridging these discussed.

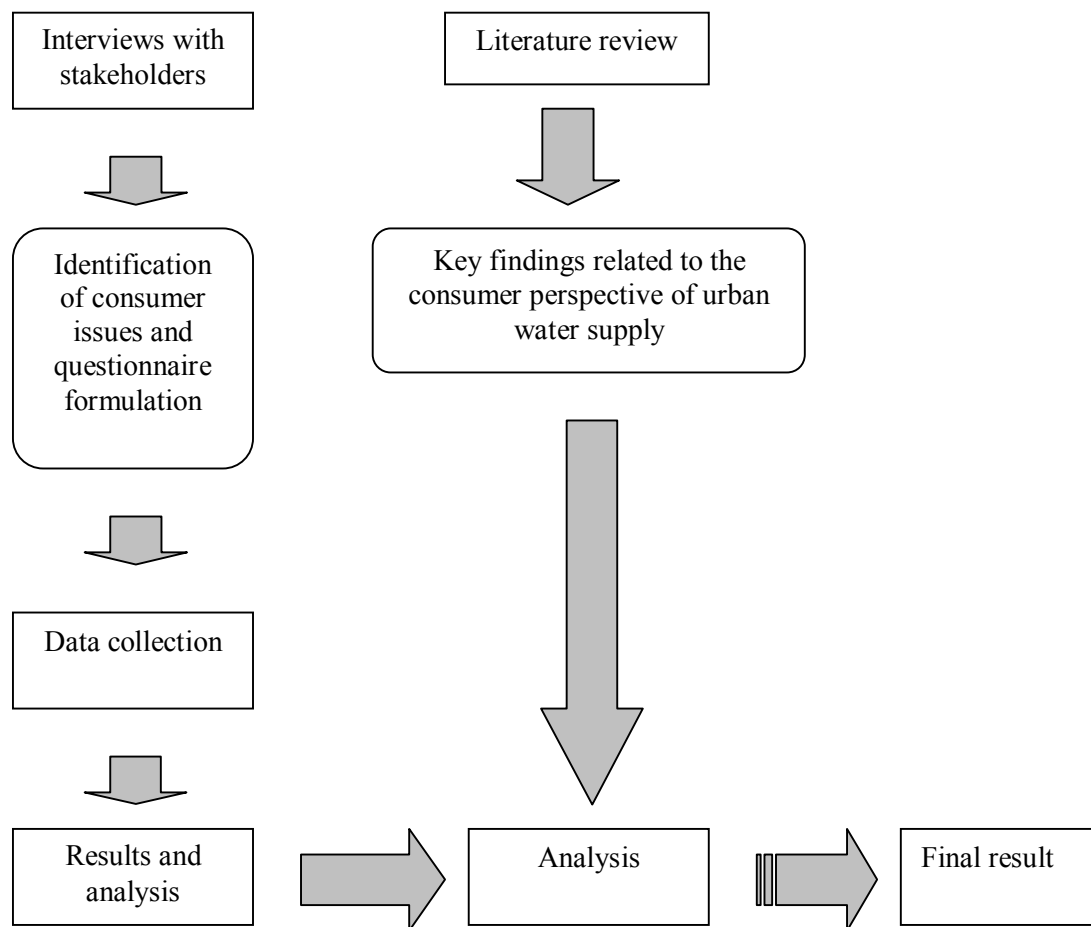


Figure 4.1 Methodological model

4.1 Interviews with stakeholders

In order to understand the water sector perspective and to identify key issues for evaluation a

number of stakeholders were identified based on their responsibilities related to Göteborg urban water supply. Three key institutions were identified based on the aims of the study; the Eco-Cycle Office, the Göteborg Water and Wastewater Works and the County Administration Board. All of them carry great responsibilities and knowledge of the current supply system and water management in Göteborg.

The Eco-cycle Committee is responsible for the overarching planning of water and sewage management in Göteborg. The Eco-cycle Office is also responsible for implementing the water management plan formulated by the committee and for gathering information to underpin political decisions made by the committee (including recommendations on water- and sewage charges). (Web ref 4)

Göteborg Water and Wastewater Works is responsible for operation and maintenance of the two water purification plants of Göteborg; Alelyckan and Lackarebäck. This includes maintenance of pipelines and tunnels for the transport of drinking water and wastewater. The Eco-Cycle Office communicates the needs of services and Göteborg Water and Wastewater works is the supplier. The Eco-Cycle Office and Göteborg Water and Wastewater Works have two different roles in Göteborg water management; one defines the needs and planning role and the other has an operational and maintenance role. Thus, it was considered important that both these stakeholders were consulted.

