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Summary

The specific attitudes and behaviours of individuals of a given society must be properly understood in order to develop adequate and relevant public policies regarding water consumption. We have conducted a survey research in order to measure the perception of the Geneva population regarding main social aspects of water consumption. We collected 907 valid questionnaires. In particular, we wanted to address research questions such as: are water consumers influenced by their ecological awareness? Is their consumption influenced by price changes? We observed that most of the respondents indicate that they have an ecological awareness regarding their daily consumption of public water. However, we have also discovered that they are generally not able to quantify their consumption (for drinking, cleaning, washing...). Relationships between classes as well as relationships between variables have been analyzed and then research hypotheses have been verified on the basis of non-parametric statistical tests. This empirical research provides some elements of perception regarding public water consumption leading to recommendations for better demand management.

Keywords

Survey research, Water Consumption, Demand Management, Public Policies

Introduction

Drinking, cooking, washing and sanitation are some of the more common fresh water individual daily uses. Unfortunately, in many parts of the world, water is not available in abundance and its bad quality has often negative effects on children and adults health. In Switzerland, the situation is totally different: people can benefit from local network supply services allowing them to receive fresh water in their houses and work places all over the year. This resource is neither scarce nor difficult to access. Consequently, the past two generations have been living in particular favourable setting and might have forgotten that an efficient tap water system is not given for granted.

This empirical work attempts to analyse the situation of one of the main Swiss cities, Geneva. It is an international city located close to the Swiss and French Alps, at the bottom of one of the biggest European lakes, Lake Geneva. Thanks to its geographical position, there are many supplying possibilities; the currently exploited ones are Lake Geneva (80%), Rhône and Arve rivers, and underground water (D'Urso 2006). The inhabitants of the city and its surrounding urbanized area, Canton Geneva, take advantage of an efficient functioning network that delivers everyday high quality fresh water in all private and public buildings. Water is provided at an affordable price for the consumer: the average individual monthly cost for water consumption is CHF 6.27 (around USD 6.22, see SSIGE – SVGW Zurich, <http://www.svgw.ch>) while the standardized Canton median individual monthly salary is estimated around CHF 6'350 (around USD 6'302, see Geneva Cantonal Office of Statistics, <http://www.ge.ch/statistique>). In such a context, water is a cheap and abundant resource; therefore, the risk of its overuse and waste seems to be a relevant area of study.

Although many economics findings provide price elasticity ratios based on econometric models, we believe that price is not sufficient to induce an optimal behaviour of the population regarding public water consumption. We learn from Service Science that clients are co-producers of a service (see Dubosson et al. 2006). For instance, a service provided by a Utility consists in providing inhabitants with tap water of quality. If most inhabitants behave properly (e.g. pay the service, do not flush away toxic liquids, consume wisely), the service production can meet high standards of quality without many difficulties. A service also corresponds to an intangible (or invisible) production. It is thus crucial that the Utility “tangibilizes” elements of value that will be perceived by its customers and consequently properly influence their behaviour in the production process.

We have conducted a survey research in order to measure the perception of the Geneva population regarding the main social aspects of water consumption. We collected 907 valid questionnaires. The Haute École de Gestion of Geneva (HEG-GE) has created a laboratory of market research (LEM, Laboratoire d'Études de Marché) whose main objective is to form students to marketing survey techniques. Among the mandates already carried by the LEM, let us quote "Consumer choices among alternative electricity programs in Geneva – An Empirical Analysis" (Baranzini et al. 2007), "Elements of perception regarding sustainable developments in Geneva". The mandate under study in this paper, "Influences of public ecological awareness and price on potable water consumption", was conducted from September 2006 to March 2007.

The two main research questions underlying this empirical survey are the following:

1. Is individual water consumption and ecological sensibility connected to individual behaviour?
2. Has water price any effect on its consumption?

