

Article

Wastewater Reflections in Consumer Mind: Evidence from Sewage Services Consumer Behaviour

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Abstract: Environmental concerns have become an important decision-making determinant for consumers. Hundreds of emerging pollutants and their metabolites are listed as present in European aquatic environments and human settlements are blamed as major sources of water pollution. It was assumed that as long as water treatment is not totally effective and it requires a high amount of energy and resources, household's contribution through correct behaviour in relation to the load of waste they discharge in the sewage system can reduce efforts towards wastewater treatment. Consequently, the main objective of this study was to investigate households' perception and behaviour related to wastewater treatment services. Results are based on a random survey with a sample of 125 Romanian consumers of water supply and sewage services. A key finding is that investigated wastewater services consumers perceive the effect of discharging untreated wastewater in the environment as highly negative both on human health and on the environment, thus pointing out the importance associated by them to water treatment. This research argues that understanding wastewater services consumer behaviour enlarges the way toward reducing environmental disturbances.

Keywords: wastewater; sewage service consumer; behaviour; perceptions; harmful waste; pharmaceuticals

1. Introduction

Environmental resources consumption is closely related to what and how individuals and communities, as a whole, consume and to the structure of the economy that provides goods and services [1]. As long as consumption is central to all production processes, plenty of questions have been raised over environmental impacts of consumer behaviour. Consumption, in general, plays a crucial role in our day-to-day life, since it involves and reflects social relationships, actions that imply sale, use and disposal of goods [2]. Scientific research gives hope that understanding consumer behaviour can contribute to reducing environmental disturbances.

During the last decades, environmental concerns has become an important consideration in consumers' decision making. Nowadays, more than 700 emerging pollutants and their metabolites are listed as present in European aquatic environments [3], human settlements are among the major sources of water pollution and worldwide 80% of municipal wastewater is discharged untreated into water bodies [4]. Thus, when shaping our purchasing decisions by an evaluation of the product or service impact on the environment, environmental concerns and awareness and purchase behaviours are intersected by ethical concerns [5,6]. When consumers make a decision about acting or not acting

there is a possibility that decision contributes to a more or less sustainable pattern of consumption [7]; however, it is quite difficult for individual consumers to discern the environmental consequences of their behaviours [8]. And as long as much of the focus of ethical consumption is on the individual [9], the investigation of water and sewage services consumer perception and behaviour will cast light on the current situation, thus providing guidance for the steps to take in order to stimulate a more sustainable behaviour. Authors assumed that water treatment requires a high amount of energy and resources and households' contribution through a correct behaviour in relation to the load of waste they discharge in the sewage system can reduce the efforts made for wastewater treatment.

Romania has been experiencing a rapid economic growth and urban expansion, which impact on population lifestyle pattern, after the accession to EU in 2007. Between 1990–2010 rural population decreased by more than one million, from 10.8 million to 9.6 million [10] and this trend continued, as between 2013–2016 rural population decreased from 9,216,016 to 9,124,490. Part of them moved to urban areas [11]. Consequently, concerns related to urban life such as air pollution, landscape changing or solid-waste management are more and more prominent. In Romania, water pollution caused by human agglomerations is determined by several factors: low population rates linked to wastewater collection and treatment systems, improper operation of existing treatment plants, development of urban areas and insufficient protection of water resources and improper waste management [12]. For example, in terms of managing municipal solid waste, Romania is one of the most underperforming European Union Member States, with the highest landfilling rate of 72% in 2015, while the EU average in the same year was of 25.6% [13].

Taking into account the contribution of sewage services consumer behaviour in building sustainable society and the high need to intervene for decreasing water pollution in Romania, the main objective of this study is to investigate households' perception and behaviour related to wastewater, more precisely, their perceptions about the impact of untreated wastewater on environment and human health, as well as their behaviour related to the discharge of harmful substance in the sewage system. In establishing the above-mentioned objective, authors started from the assumption that an ecological water behaviour considers water as a limited resource and people having a responsibility towards conserving it.

The paper continues with the "Material and Methods" section (which describes the variables used and the survey methodology). The next chapter is dedicated to "Literature Review", which focuses on the "Effects of discharge of untreated wastewater and necessity to treat wastewater" and on the "Effects of waste cooking oil, pharmaceuticals and other chemicals on water quality". The fourth section is dedicated to "Results and Discussion". The final remarks and practical perspective belong to "Conclusions".