The County Administration Board is the authority for the Water District of Västerhavet, which means that they are responsible for implementing the EU Water Framework Directive in this region. The District is made up of 113 municipalities and the water authority has parallel planning responsibility for the water management together with the municipalities in the region. (Hedelin 2005)

One representative from each institution mentioned above was interviewed and the result formed the basis for questionnaire formulation. In addition, researchers at Water Environment Technology (Chalmers University of Technology) were consulted, giving added value to the content of the consumer survey. All interviews took place in May 2006 and were documented through tape-recorder. .

4.2 Identified consumer issues and questionnaire formulation

After processing the interview results consumer issues for evaluation were identified and the questionnaire was structured in four parts: 1) Consumer characteristics, 2) Awareness, 3) Attitudes and 4) Willingness to pay. The questionnaire is found in Appendix 1.

4.2.1 Consumer characteristics

The survey included basic demographic information i.e. gender and age as well as method of payment for water. These were added for analytical purposes to find correlations in the results. Identified gender and age differences in consumer awareness, attitudes and willingness to pay can be used when information campaigns are designed. If the awareness is especially low amongst one age group, for example, special attention can be paid to reach out to these consumers. It can also give feedback on how earlier attempts to raise awareness has succeeded to reach out to all groups of society.

Method of payment for water is included as a characteristic as it is already known that the average water consumption is lower amongst the people that pay their water bill themselves as opposed to having it included in the housing bill. It would however also be interesting to see if any other differences between these two groups can be identified related to attitude, awareness and willingness to pay.

4.2.2 Awareness and perception

It is understood from the interviews that the current management strives for general awareness of the urban water cycle. Increased awareness will mean more responsible consumers (Web ref 12). An informed and interested public is more likely to behave in a way that protects the watercourse. They are also more likely to be interested in how the water management is carried out and more willing to participate in the decision-making process. This is important since public participation is thought to be crucial in a sustainable water management. To map the most basic public knowledge about the urban water supply the following questions were included in the questionnaire:

- Where does Göteborg get its drinking water?
- Where does the sewage go?

Awareness of current water management was also assessed by asking the questionnaire participants if they knew who was responsible for delivering drinking water.

The water sector does not exhort the consumers to save cold water today. First of all, because Göteborg has access to a large amount of raw water in the Göta River. The other reason is that the piping system is designed for much higher water consumption than the current. The quality of the drinking water could be deteriorated if the flow through the pipes was reduced. So increasing the awareness of personal water consumption amongst the public to reduce the overall use of water is not a main concern. However, a low awareness of personal water consumption could be an indication of a general perception that water is a free right and not a

valuable resource. The perception of personal water consumption was measured by asking the survey participants to estimate their daily water use.

4.2.3 Attitudes

Two areas were considered important when assessing the respondents' attitudes:

- Public attitudes towards possible future supply scenario
- Do the consumers think that their attitudes/behaviour would be different if the ones that do not pay water bill would start paying and vice versa.

The future supply scenario identified through stakeholder interviews was a supply system where we would have two taps with different qualities at home. The respondents were asked if they would consider such a system acceptable.

It is important to seek the opinions of the end-users before new technology is introduced.

Critical issues of concern amongst the consumers could be identified this way (Friedler, 2006).

Information campaigns following the survey could then focus on these issues. This would increase the chances for a successful implementation.

4.2.4 Willingness to pay

The public need to be aware of the challenges water management is facing today, if we are going to successfully protect raw water sources according to stakeholders. The water supply system is under pressure due to high microbial levels in the Göta River. Supplementary water need to taken from the water reservoir of Lake Delsjöarna when the river water is insufficient. If the river water quality is insufficient for long periods of time, as an effect of a landslide for example, the resulting consequence entails 100.000-200.000 consumers without water within weeks. This makes the supply system in Göteborg quite vulnerable. To ensure that the Göteborg water supply will maintain its present drinking water quality investments of around 75 millions SEK per annum above the current costs is required. It is important that the consumer willingness to pay is assessed. If the willingness to pay is low, information campaigns might need to be planned to inform the public about these investments and why they are so important in the long term-perspective.

When formulating the question, the total investment cost was divided between the citizens of Göteborg, 500 000.

4.4 Focus group

An informal focus group meeting was held in order to test how the questions were interpreted and if they were easily understood. Feedback from this discussion was taken into consideration

for the phrasing of the final questionnaire. It is common practice in the creation of a questionnaire, (Wärneryd.B.1993). It is in essence a trial run with resulting improvement if necessary.