Thus, individuals' awareness has been analysed focusing on individual perception and also through the analysis of individual demand-price elasticity. In terms of prices, most of the respondents do not know what they are paying for their water consumption. At the same time 80% indicate that its price is normal or cheap. Consequently, we had to include Contingent Valuation Methods (hypothetical scenarios) (Imandoust SB et al. 2007) in our questionnaire to assess the consumption sensitivity relative to price. Relationships between classes as well as relationships between variables have been analyzed and then research hypotheses have been verified on the basis of non-parametric statistical tests. This empirical research provides some elements of perception regarding public water consumption leading to recommendations for better demand management.

This short paper is organized as follows. In the next section, we present some of the existing literature connected with our research. Then, we present the main descriptive statistics obtained from the survey. Few hypotheses related to the theme retained for this paper follow: the influence of public ecological awareness and price on potable water consumption in the Geneva area. In conclusion, we indicate limitations of this study and directions for future research.

Literature review

In the past two decades, many studies have been conducted in order to define the household water demand at different years in several worldwide locations. From Americas to Europe and the emerging Eastern countries, this topic has been analyzed in depth with the purpose to find the best policies for an optimal consumption of this resource (see for example Cavanagh MS et al. 2002, Corral-Verdugo V et al. 2003, Kerhavarzi AR et al. 2006, Kolokytha EG et al. 2002, Monteiro H 2005, Nauges C et al. 2001, Pashardes P et al. 2001, Wong LT et al. 2006, Zhang HH et al. 2005).

Since water scarcity affects many countries of the world and water utilities are usually managed by government or public regulated monopolies, the main challenge is to find economical solutions (e.g. excellent fresh water supply to all households) that simultaneously allow to satisfy demand, to cover costs and be environmentally sustainable.

Actually, several authors have employed econometric methods (Cavanagh MS et al. 2002, Monteiro H 2005, Pashardes P et al. 2001) to find the best water pricing methods to ensure optimal water price policies. More precisely context analysis, social aspects and other social variables have been taken into account to study household water consumption (see for example Corral-Verdugo V et al. 2003, Keshavarzi AR et al. 2006, Kolokytha et al. 2002, Nauges C et al. 2001, Wong LT et al. 2006, Zhang HH et al. 2005).

Regarding the optimal pricing policy, Monteiro (Monteiro H 2005) relates several studies in which the main advantages and drawbacks of an average or marginal cost-based pricing policy, seasonal or temporal variations, capacity constraints and multistage marginal cost

pricing and revenue requirements are explained. *In fine*, marginal cost pricing is, according to this author, is the most efficient water pricing policy.

Other empirical studies focus on survey research methodologies that have been conducted in Canada and in the USA to determine household water demand under increasing block prices (Cavanagh MS et al. 2002). With similar methodologies, different pricing systems have been tested in Cyprus (Pashardes P et al. 2001) and in Iran (Keshavarzi AR et al. 2006). For instance, in the Fars province, Iran, findings indicate that households with higher per capita water consumption are those with the smaller families. Alternatively, a survey of 60 typical apartments Hong Kong, a crowded urbanised area, shows that annual domestic consumption would be correlated with the occupant load of a flat (Wong et al. 2006).

In France (Nauges C et al. 2001), household water consumption seems to be partly inelastic to price. Age, number of household components, education level of the family head and climate are argued to influence household consumption. These socio-demographic variables play a more important role demonstrated by other empirical researches (Corral-Verdugo V et al. 2003, Keshavarzi AR et al. 2006, Kolokytha EG et al. 2002, Nauges C et al. 2001, Wong LT et al. 2006, Zhang HH et al. 2005); they prove that water pricing is the main driver of individual water consumption.

Individual education, housing environment, household income, education programs, billing systems are showed to also have an influence on residential water use in two important Chinese cities (Zhang HH et al. 2005). In Sonora, Mexico, an empirical research (Corral-Verdugo V et al. 2003) confirms these findings: water consumption depends to some demographic characteristics such as gender, age, socio-economic classes. They also claim that information campaign could positively influence those who mainly waste water: adults and rich people.