2. Materials and Methods

The study is based on a survey that used a sample of 125 people, consumers of water supply and wastewater treatment services from Romania, interviewed by phone. Phone numbers were randomly generated and an interview was requested. The acceptance to respond rate was 8%. The error was 8% and the confidence interval was 92%. The questionnaire included 16 variables related to perception and behaviour of private consumers of water supply and wastewater collection services and one demographic variable (gender), as described hereinafter and synthesized in Figure 1.

The study of perceptions focused on three directions. One was concerned with the effect of discharge of untreated wastewater, which was investigated in the following five situations: (i) direct effect on respondent health when they live in an area where wastewater is discharged in nature without being treated; (ii) indirect effect on respondent health through consumption of food from areas with untreated water; (iii) direct effect on other people's health when they live in an area where wastewater is discharged in nature without being treated; (iv) effect on economic activity; (v) effect on the environment. These five directions were considered the most relevant ones based on the results of two focused groups, of 5 and 7 participants each. Answer options were arranged on 11 points Likert scale, as follows: "−5 (very bad), −4, −3, −2, −1, 0 (no effect), 1, 2, 3, 4, 5 (very good)".

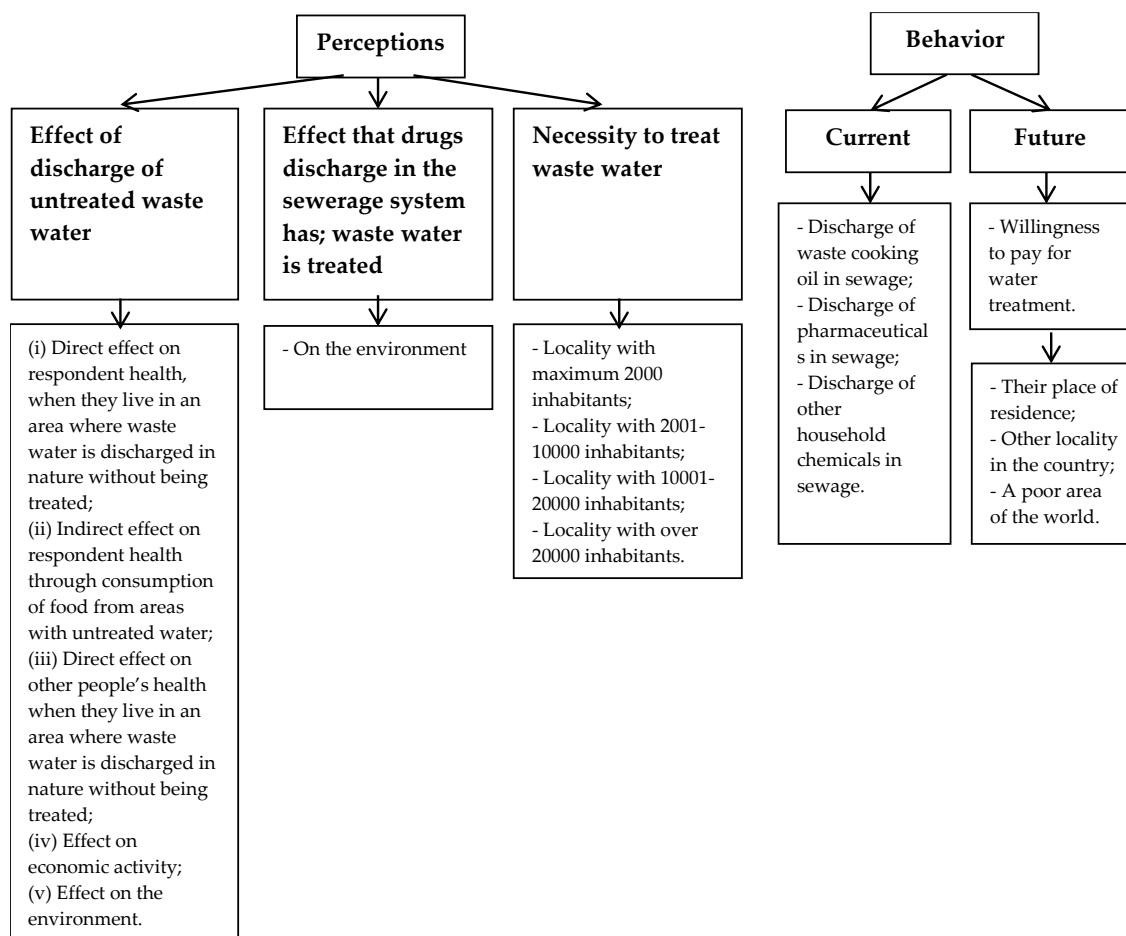


Figure 1. Variables investigated in the study.