4.5 Data collection and analysis

The 300 face-to-face interviews were held during four weeks in July 2006. It was carried out in different location around the city centre of Göteborg. This was done to increase the chance of a fair representation of the target group, i.e. the population of Göteborg above the age of 18. The following selection criteria were taken into consideration.

Time of the day: The interviews were mainly carried out between 16.00-19.00. By choosing this time, people that are working during the day are also consulted.

Geographical location: The interviews were held in various locations in the city centre, to diminish the risk of consulting only one category of people. The interviews were carried out on Kungsgatan, in the shopping centre Arkaden and on Fredsgatan as marked in Figure 4.2. The shops located around these areas are targeted at different groups in respect to age and gender so that the people passing by would be a cross-section of the community.

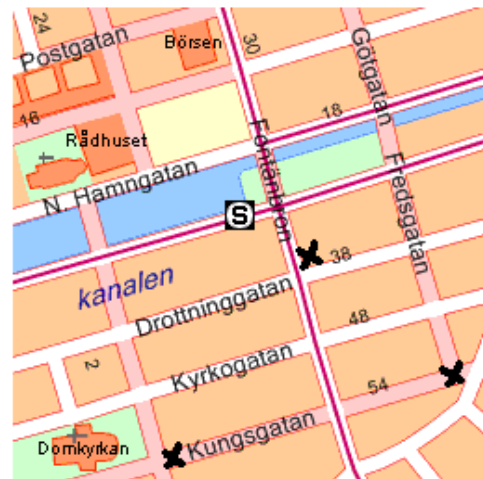


Figure 4.2. City centre of Göteborg. Interview location marked with cross. (Web ref 13)

Data analysis

The questionnaire (Appendix 1) contains both open and closed questions. Question 4,5 and 6 assesses the respondent's awareness of current water management and are open questions. Question 11 identifies the source of respondents' knowledge on current water management and is also an open question. The answers were documented verbatim during the interview and coded afterwards during the analysing phase. The rest of the questions are closed with yes and no answers.

The questionnaire results were processed using Microsoft Excel. Tables and graphs were created to illustrate the data. The mean arithmetic value and standard deviations were calculated for the estimated water consumption.

The literature review that was carried out during the initial stage of the case study gave important input in the final result assessment. During the literature review, scientific articles, policy recommendations and reference books were studied. Swedish and EU policy recommendations about public awareness and participation were compared with the questionnaire results to identify implementation gaps.

5. Results and Discussion

5.1 Consumer characteristics

5.1.1 Gender

60% of the respondents were women. The unequal gender distribution could be explained by the fact that a higher proportion of women were shopping in the city centre when the interviews were carried out. The gender distribution is presented in table 5.1,

Table 5.1 Gender distribution

	Number	%
Men	121	40
Women	179	60
Total	300	100

5.1.2 Age

The age distribution is illustrated Table 5.2 and Figure 5.2. The largest group is men and women under the age of 30, which encompasses one third of the respondents. More young people spending time in the shopping areas could explain this age distribution.