In Tesseloniki, Greece, authors (Kolokytha EG et al. 2002) show that, in a context where the level of the water supply infrastructure is low, people don't trust the quality of their tap water, the individual consumption level is not correctly perceived and price has a limited effect on residential water demand. This last finding is also confirmed by the Mexican survey (Corral-Verdugo V et al. 2003). A low Willingness-To-Pay (WTP) for improvements in water services and a high level of public awareness concerning current and future water related problems are also highlighted.

In 2000, considering the EU 15 countries altogether, 94.53% of the population had an easy access to water supply. Quality standard and water price were considered to be fairly good by 92.8% of the population (this percentage seems to remain valid in the following years according to Fiorio et al. 2007).

Finally, in western Switzerland (D'Urso 2006), about 90% of the population drink tap water and 94.9% are aware that drinking tap water is a more ecological behaviour than buying bottled water.

This literature review, although not exhaustive, indicates that too little sociological knowledge is available to understand the sociological aspects of water consumption. In this study, we intend to discover social patterns associated with water consumption in a wealthy and international city, Geneva, enjoying an efficient public water service.

Methodology

This empirical study investigates the "Perceptions of water consumption in Geneva" was conducted from October 2006 to March 2007. It was realized with the help of a group of students under the supervision of the LEM research staff and encompassed the following steps: determination of the axes of investigation, design of the questionnaire, data collection, coding and statistical data processing, and finally communication of the results.

In the exploratory phase we conducted (around 40) in-depth interviews exploring this topic. Two main themes emerged from these: apparently, ecological sensibility and price of water influence individual water consumption.

On the basis of the two identified research themes, we have designed a questionnaire administered to the active population of the Geneva area. Respondents were selected on a random basis in the streets, open spaces and other public places of the Geneva area. The questionnaire (the complete questionnaire, in French, is available on request) was made up by 22 close questions attempting to define water consumption perception and price elasticity of the demand features. Individual current consumption questions have been asked; hypothetical scenarios have also been presented in order to provide further elements of analysis leading to policy making suggestions.

907 people responded to the questionnaire, 54.7 % men and 45.3% women. Age classes are homogeneous. Generally, socio-economic statistics of the sample are representative of the socio-economic parameters indicated in the official statistics of the Geneva Canton. Moreover, 58.9% of the respondents rent the habitation in which they live all charges included. 13.5% of the total sample are renters but pay extra charges for water, gas supply and waste collection services; 23.6% are owners and pay all charges in full.

Descriptive Statistics

Here are some of the main descriptive results obtained by the analysis of the questionnaires collected.

69% of the respondents affirm to be attentive not to waste water, 24.7% don't pay attention to it. 50.9% think not to be informed enough on consumption and conservation systems. However, we should highlight that 83.2% don't know their individual monthly consumption. After telling people the average individual daily water consumption (162 litres), 64.7% think it's a too high consumption. Concerning toxic liquids flushed away through pipelines, 48.3% are attentive about this topic while 26% rarely or never pay attention to it.

Here follows the answer to the question "Please order these features that have influence on you when purchasing a wash-dishes or a wash-machine?"

50% answered "Price" as the main feature, then follows "Energy consumption" with 25%. Water consumption is solely quoted only as the 4th criterion.

80% of the sample can't estimate what's the water price for domestic use (1000 litres). When this information is given to the respondents, CHF 1.60 m³, 50% indicate that it is a fair price while 20% estimate it is cheap.

Although Geneva inhabitants generally don't know water price, 74.1% know that the water supply tariffs are paid to SIG (*Services Industriels de Genève*), the Cantonal public company in charge of water and energy supplies (gas and electricity) that operates as the local public monopoly.

If the water price shifted between a range of CHF 0.5 to CHF 2 per month and per person, 14% of the respondents would lower their consumption. 21% would also lower the consumption if the price increased would range from CHF 2 to CHF 4. However, 20% of the sample affirms that price does not influence their water consumption, 16% cannot answer.

On the contrary, 78% would not increase their water consumption if water were free, 7% would increase their consumption and 15% cannot answer.