The second direction aimed to observe perceptions about the effect that drugs discharge in the sewerage system has on the environment in case wastewaters is treated. The efficiency of wastewater treatment was also evaluated by incorporating the treatment process in the question. Answer options were available on an 11-points Likert scale ranging from very bad (−5) to very good (5). Before asking this question, two different opinions about the quality of treated wastewater were presented to respondents: one advanced by a water company and by a business actor (expert in building treatment facilities) and the other one from researchers. The two opinions described opposed views on the result of water treatment and they were selected in a way to reflect the information that sewage services consumers normally receive through mass-media. The former stated that, after the treatment process, “wastewater arrives to a quality comparable to or even better than river water quality” [14]. The latter highlighted the fact that even after treatment a significant part of pharmaceuticals remain in treated wastewater [15,16].

The third direction aimed to find out people's perceptions regarding the necessity of treating wastewater taking into account various sizes of the population that generates wastewater. Answer options included evaluations on a 5-points Likert scale from very low necessity (1) to very high necessity (5). The size of the population was included in this evaluation in order to observe if it has an influence on this perception due to the fact that sewage system is planned to be introduced gradually in various localities according to the number of inhabitants.

Current behaviour of water and sewerage services consumers was investigated in relation to the actions that increase load pollution of household wastewater. For this purpose, the three main sources of avoidable household pollution were included in the questionnaire: waste cooking oil, drugs and other household chemicals. These three pollution sources were identified as the most frequent ones

during two focus group sessions (with 5 and 7 participants each). People were asked to estimate how much they discharge in the sewage system of each category as a percentage of the total category. It was implied that the rest of the quantity was put in the garbage bin or discharged in special collection points. Future behaviour under the form of self-reported willingness to pay for wastewater treatment was tested for three scenarios: pay for water treatment in their locality of residence, other locality in the country and a poor area of the world.

Data analysis was carried out using the software Excel and SPSS. For comparing the differences of an ordinal variable, between two groups, the Mann-Whitney U test was used. The Wilcoxon Signed Rank test was performed to find out whether there was a statistically significant difference in the ranks of two continuous (non-normally distributed) variables. The level of statistical significance was set at $p < 0.05$.

3. Background

3.1. Effects of Discharge of Untreated Wastewater and Necessity to Treat Wastewater

In a study of Prüss-Ustün et al. [17] developed based on data obtained from 145 countries, which estimated the burden of diarrheal diseases (such as cholera, typhoid and dysentery) from exposure to inadequate water, it was shown that in 2012, 502,000 diarrhoea deaths were caused by inadequate drinking water and 280,000 deaths by inadequate sanitation. Instead, the situation is not so dramatic in Romania.

The legal basis of EU wastewater legislation is represented by Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment [18], modified through Directive 98/15/EC [19]. Directive 91/271/EEC was fully transposed into Romanian legislation through Government Decision no. 188/2002 on the approval of the rules on the conditions of discharge of wastewater in the aquatic environment (amended and supplemented by Government Decision no. 352/2005, Government Decision no. 210/2007) [20]. Through the Treaty of Accession to the European Union, Romania obtained transition periods, so that by 31 December 2015, all agglomerations of more than 10,000 inhabitants complied with the provisions regarding the collection and advanced treatment of wastewater and until 31 December 2018 all agglomerations with 2000–10,000 inhabitants will have to comply with the collection and secondary treatment of wastewater (mechanical-biological treatment). Taking into account both the positioning of Romania in the Danube river basin and the Black Sea Basin and the need to protect the environment in these areas, Romania declared its entire territory as a sensitive area [12]. This decision is reflected in the fact that agglomerations with more than 10,000 equivalent inhabitants have to provide an infrastructure for urban wastewater treatment that allows for advanced treatment, especially with regard to nitrogen and phosphorus nutrients (article 3(1) of Government Decision no. 352/2005 (Government of Romania, 2005)).