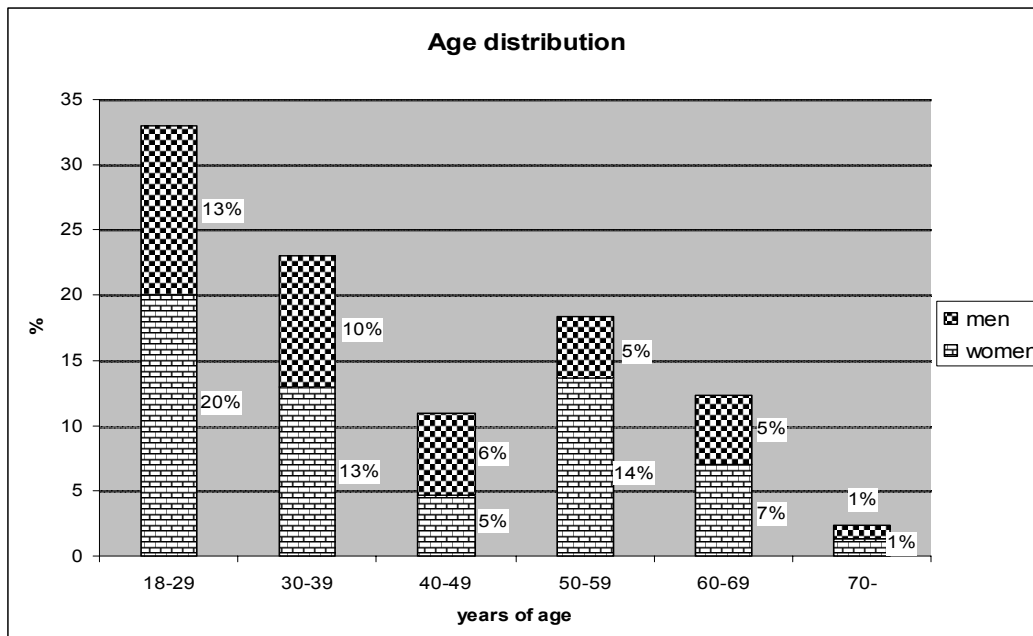


Figure 5.2 Age distribution.

Table5.2. Age distribution

Age	Women	Men	Total	Percentage
18-29	60	39	99	33
30-39	39	30	69	23
40-49	14	19	33	11
50-59	41	14	55	18
60-69	21	16	37	12
70-	4	3	7	2
Total	179	121	300	100

5.1.3 Method of payment for water

The data has been divided between the methods of payment for water. The result is presented in table 5.3. Most survey participants pay their water through their housing bill. No significant difference existed between the number of men and women that receive water bill. The number of respondents that pay their own water bill, separate from rent, increased with rising age as is shown in table 5.3, with the exception of people over 70 years of age. This reflects that it is more common to own your own house, as you get older.

Table 5.3 Method of payment for water

Method of payment for water	Age						Total	Percentage
	18-29	30-39	40-49	50-59	60-69	70+		
Number of participants that pay their own water bill	6	8	8	12	13	0	47	16
Number of participants that pay water tariffs incorporated in rent	93	61	25	43	24	7	253	84

5.2 Awareness

Three questions were asked in order to map public awareness of current water supply and management (Appendix 1):

- Question 4. Do you know where the drinking water is taken from?
- Question 5. Do you know where the sewage goes?
- Question 6. Do you know who is responsible for the drinking water delivery?

Of all participants, 19 % said they did not know the answer to any of the questions about water

source (question 4), wastewater disposal (question 5) and water administration (question 6). Most unaware were young people and especially young women; 42% of women age 18-29 said that they did not know the answer to any of these three questions about current water supply (Figure 5.3). This value was 15% for men in the same age group. It is not possible to find an explanation behind this gender difference from the result of this study. One theory could be that women want to be certain when giving an answer and are less likely to guess. The age difference in awareness appears quite natural since older people have had a longer time to take in knowledge about these issues.

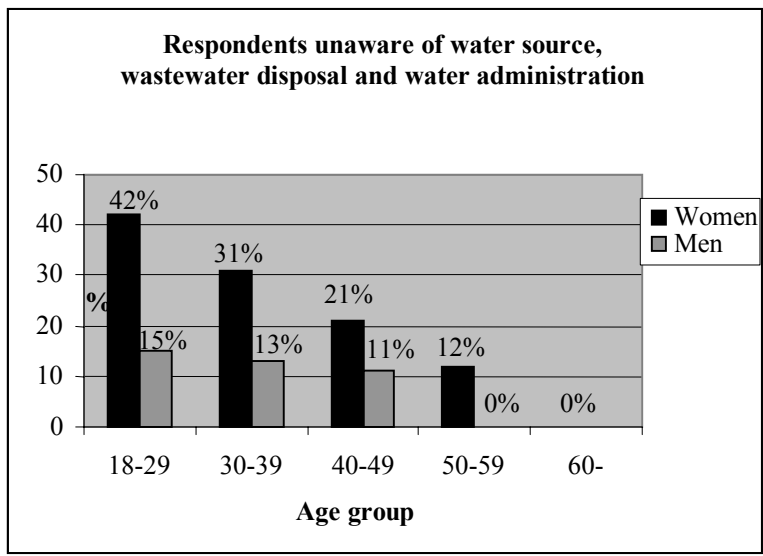


Figure 5.3. Percentage of the respondents that did not know answer to any of the questions about water source (question 4), wastewater disposal (question 5) and water administration (question 6).

5.2.1 Awareness of drinking water source

The respondents' answers were categorised into five levels of knowledge about the water source, which are presented in table 5.4. Only 10 % knew that raw water is taken from both the Göta River and the Lakes Delsjöarna. 2% also knew the name of the water purification plants, Alelyckan and Lackarebäck. 45% was unable to answer the question. A significant difference between the percentage of women (52%) and men (36%) that did not know the source of raw water was evident. An almost equal amount of the remaining interviewees said that Göteborg gets its water from the Göta River (20%) or the Lakes Delsjöarna (25%). The age group that was least aware of the water source was 18-29. 75% of the women and 51% of the men said that they did not know where Göteborg gets its water. This shows a low level of water source awareness amongst young people.