These statistics show that the Geneva people are not very concerned by the topic of water consumption. It is as if they did not value the quality of the service anymore. The lack of interest from the concerned parties causes a problem whenever authorities take in account opportunities of investments in this sector: the resulting policies would risk to be unpopular and inefficient. In the following part of this paper, we look at the main relationships existing among variables under study and attempt to identify key levers to improve global awareness over this topic.

Hypotheses testing

Statistical tests have been used with the aim to treat more precisely to our research questions. In particular, hypothesis test enables us to find out links between individual awareness and behaviour and water consumption. Questionnaires have been coded through SPSS 15 software and tests have been made according to methods described by Bryman and Cramer (Bryman A et al. 2006).

As mentioned earlier in this paper, Geneva Canton fresh water distribution is managed by SIG (*Services Industriels de Genève*), the publicly owned company in charge for the main public Utilities (water and energy). Therefore, it can be affirmed that fresh water distribution is a public service: that means that the main public powers, representative of the local community, are in charge of providing a high quality service to the community itself at an affordable price. In service production, customers are considered to be co-producers of the good as they take part into its production process (Catenazzo G et al. 2008). Thus, people can contribute in everyday life keeping the high quality of the service provided by being attentive not to flush away toxic liquids, by using water consumption wisely and by paying the water bills.

In Geneva, not everybody pay their water bills directly. Indeed, renters, that represent a large part of the population, often see this cost included in their housing fee. Our sample confirms this characteristic, as just one fourth of the population own the flat or house where they live. If we sum together owners and all those people whose water bills are not included with their rents, we can argue that only 37% of the population pay directly their water bills. We could expect that individuals who pay their water bills feel more involved in keeping a high quality water delivery service and their behaviour is more ecological friendly.

To analyse in depth this peculiarity, we refer to two of the questions submitted to the respondents. First, they have been asked "are you attentive not to waste water?" and the possible given answers were "yes" and "no". Second, we have also asked to the respondents

whether they pay or not their water bills, (again, a dichotomous scale choice was provided, “yes” and “no”). Consequently, we have stated our following hypothesis as follows:

Ho: There is no relationship between the fact that individuals pay or not their water bills and their water waste awareness.

Ha: There is a relationship between the fact that individuals pay or not their water bills and their water waste awareness.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sides)
Pearson Chi-Square	26.894(a)	2	.000
Likelihood Ratio	26.593	2	.000
Linear-by-Linear	20.813	1	.000
N of Valid Cases	893		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.93.

We have used the Pearson’s Chi square test to study two independent nominal variables. We have retained a significance level of 5% that is the first-type error (or the risk to reject the null hypothesis when it is actually correct). The p-value of 0 (see table above) indicates that we can reject the null hypothesis at the significance level of 5%. Therefore, we can conclude that there is a relationship between the fact that individuals pay or not their water bills and their water waste awareness. More precisely, cross tables show that individuals who pay by themselves their bills feel significantly more concerned with the quality of the service provided than the others. Thus, the payment action seems to influence the individual behaviour regarding water consumption.

To determine if the individual behaviour over water consumption is driven by service concerns or price dynamics, we have furthered our analysis by studying pricing features. Respondents have been consequently faced with hypothetical pricing scenarios (CVM). *A priori*, we could think that if price directly influenced individual water consumption, then higher prices would induce a decrease on the consumption. Although water demand is partly inelastic to price (Nauges C et al. 2001), we could expect that households with lower incomes would be more sensitive to increases of the water price and consequently reduce their consumption.

To verify if price really influences water consumption or not, we focus our attention on to two questions of the questionnaire. In the survey, respondents were informed that their average fresh water consumption is about CHF 8 per month. Knowing this figure, they were asked what is the minimum price increase that would force them to reduce their consumption. Seven possible choices were given: “between CHF 0.50 and CHF 2”, “from CHF 2 and CHF 4”, “between CHF 4 and CHF 6”, “from CHF 6 and CHF 8”, “more than CHF 8”, “price does not influence my consumption” and “I don’t know”. The second question measures monthly household income and the corresponding scale was divided into the following classes: “less than CHF 2’500”, “between CHF 2’500 and CHF 5’000”, “from CHF 5’000 and CHF 7’500”, “from CHF 7’500 and CHF 10’000”, “between CHF 10’000 and CHF 12’500”, “from CHF 12’500 and CHF 15’000” and “more than CHF 15’000”. In order to test this economic assumption, we can assume that if price has an impact on individual water consumption, then there is a relationship between monthly household income and the minimum water price shift requested to reduce the individual consumption.