In 2016, in Romania, the total wastewater discharged was of 1940.98 million cubic meters, of which 1933.85 required treatment and of this quantity 83.74% were treated (36.46% improperly treated and 47.28% properly treated) [21]. In the same year, there were 47 accidental pollutions due to the negligence of some economic operators caused during the technological processes or to the non-observance of the legal provisions regarding the discharge of wastewater into natural receptors [21]. However, lack of education and the carelessness unpunished by authorities have turned many places of Romania into garbage dumps. For example, following inspection on 40 watercourses in the West of Romania, the Environmental Guard discovered ten such illegal landfills. They only gave one fine of about 21,000 Euros after a town hall covered with the bulldozer the garbage dumped in the Apuseni Natural Park [22].

In relation to the necessity to treat wastewater, in a study of Lu et al [23] it was shown that, in China, the deterioration of water quality by a single grade increases by 9.7% the digestive cancer death rate and it influences proliferation of “cancer villages”, which means, based on environmental pollution, that a village has a higher morbidity cancer rate than the average level [24].

3.2. Effects of Waste Cooking Oil, Pharmaceuticals and Other Chemicals on Water Quality

Toxic organic pollutants found in waters are pesticides which include, for example, fungicides, insecticides, herbicides, halogenated aromatic hydrocarbons, formaldehyde polynuclear hydrocarbons, phenols, biphenyls, detergents, pharmaceuticals, oils and greases [25]. Management of waste cooking oil (WCO) and fats from household and industry poses a significant challenge because of their disposal and contamination, especially of waters [26]. Worldwide, with 500 million tons of WCO yearly produced, China is the largest producer of waste cooking oil [27], while at EU level the total waste cooking oil production is about 700,000–1,000,000 tons/year [28]. According to the European Biomass Industry Association [29], it is estimated that, at EU level, 90% of cooking oil and fats are produced from vegetable oil and the potential WCO to be collected is around 8 L/capita/year; with an EU population of almost 500 million, the annual collection capacity is 4 Mton of WCO, which is seven times more than the current collected amount [29]. One of the best ways to utilize WCO efficiently and economically is by converting it into biodiesel [30] that is considered as a three-win solution, in terms of pollution, food security and energy security [27,28,31]. Lack of information and education determine that this WCO is most of the time poured down the drain, resulting in problems for wastewater treatment plants.

Most EU countries defined unused and expired pharmaceuticals as “special waste”, “dangerous”, “hazardous”, or “problematic waste” in recognition of their special status [32]. Pharmaceuticals are understood as chemicals used for human and veterinary purposes in diagnosis, treatment, alteration, or prevention of disease, health condition, or structure/function of a being, a definition that can be extended to illicit (recreational) drugs [33]. Pharmaceuticals and personal care products (PCPs) comprise numerous chemical classes. Pharmaceuticals and PCPs contain a large and diverse group of organic compounds, including endocrine disrupting compounds and pharmaceutically active compounds [34] with a significant impact on water ecology and human health [35]. Current wastewater treatment procedures have the capacity to eliminate only partially Pharmaceuticals and PCPs and, therefore, they will be found in receiving waters or in the resulting sludge which is sometimes used as fertilizer [36]. Pharmaceuticals and PCPs include products such as lipsticks, sun-screen agents, shampoos, hair conditioners, hair colours, deodorants, fragrances, toothpaste, soap and different compounds commonly present in household items (e.g., detergents, insect repellents) and they are used to improve the quality of our day-to-day life [37,38]. Triclosan and triclocarban are the two typical antimicrobial products found in pharmaceuticals and PCPs and detected in wastewaters [39]. Nitro- and polycyclic-musks, musk ketone found in fragrances, methylbenzylidene camphor present in sun-screen lotions and parabens and isothiazolin derivatives used as preservatives in cosmetics are included in pharmaceuticals and PCPs and they are present as biological and chemical stabilization [36].

For pharmaceuticals, sewage treatment plants represent a major point of entry to surface waters [40,41], as long as removal rates (which depend on physico-chemical characteristics of discharged medicines and type of treatment technology) for pharmaceuticals in wastewater treatment plants range from less than 10% to almost 100% [42,43]. Scientific evidence reveals a broad array of environmental impacts of pharmaceutical discharge, ranging from the fact that the presence of antibiotics in water may lead to antibiotic resistance [44,45] to dramatic effects on the aquatic ecosystem, for instance, due to the presence of ethinyl oestradiol, the active component of a common oral contraceptive, which leads to sexual development impairment and the feminization of male fish [46–48]. Endocrine disruption is not limited to the presence of ethinyl oestradiol. Besides, there are several non-steroidal substances called xenoestrogens which mimic in part the function of oestrogens [49,50].