Table 5.4. Awareness of water source

Do you know where Göteborg gets its drinking water?	Age						Total	Percentage
	18-29	30-39	40-49	50-59	60-69	70+		
Raw water is taken from the Göta River. When the quality of the river water is insufficient, the reservoirs of the Lakes Delsjöarna are used. Raw water is then treated in either Lackarebäck or Alelyckan, the two purification plants in Göteborg.	0	0	2	2	1	0	5	2
Raw water is taken either from the Göta River or the Lakes Delsjöarna alternatively depending on the river water quality.	3	5	2	6	7	1	24	8
Raw water is taken from the Göta River.	15	15	5	15	9	1	60	20
Raw water is taken from the Lakes Delsjöarna.	16	17	11	16	13	3	76	25
Do not know	65	32	13	16	7	2	135	45

Many people judging from the interview result have a limited awareness of their water source and other areas of the current water management. Perhaps an attitude described by Keen (2005) is widely spread. He argues that people today use water with little knowledge of the water source from which the water is taken from and where the sewage will end up because a form of disconnection exists between communities and the natural environment. It is, according to him, important to re-establish the mental connections between our behaviour and environments if a shift toward a more sustainable development should be achieved.

The ongoing implementation process of the Water Framework Directive is to result in a new way of managing water. Perhaps the most significant difference is that water management should be organized within the natural geographical and hydrological unit of the river basin. This promotes, according to the Directive, a holistic approach to watercourse management. The directive's emphasis on public consultation, *e.g.* the goal of the Directive, could only be realised if stakeholders and members of the public participates in the decision-making process.

However, from the result of the stakeholder interviews and questionnaire survey a possible pitfall for the implementation process is that urban population will be difficult to engaged in the decision-making process. It seem easier to engage the rural population, the interest in issues related to water management has according to stakeholders risen lately. The measure taken by the Water Authorities, to increase the involvement of the general public was believed to be the reason. Efforts has been made to inform water users about the Water Framework Directive and

water councils is starting to form in different areas of the water district. The purpose of these water councils is that the dialogue between the members (i.e. representatives from the industry, farmers and members of the public) and the water authorities will lead to more sustainable water management.

The interest and awareness of water management amongst the urban citizens is not expected to follow the same trend. This could be unfortunate since the behaviour of the urban population is affecting the watercourse, urban population are also in a sense polluters and it would be beneficial if their awareness and knowledge would increase in the same way as in rural areas. They are going to help paying for the measures included in the River Basin Management Plan, which could potentially be a cause of protests, especially if they are not aware of the problems that water management is facing.

The rural population are close to the water source and would find it easier to relate to the issues discussed. It is perhaps a more “natural” public involvement than involving urban population that in a way are “disconnected” from their watercourse. But it is important all the same; different methods might have to be employed to increase the level of involvement.

5.2.2 Knowledge of wastewater handling

The survey participants’ answers were categorised into four levels of awareness of sewage disposal in Göteborg. The results are presented in table 5.5.

Table 5.5. Awareness of wastewater disposal.

Do you know where the sewage goes?	Age						Total	Percentage
	18-29	30-39	40-49	50-59	60-69	70+		
Sewage is treated in the wastewater treatment plant of Rya	18	12	12	12	14	1	69	23
Sewage is treated in a wastewater treatment plant on Hisingen, name of plant unknown.	2	9	1	4	3	0	19	6
Sewage is treated in a wastewater treatment plant. Name of plant unknown	24	16	5	15	10	3	73	24
Do not know	55	32	15	24	10	3	139	46

23% knew that the wastewater is treated at the wastewater treatment plant of Rya. 6% did not know the name of the Wastewater treatment plant but knew where it was located, on the Island of Hisingen; this was thought of as showing a higher level of awareness than not knowing the

location since the memory for names sometimes can fail us. 46% said that they did not know where the sewage goes. Many of the people that knew that sewage is treated at Rya said that they had been there on a study visit with school. Study visits to water purification plants and wastewater treatment plants seem to be a very efficient way to increase awareness of the urban water cycle. One woman said that she had learned about Rya from her child that had been there on a study visit.

5.2.3 Awareness of drinking water management

The answers were categorised into five levels of awareness of the current water management. The result is shown in table 5.6.