To check this latter assumption, we stated the following hypothesis:

Ho: There is a correlation between water consumption reduction in case of price increase and the monthly household income.

Ha: There is no correlation between water consumption reduction in case of price increase and the monthly household income.

The statistical test we have employed here is a non-parametric test called rank correlation that is adapted to correlations between ordinal variables. In particular we are employing two statistics: Spearman's rho and Kendall's tau. We have retained a significance level of 5%.

			Minimum price increase for water consumption reduction	Monthly household income
Kendall's tau-b	Minimum price increase for water consumption reduction	Correlation Coefficient	1.000	.077(**)
		Sig. (2-tailed)	.	.005
	Monthly household income	N	895	804
		Correlation Coefficient	.077(**)	1.000
Spearman's rho	Minimum price increase for water consumption reduction	Sig. (2-tailed)	.005	.
		N	804	811
	Monthly household income	Correlation Coefficient	1.000	.099(**)
		Sig. (2-tailed)	.005	.
	N	895	804	
	Correlation Coefficient	.099(**)	1.000	
		Sig. (2-tailed)	.005	.
		N	804	811

** Correlation is significant at the .05 level (2-tailed).

The p-value of the rank correlation test indicates that the correlation is significant. This is confirmed by both non-parametric tests (Spearman's rho and Kendall's tau). Thus, the more the household income, the more the Willingness-To-Pay. As a consequence, we fail to reject the alternative hypothesis and affirm that there is a correlation between water consumption reduction in case of price increase and the monthly household income.

However, Spearman's rho (.099) and Kendall's tau (.077) correlations are very weak. Thus, as these correlations are really low, we conclude that the price does not represent a sufficient driver to influence individuals' behaviour concerning water consumption. Indeed, people perceive that their water consumption would not be significantly affected by a change of its price. This confirms findings of other researches, mainly in France (Nauges C et al. 2001) who argue that household water consumption seems to be partly inelastic to price. We can then conclude that pricing is not a strong enough social lever to be included in an efficient public water policy.

Conclusions

In this paper, we have presented some of the main results issued by a survey conducted in autumn and winter 2006-2007 at 907 individuals living in Geneva, Switzerland, both in city and its surrounding area. Our work had the purpose to acknowledge individual sensibility over individual fresh water consumption. Water consumption may be dependent on its price, ecological sensibility, information and other variables. We have attempted to determine the main elements that would influence public ecological awareness on water consumption in Geneva area.

We have observed that in Geneva, as elsewhere in Western Europe, people are used to get high quality water in their taps at a very affordable price. This has made people less and less aware of the benefits they are provided with. In fact, although most people affirm to be attentive not to waste water and not to flush away toxic liquid through the pipelines, simultaneously, whenever purchasing high water consumption home devices such as wash-dishes or wash-machine, people don't consider water consumption as a key factor.

The knowledge about water consumption perceived by individuals (for example, the magnitude of individual consumption, current water tariffs) is low. Consequently, public information campaigns should take this into account. Moreover, it should be noted that the water price level has a limited impact on individual behaviours. A price increase would have a limited impact on consumption: as evidenced in this paper, the water price shifts acceptance aiming at reducing consumption has no straight connections with household incomes. Considering this, a pricing driven policy would be rather inefficient.

The people who directly pay their water seem to be more concerned by water savings than people who don't pay directly their bills. For this reason, attention should be rather focused on increasing the individual commitment by forcing more Geneva citizens to pay directly their water bills. This should affect individual awareness and, additionally, have positive impacts of the quality of the service provided.

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