It stands to reason that increased attention was given to environmental impact of uncontrolled medicines disposal or to adherence in medicines taking. In contrast, there has been relatively little research on pharmaceutical wastage behaviour *per se*. Although there are many pieces of EU legislation referring to pharmaceutical waste and authorities' efforts (e.g., information and educational campaigns) are directed to avoid that unused or expired pharmaceuticals are discharged in sinks or toilets, this behaviour is still common in Romania and worldwide. For example, in the United Kingdom, 12% of

people dispose of unused or expired tablets via toilet or sink [51], while in Lithuania the percentage of people with the same behaviour was of 14% of the interviewed citizens, both from urban and rural settlements [52]. In Afghanistan, more than 10% of the respondents flushed the expired medications down the toilet or sink [53]. In a study that investigated the storage and disposal habits of medications amongst 230 Serbian families, it was revealed that the most common method for disposal of medications in households was disposal in the garbage (85.6% [urban] and 74.5% [rural]) or toilet (8.7% [urban] and 6.4% [rural]) and burning of expired medications in the back yard of the home was also a common practice for medication disposal in rural households (13.8%) [54]. The causes of medicines wastage are mainly the fact that people change their mind about taking the pharmaceuticals they have bought, they take only a part of them, or they replace their expired stocks [55].

In Europe, the presence of pharmaceuticals in STP (sewage system plant) effluents was confirmed over time almost everywhere from the Czech Republic [56], Serbia [57], the Netherlands [58], the United Kingdom [59] or to Spain [60]. In a study of Ferrary et al. [61] that investigated the ecotoxicity of several human pharmaceuticals (carbamazepine, clofibric acid and diclofenac) based on samples of the effluents from four European countries (France, Greece, Italy and Sweden) that were collected for various STPs, showed, for example, that all tested pharmaceuticals were detected in the effluents and carbamazepine seemed to be the most dangerous compound for aquatic environment; this was based on its extremely low removal rate in STPs. A study carried out in Italy assessed efficiency and identified the factors affecting the removal of 26 pharmaceuticals (that fall within the category of anti-inflammatory and cardiovascular drugs, antibiotics, gastrointestinal and diuretics drugs, lipid regulators) in STPs; total amount of those pharmaceuticals discharged into the environment ranged between 60 and 180 kg/day [62]. Huerta-Fontela et al. [63] studied occurrence of 55 pharmaceuticals, hormones and metabolites in raw waters used for drinking water production and they found that effectively drinking treatment removed 30 out of 35 investigated pharmaceuticals and that phenytoin, atenolol, sotalol, hydrochlorothiazide and carbamazepine epoxide were detected in discharged waters. In Romania, Chitescu et al. [64], based on twenty samples of Danube water and three of the main tributaries, studied the occurrence of 67 pharmaceuticals and antifungals in the Danube river and observed that diclofenac reached the highest concentration.

Another group of bioactive chemicals with significant negative impact on environment is found in PCPs. The main source of PCP infusion into the environment is through STPs [39] and conventional wastewater treatment processes are not sufficient for PCPs removal as indicated by Santos et al. [65]. Escher and Fenner [66] found out that transformation of PCPs occurs in wastewater treatment processes, sediments, soils, or drinking water treatment processes. In China, for example, the adsorbed and dissolved concentrations of nine PCPs were investigated in various wastewater treatment plants and it was showed that they were largely present in dissolved form in the raw influent and in the final effluent [67].

4. Results and Discussion

4.1. Perceptions Related to Wastewater

4.1.1. Perceptions of the Effect of Discharge of Untreated Wastewater and Perceived Necessity to Treat Wastewater

In the present study, interviewed people perceived the impact of untreated wastewater as being negative in all tested cases (Tables 1 and A1). They considered that the most harmful effect is on the environment and perceived it significantly stronger than the effect on their own health (Tables 1 and 2). This suggests that awareness or support request messages may be more effective when they refer to the negative impact of untreated wastewater on the environment rather than on other impacts. From a practical perspective, such a result can be used, for example, by the water company in case tariffs increase as a consequence of investments in water treatment infrastructure and the company wants to temper the negative effect by explaining why those investments were necessary.