Table 5.6 Public awareness of current water administration

Do you know who is responsible for the drinking water delivery?	Age							total	percentage
	18-29	30-39	40-49	50-59	60-69	70+			
The Eco Cycle Office through the Göteborg Water and Wastewater Works.	0	3	0	4	2	0	9	3	
The Göteborg Water and Wastewater Works	12	17	13	11	13	2	68	23	
City of Göteborg	12	7	8	14	10	3	54	18	
Private company	2	3	0	2	1	0	8	3	
Do not know	73	39	12	24	11	2	161	54	

The Eco-cycle committee is responsible for the overarching planning of water and sewage management in Göteborg. They send the water and wastewater bill to the customers and they are responsible for the customer contact. The Eco-cycle Office request operational services from Göteborg Water and Wastewater Works and Gryaab. Only 3% of the survey participants knew this. 23% said Göteborg Water and Wastewater Works. 18% said the City of Göteborg and 3% thought that a private company was responsible for delivering the drinking water. 54% said they did not know.

84% of the respondents do not pay water bill and do not have any reasons for contacting the Eco-Cycle Office for issues regarding water bills et.c. This might explain the low awareness of water administration.

5.3 Perception

5.3.1 Consumer perception of water consumption level

The average estimated water consumption was 99 litres. The average estimated daily use of water amongst the respondents that pay their water bill themselves was 141 litres. The rest of the respondents, where water costs are included in their rent, estimated their water consumption at 92 litres. Women estimated higher water consumption, 105 litres compared to men, 91 litres. The average daily water usage in Göteborg is 185 litres. (Web ref 4) This means that the people paying their own bill were closer in their estimation and more aware of the situation, yet underestimating the amount of water consumed.

Many of the respondents found it difficult to make an assumption, which led to a large variation in the estimated values. The high standard deviation values (see table 5.7, 5.8, 5.9) are an indication of this.

Table 5.7. Estimated water consumption (Litres). All respondents

	Mean	Std. Deviation	N	Could not give an estimation
Total	99.44	165.26	258	42

Table 5.8. Estimated water consumption (Litres). Men and Women

	Mean	Std. Deviation	N	Could not give an estimation
Men	90.63	95.94	114	7
Women	105.48	201.43	148	31

Table 5.9. Estimated water consumption (Litres).

	Mean	Std. Deviation	N	Could not give an estimation
Pay water bill	141,26	179.87	38	9
Do no pay water bill	92,38	160.28	226	27

5.3.2 Consumer perception on the influence of the method of payment on water usage behaviour

The respondents that pay water bill were asked if their behaviour/attitude would differ if the

charge for water was incorporated in their rent. The results have been displayed using the criteria listed above and also subdivided between the sexes. 76% said no, see figure 5.10. One respondent in this group said:

51% of interviewees that did not pay water bill said they believe their behaviour/attitudes would be different if they received a separate water bill. A higher proportion of women in this group said they believe they would change their habits, (62%), compared to men (38%). These results are illustrated in figure 5.11 and 5.12

The following question assessed methods of payments effect on water usage behaviour. Respondents in Group A were asked whether they would change their attitude or behaviour if they would stop paying water bill. A majority of the respondent, 76% said no. One interviewee said that she would maintain a water saving behaviour even if her consumption would not be monitored, it was, according to her a matter of not using a valuable resource in a wasteful way. She mentioned concrete things like not letting the water run while brushing teeth and not doing the dishes under running water, it comes natural. Her attitude was shared with many in her group.

5.4 Attitude

One different future supply scenario mentioned in the interview with stakeholders was that of water supply from two different taps with qualities delivered to households. One tap would contain drinking water the other water of a secondary quality suitable for flushing the toilet, washing the car etc. The respondents were asked if they consider such scenario acceptable. A majority of the respondents, 76% believe they would find this acceptable. There were some matters of concern that came up during the interviews. These were mainly safety and economical conditions, 10% said they would need more information on these issues before they could make up an opinion. 14 % said no. Women were more positive to this type of system than men. 80% of the women believe they would find it acceptable compared to 69% for men.

Table 5.10 Would you consider it acceptable to have two taps at home with different qualities?

Would you consider it acceptable to have two taps at home with different qualities?	Age						total	Percentage
	18-29	30-39	40-49	50-59	60-69	70+		
Yes	79	55	23	41	26	4	228	76
No	12	7	6	7	7	2	41	14
Do not know	8	7	4	7	4	1	31	10

10% of respondents said they needed more information before forming an opinion. The comments made by this group were;

- “I would find it acceptable if safety could be guaranteed. This is very important with children in the house”. Man, 41
- “I do not know, it seems quite meaningless”. Woman, 21
- “I do not know depends on if it is safe in the aspects of bacteria, hygiene”. Man, 48
- “It depends on, not if there is an odour”. Man, 25. Two more people made this comment.
- “I do not know, it does not seem very cost efficient”. Man, 32
- “Do not know. It would be acceptable if the costs would not rise”. Man, 33
- “Do not know. It would be acceptable if I would not have to pay the installation costs”. Man, 34
- “Do not know. I am not satisfied with the current quality, if this is a way to increase the drinking water quality I would find it acceptable”. Woman, 58
- “Do not know. I would find it acceptable if costs would go down”. Woman, 61

76% of the interviewees believe they would find this supply system acceptable. The comments made by this group were;

- “Yes, if that system would be good for the environment”. Woman, 33
- “Yes, I actually had a conversation about this yesterday with a friend”. Woman, 36
- “Yes it would be ok to flush the toilet with that water but I would not like to water my plants in the garden”. Woman, 37

14% of the interviewees said no. The comments made by this group were;

- “No, it would be unnecessary; the costs would be too high”. Man, 65
- “No, not as long as I have small children“. Woman, 35

5.5 Willingness to pay

To ensure that the Göteborg water supply will maintain its present drinking water quality investments of around 75 millions SEK per annum above the current costs is required. Every citizen of Göteborg would need to pay 150 SEK more for water each year if these costs would be divided between all consumers. The respondents were asked if they consider this sum, 150 SEK, reasonable. The results are presented in Table 5.11.

Table 5.11 Willingness to pay to secure current drinking water quality.

Do you think it would be reasonable to pay 150 SEK more per year for water?	Age							total	Percentage
	18-29	30-39	40-49	50-59	60-69	70+			
Yes	88	65	28	50	36	7	274	91	
No	7	3	4	5	1	0	20	7	
Do not know	4	1	1	0	0	0	6	2	

7% of the interviewees did not consider this sum reasonable. The comments made by this group were:

“We already pay so much tax. The property taxes should be lowered before water charges go up”. Man, 42

-“No, lower the costs instead and let the taxes pay for these investments”. Man, 27

-“No, it should be included in the property tax”. Woman, 32

-“No, I do not want to be forced”. Woman, 49

-“No, it is a political issue”. Man, 48

-“No, I am not satisfied with the current service, I live in the top flat in my house and I do not get cold water”. Woman, 62

-“No, it is a high sum”. Woman, 50

91% of respondents would be willing to pay 150 crowns extra a year. The comments made by this group were:

-“This amount [150SEK] compared to the true value of water is nothing. 150 SEK, you would easily spend that amount on one single visit to a café in town”. Woman, 32

-“Yes I would be willing to pay up till 1000 SEK more per year”. Woman, 29

-“Yes, I am not satisfied with the current quality, I have a sensitive stomach, prefer bottled water”. Woman, 26

-“Yes, if it is necessary, so we do not have to buy bottled water”. Woman, 21

-“Yes, do not want a society where you have to buy bottled water”. Man, 23

-“Yes, but the Polluters Pay Principle (PPP) should be applied”. Woman, 31

-“Yes, but it sounds like large sum”. Woman, 32

-“Yes, but the rent is already so high, so the landlord should pay those raised costs”. Woman, 33

-“Yes, but it is important that there is public control of the way the costs are distributed, so that

you would know where the money goes to”. Woman, 44

-“Yes, it is a low cost considering how important clean water is”. Woman, 56

-“Yes, this will be reality in a near future”. Woman, 57

-“Yes, but it would be better if the ones that pollute would pay”. Woman, 54

-“Yes, but the authorities have to account for the investments made, so you know that the money only is used for this purpose”. Woman, 60

-“Yes, raise the cost of water and lower the property tax”. Woman, 63

-“Yes, but the authorities have to report for the investments made”. Man, 78

2% said that they did not know if this sum is reasonable. This comment made by a 21 year-old man in this group;

-“Do not know, I need more information, it is very important with preventive measures”.

No correlation between method of payment for water and willingness to pay was found.

Overall it seems as if the public acceptability for raised cost for water is quite high. But one must not forget that the interviewees were given relatively detailed information on what this money would be used for. In reality, the willingness to pay may be less than what is indicated in this study.

5.6. Source of knowledge

The respondents with knowledge about Göteborgs water source or wastewater disposal were asked where they thought they had gained their knowledge about the urban water system from. The required level of knowledge was to be aware of the fact that wastewater is treated at the Water treatment plant of Rya and, for drinking water, to be aware of one at least one of the following:

Raw water is taken from....