Table 1. People’s perceptions regarding the impact that the discharge of untreated wastewater has on: respondent health directly; respondent health indirectly through consumption of food from areas with untreated water; other people’s health directly when they live in an area where wastewater is discharged in nature without being treated; economic activity; the environment (mean evaluation scores of the sample; range: −5 (very bad) to +5 (very good)).

	Direct Impact on Respondent Health	Indirect Impact on Respondent Health through Food Consumption	Direct Impact on other’s People’s Health	Impact on Economic Activity	Impact on the Environment
Mean	−3.60	−3.18	−3.58	−2.28	−4.02

Table 2. Wilcoxon Signed Ranks Test results for people’s perceptions regarding the impact of discharging untreated wastewater: comparison between the five selected categories of impacts.

	Test Statistics ^a						
	“Environment” Compared to “Indirect Respondent Health”	“Direct health” Compared to “Indirect Respondent Health”	“Economic” Compared to “Indirect Respondent Health”	“Direct others” Compared to “Indirect Respondent Health”	“Environment” Compared to “Direct Respondent Health”	“Economic” Compared to “Direct Respondent Health”	“Direct others” Compared to “Direct Respondent Health”
Z	−5.531 ^b	−3.022 ^b	−4.368 ^c	−3.082 ^b	−2.655 ^b	−6.423 ^c	−0.314 ^c
Asymp. Sig. (2-tailed)	0.000	0.003	0.000	0.002	0.008	0.000	0.754

^a. Wilcoxon Signed Ranks Test; ^b. Based on positive ranks; ^c. Based on negative ranks.

When the direct impact of untreated wastewater on respondent health and the indirect impact through the food they consume from the affected area are each compared to other impacts, all differences are statistically significant except for the one between the impact on respondent health and the impact on other people’s health. The absence of difference in this case may indicate that their perceptions are not biased by a higher concern for one’s own health compared to the interest for other people’s health.

4.1.2. Perceptions of the Effects that Pharmaceuticals Discharge in the Sewerage System Has on the Environment Even When Wastewater Is Treated

In the present study, the average level of people’s perceptions about the effect that drugs discharge in the sewerage system had on the environment in case wastewaters was treated was “very harmful”, of −4.39 points (while the maximum negative effect on the scale was −5), indicating that they considered the negative effects of drugs persist beyond the treatment procedure, seriously affecting the environment. It can be observed that when the effect of pharmaceuticals is evaluated separately, the perception of their negative effect on the environment is stronger: −4.39 versus −4.02 for untreated wastewater in general, suggesting that bringing to the forefront information about the effects of pharmaceuticals on wastewater can stimulate a more responsible behaviour. For policy makers, this result is encouraging from the point of view of the effectiveness of an information campaign, as it reveals people’s propensity to trust the information that highlights the negative consequences of discharging pharmaceuticals in sewage system. However, the results must be understood only as the first step toward a sustainable behaviour, because their awareness does not guarantee that behaviour will improve and additional drivers are required to trigger a behavioural change.

4.1.3. Perceptions of the Necessity to Treat Wastewater in Localities of Various Sizes

The necessity of treating wastewater is acknowledged and perceived as being from “high” to “very high” regardless of the population size that generated it (Tables 3 and A2), thus pointing out the importance associated by tested people to water treatment. The fact that perceived necessity increases

with the size of the population (Table 4) indicates a correct understanding of this environmental problem by surveyed citizens. For the first two types of localities (the smallest ones), women perceived a higher necessity of wastewater treatment compared to men ($p < 0.05$), thus making them a more suitable audience for awareness education campaigns.

Table 3. People's perceptions regarding the necessity of treating wastewater in various types of localities (mean evaluation scores of the sample; range: 1 (lowest) to 5 (highest)).

	Locality with Max 2000 Inhabitants	Locality with 2001–10,000 Inhabitants	Locality with 10,001–20,000 Inhabitants	Locality with over 20,000 Inhabitants
Mean	3.09	3.88	4.54	4.97

Table 4. Wilcoxon Signed Ranks Test results for people's perceptions regarding the necessity of treating wastewater in various types of localities: comparison between the four selected types of localities.

Test Statistics ^a						
	Loc. 2001–10,000 Compared to Loc. Max 2000	Loc. 10,001–20,000 Compared to Loc. Max 2000	Loc. over 20,000 Compared to Loc. Max 2000	Loc. 10,001–20,000 Compared to Loc. 2001–10,000	Loc. over 20,000 Compared to Loc. 2001–10,000	Loc. over 20,000 Compared to Loc. 10,001–20,000
Z	−8.199 ^b	−8.858 ^b	−8.845 ^b	−7.768 ^b	−8.549 ^b	−6.582 ^b
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000

^a. Wilcoxon Signed Ranks Test; ^b. Based on negative ranks.