- *the Göta River. When the quality of the river water is insufficient, the reservoirs of the Lakes Delsjöarna are used. Raw water is then treated in either Lackarebäck or Alelyckan, the two purification plants in Gothenburg.*
-*the Göta River or the Lakes Delsjöarna alternatively depending on the river water quality.*
-*the Göta River.*
-*the Lakes Delsjöarna.*

The result of the perceived source of knowledge on Göteborg water system is shown in table 5.12. None of the respondents said that they had learnt what they know about urban water cycle through information given by the City of Göteborg. The water sector should try to reach out to the consumers more because the information from the water sector would probably give a more nuanced picture of the urban water cycle and the challenges Göteborg water supply is facing.

Table 5.12. Source of respondents' knowledge on current water management

Perceived source of information	
Media	21%
School	12%
Friends and family	11%
Road signs	7%
Work	6%
University studies	4%
Do not know	39%

6. Conclusions and recommendations

The public awareness of the urban water cycle, water supply management and levels of consumption is low. There is a need for finding ways to increase the awareness. Visits to treatment plants, signs/information boards and having water bills separated from the rent, seem to be efficient ways of increasing the public awareness. There is also need to target such campaigns to different age groups as the level of awareness differs greatly.

One area that serves as a recreational area for the city of Göteborg is around the Lakes Delsjöarna. This might be a good location since the Lake serves as the water reservoir of Göteborg. Other creative ways of reaching out to people with this information would be needed so that all groups of society benefit from the information.

Water representatives believe that the goal of the Directive, to reach “good status” by 2015 will not be reached if the public and stakeholders are not involved the decision-making process. To involve the public in the decision-making process will be a challenge and the question is to which extent and in which way the public should be involved.

The attitudes towards a future scenario of having two taps in the household: one with drinking water quality and the other with secondary quality are relatively positive (76%). This is however not a near term future scenario and critical issues of concern amongst the consumers include hygiene, safety and the effect on the private economy.

If a system where we would have two taps at home is to be realised in the future, information campaigns should be planned to inform about the critical issues such as health, safety and private economy so that consumers would become more positive to such a system. The opinions and attitudes of end-users are of great importance for a successful implementation process of a new technical system (Friedler, 2006).

The willingness to pay for maintaining today’s drinking water quality is high (91%). Many of the respondents commented on the low price of water compared to its high value. It is important to inform the public about the water improving measures that will be carried out so that they know where the money generated by raised water tariffs and “water charges” is used for. The acceptability of raised cost would be higher this way.

7. Final remarks

During the flooding in the region of Göteborg in December 2006 the local newspaper Göteborgsposten, (2006-12-13) reported that the intense rain threatened the drinking water quality. Water quality deterioration caused by heavy rainfall will be more frequent in the future because of climate change. The long-term measures that is needed to maintain today's drinking water quality need to be discussed continuously and not only when flooding and extreme weather occur.

It would be interesting to carry out a similar study after the high media coverage of Göteborg water supply that took place after this study was made. This would enable comparisons and trends of change in attitude and awareness could be identified.

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Appendix 1: Consumer Survey Questionnaire

1. **Gender:** Female [] Male []
2. **Year of Birth:**.....
3. **Do you pay your water bill yourself?** a. Yes [] b. No []
4. **Do you know where Göteborg gets its drinking water from?**
a. Yes:..... b. No []
5. **Do you know where the sewage water end up/goes to?**
a. Yes:..... b. No []
6. **Do you know who is in charge of the drinking water delivery?**
a. Yes:..... b. No []
7. **How many litres of water in total do you think you are using a day?.....**
8. *If we would have two different taps in our homes in the future, one with drinking water and the other with water of secondary quality suitable for watering the plants or flushing the toilet etc. Would you consider that acceptable?*
a. Yes [] b. No [] commentary:.....
9. *A household pays on average around 3600 SEK for water a year. The production costs of drinking water will rise in the future due to increased levels of bacteria in the Göta River, where Göteborg takes its water. If the costs of the investments that need to be done to ensure today's drinking water quality would be divided amongst the population of Göteborg, everyone would need to pay 150 SEK more each year. Do you think it would be reasonable to pay that amount?*
a. Yes [] b. No []
10. **Do you think that your behaviour/ attitude would be different if you /(did not)/ paid your water bill yourself?** a. Yes [] b. No []
[If correct answers to question 5 or 6]
12. **Where have you garnered the information about issues regarding water management in Göteborg?**
a. b. Do not know []