4.2. Behaviour Related to Wastewater

4.2.1. Discharge of Waste Cooking Oil, Pharmaceuticals and Other Chemicals

Within the present analysis it was found that people's behaviour that contributes to water pollution is rather sustainable because they discharge only a small part of their harmful substances in the sewage system: on average, 37% of waste cooking oil, 4% of pharmaceuticals and 8% of other household chemicals end up in the household sewage system. Among the three categories of pollutants, waste cooking oil, drugs and domestic use chemicals, drugs are the most rarely thrown away in the sewage system, a behaviour supported by their belief that the effect of discharging them on the environment is serious, even if water is treated previously to its discharge. It was also observed that women discharge significantly less drugs than men, based on self-reported behaviour ($p < 0.05$). Women also considered that the effect of untreated water on the environment and on their health through consumption of food from places with improperly treated water was more serious, compared to men ($p < 0.05$), suggesting that women are more concerned with this problem than men.

4.2.2. Willingness to Pay for Wastewater Treatment

Willingness to pay (WTP) estimations can serve as a starting point for understanding people willingness to contribute financially to water treatment costs. However, such self-reported results must be regarded with caution as they often indicate higher level than people would accept to pay in a real setting. In the US, it was found that people are willing to pay \$1.53 per prescription in order to support the creation of a pharmaceutical disposal program [41]. In a study of Genius et al. [68], investigated consumers were willing to pay up to 17.67% over their water bill for an improved service, meaning a continuous water supply and improved water quality. In the case of the present study, WTP for water treatment that directly affects them is, as expected, higher than a payment made for altruistic reasons in other part of the country (36 euro/year vs. 17 euro/year). However, surprisingly, WTP for water treatment in a remote and poor world area is higher (40 euro/year) than a payment offered for water

treatment that directly affects them (Tables 5 and 6). This result is in line with their perception that the strongest negative effect of polluted waters is on the environment (Table 1), confirming their awareness about the necessity to treat wastewater. Gender had no influence on the WTP for wastewater treatment in any of tested situations.

Table 5. Average amount of money that people are willing to pay for water treatment (euro/year).

	Their Place of Residence	Other Locality in the Country	A Poor Area of the World
Average sum	36	17	40

Table 6. Wilcoxon Signed Ranks Test results for people's WTP for wastewater treatment in various locations: comparison between the three selected types of locations.

	Test Statistics ^a		
	"Other Locality in the Country" Compared to "Their Place of Residence"	"A Poor Area of the World" Compared to "Their Place of Residence"	"A Poor Area of the World" Compared to "Other Locality in the Country"
Z	−7.893 ^b	−5.920 ^b	−2.767 ^c
Asymp. Sig. (2-tailed)	0.000	0.000	0.006

^a. Wilcoxon Signed Ranks Test; ^b. Based on positive ranks; ^c. Based on negative ranks.

Water is seen as the most valuable resource and as a transversal issue for all policy sectors, from environment to health or military security [69], which makes the preservation of water quality an objective as important as its availability. Moreover, environment is a public good and pollution can get a transboundary character and, therefore, it is the interest of all countries to participate in pollution reduction. In this context, the investigation of sewage services consumer behaviour should be used as an intervention tool by stakeholders in the implementation of sustainable water policies for the protection of the interests of people who live beyond the source of pollution. In particular, water pollution in Romania has relevance to other states for at least two reasons. Firstly, there are important rivers, such as the Danube, Tisza or Prut, which are shared with other countries. Also, the health of the ecosystems of the Danube Delta, a UNESCO World Heritage site, is highly influenced by the quality of the waters that flow into it. Finally, all Romanian watercourses end into the Black Sea, another internationally shared water. Secondly, water chemical charges may be transferred into agricultural goods for which it is used, which may be consumed by people from other countries.

The results of the study should be considered taking into account its limitations. Firstly, the size of the sample is small and, despite its random nature, a larger sample, more representative at country level, should be selected in a future study. Secondly, people tend to overestimate their answers regarding their positive behaviour dedicated to environment protection (e.g., willingness to pay or restrain from polluting actions), therefore self-reported answers can be compared against objective measurements, for instance, obtained through their participation in controlled experiments.

5. Conclusions

Household contribution to environmental degradation and, implicitly, to its protection is well recognized, thus, making the understanding of their behaviour highly relevant in fulfilling sustainable development goals. The results of the present study profile a group of people with perceptions and behaviour that support relatively well the reduction of environmental pollution through lower discharge of harmful substances in sewage system.

Perception of high necessity to treat wastewater and of high negative consequences of untreated wastewater discharge in nature on human health and environment testify that surveyed people correctly understand the relationship wastewater-environment. These perceptions represent the premise for building a responsible behaviour regarding pollutants discharge in sewage system.

Consequently, local actors such as administration or NGOs should invest less in awareness campaigns on wastewater impact and more in infrastructure facilities that will ease for people the task of disposing their harmful waste in a proper way. In the case of pharmaceuticals, creation of collection points and increasing people awareness regarding the possibility to bring their expired or unused medicines to pharmacies is a suitable approach for the studied group. Perceptions that reflect strong negative consequences on environment of pharmaceutical residues in treated wastewater indicate two facts. Firstly, information regarding these consequences are credible to and easily assimilated by interviewed people, which makes this information suitable to support requests oriented toward actions that aim to reduce pharmaceuticals load in wastewater (for example, coupons or other incentives to bring unused or expired medicines to collection points). Secondly, such perceptions show that tested consumers are aware of the impact of pharmaceuticals on the environment and of their persistence in wastewater even after treatment, thus, indicating that the activation of their willingness to act in favour of pollution prevention can be effective in their case.

The behaviour of the surveyed people related to the discharge of harmful substances in sewage systems suggests that actions aiming to build a sustainable behaviour should focus more on reducing the quantity of discharged waste cooking oil, for instance through improving the collection infrastructure. In this case, educational campaigns may be necessary to improve disposal behaviour. Moreover, it can be assumed that a pro-environmental behaviour on harmful waste discharge in sewage system increases the likelihood of engaging in other pro-environmental behaviours [70,71].

Results showed that investigated people perceived that the need to treat wastewater increased along with the size of locality, which indicates they were aware of the anthropic impact on the environment. The education-information efforts have to be correlated to the pollution level, which is directly dependent on size of the locality (if no additional factors influence the situation), thus increasing the need of intervention in larger localities. However, this should not lead to neglecting the small localities both in terms of wastewater treatment and community awareness and involvement measures. The integration of sewerage services consumer behaviour with expert knowledge will allow the support of definition and implementation of sustainable wastewater policies.

As a final reflection, it is suggested that policy makers should use the information of this study to support the implementation of information-education campaigns that aim to maintain and update awareness on pollutant effects and on proper disposal behaviour. However, the main actions should focus on stimulating sustainable behaviour through various ways, such as construction and improvement of collection and recycling infrastructure (e.g., return of unwanted medicine schemes) available to households or introduction of price incentives and subsidies.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. People's perceptions regarding the impact that the discharge of untreated wastewater has on: respondent health directly; respondent health indirectly through consumption of food from areas with untreated water; other people's health directly when they live in an area where wastewater is discharged in nature without being treated; economic activity; the environment (percentage of people from the entire sample that selected a specific level of impact).

Type of Impact	Direct Impact on Respondent Health										Indirect Impact on Respondent Health Through Food Consumption										Direct Impact on other's People's Health										Impact on Economic Activity										Impact on the Environment														
Level of impact *	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5											
Percentage	46	29	16	7	2	0	0	0	0	0	0	25	26	22	14	7	2	1	2	0	0	0	42	29	10	6	6	2	2	2	1	0	0	16	17	19	14	18	11	1	2	2	0	0	39	30	10	10	4	2	3	2	0	0	0

* −5 = very bad, −4, −3, −2, −1, 0 = no effect, 1, 2, 3, 4, 5 = very good.

Table A2. People's perceptions regarding the necessity of treating wastewater in various types of localities (percentage of people from the entire sample that selected a specific level of necessity).

	Locality with Max 2000 Inhabitants					Locality with 2001–10,000 Inhabitants					Locality with 10,001–20,000 Inhabitants					Locality with over 20,000 Inhabitants				
Level of necessity **	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Percentage	6	32	21	27	14	0	3	30	43	22	0	1	2	41	55	0	0	0	6	93

** 1 = very low necessity, 2 = low necessity, 3 = average necessity, 4 = high necessity, 5 = very high necessity.

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