





Article

# PET-Bottled Water Consumption in View of a Circular Economy: The Case Study of Salento (South Italy)

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Received: 7 August 2020; Accepted: 25 September 2020; Published: 27 September 2020



**Abstract:** Polyethylenterephtalate (PET) is the preferred packaging material in the bottled water industry and represents the main cause of waste production. This work investigated the drinking water consumption habits, with particular reference to PET-bottled water, of people living in the province of Lecce (Apulia Region, Southern Italy) by age and geographical groups. Their perception about the quality of tap water was also explored. The survey was performed by the administration of a questionnaire to 4137 citizens. Bottled mineral water was consumed by about the 90.4% of respondents with an average consumption of 387.7 L/year per capita (375.2 L/year in PET-bottles, 12.5 L/year in glass bottles). Public supply system was used by the 61.5% of respondents with an average consumption of 169.4 L/year per capita. The consumption of tap water was negatively related to the perception of its bad quality and the residence in a big city (Lecce); while it was positively associated with the age group  $\leq 16$  years old. Effective communications strategies must be developed in order to promote the consumption of tap water and implement good practice of circular economy.

**Keywords:** plastic packaging; bottled water; water consumption; circular economy; resource management

## 1. Introduction

The most common water supply systems for human consumption are tap water and bottled water. The former is distributed by aqueduct and available to consumers by tap, the latter includes the drinking water available on the market in glass or in polyethylenterephtalate (PET) bottles [1]. Lifestyle changes led to the growth of the bottled water market over the last decade, with more and more glass packaging being replaced by plastic packaging [2]. About 4% of the world's oil and gas production is used as a raw material for plastics production and a further 3–4% is spent to provide energy for their production [3]. In addition, most of the plastic produced each year is used to produce short-life packaging that quickly becomes waste that, due to the durability of polymers, degrades slowly in the environment, accumulating and destroying natural habitats around the world. These reflections indicate how the current production and consumption of plastics is unsustainable and new strategies are needed to limit their use. Polyethylenterephtalate (PET) is the commonly used type of plastic and represents one of the main causes of waste production [4]. It is a sturdy material that is long lasting, chemically and thermally stable, and it can be easily recycled. These traits make it suitable

for many uses, such as food and beverage packaging and in particular it is useful for bottled water production [5].

It is estimated that over 400 billion PET bottles are produced globally every year and the 46% of them are used as water packaging. By 2021, this production could increase by 20%, generating negative effects and contributing to the increase of plastic waste, released into the environment [6,7]. Italy is the second European country, after France, for the amount of bottled water produced and exported abroad [8]. Moreover, Italy holds the European record of bottled water consumption, with approximately 221 L/year per capita, while in 1980, was 47 L/year per capita [9]. This highlights the changes that have occurred in the last 30 years in the life habits of Italians, caused both by the introduction of polymer bottles instead of glass as well as a general perception of the better organoleptic and healthy quality associated with bottled water, compared to tap water [10]. The choice to drink bottled water creates significant environmental impacts, many of them related to the intrinsic chemical stability of PET, makes it highly resistant to environmental biodegradation. Actually, it requires very long degradation time that can last up to 500 years, producing waste accumulation in terrestrial and marine environment [11]. Moreover, the study of Gleick et al. [12], have calculated the energy-related footprint required for plastic bottled water manufacturing. Specifically, they analyzed the amount of energy consumption for the entire life cycle. At least 100 MJ Kg<sup>-1</sup> of energy is utilized for processing virgin material into PET plastic bottle. The other following phases are needed in order to obtain the final product, such as bottling, sealing, labeling, refrigeration, and transport, that required additional energy consumption, 5.6–10.2 MJ L<sup>-1</sup>. In addition to energy costs, bottled water manufacturing also requires considerable water consumption. On average, it takes about 3 L of regular water to produce 1 L of bottled water so, in 2018, Italian consumption rates amounted to a wastage of 50 billion L of water a year [13]. Niccolucci et al. [9] calculated the water footprint for tap and bottled water in Italy, that is the volume of freshwater required, directly and indirectly, to provide final consumers with a certain volume of drinking water. Pasqualino et al. [14] instead calculated the Carbon Footprint to evaluate the gas emission concentration, caused by bottled water production.

According to plastic Europe, 355 million tons of plastic were produced in 2016, of which the 30% were used for packaging purpose. The increase of plastic consumption has resulted in a high amount of plastic littering ending up in the oceans, generating negative impacts on marine life and habitats, as it has been shown by Azzarello and Van Vleet [15], Derraik [16], Moore [17], Sazima et al. [18]. Not only ecological impacts, but also social and economic effects might be caused by marine littering (human health issue, seafood safety) [19]. In view of the negative effects generated by the production and consumption of bottled water on the environment, possible solutions for the protection of the ecosystem are needed. Increasing attention is being given to plastic pollution pressure on ecosystem by coastal areas. Despite plastic pollution being a global concern, coastal towns and countries crossed by rivers might act as hotspot of waste dispersion. A consistent literature exists at this regard. A great amount of plastic widespread in marine ecosystem, derived from coastal area, due to a mismanagement of waste, pressure of tourism and recreational activities, especially during summertime [20]. Didem Civancik-Uslu et al., [19] used an innovative indicator to demonstrate the negative impact of plastic bags on the marine environment, in terms of increasing marine littering. Other recent studies have recently identified single-use plastics, including plastic bags as one of the major contributors to marine litter, in addition to other environmental impacts [21,22]. In fact, the increasing population in coastal area, the vicinity to high urbanized centers, tourism, and marine traffic, are considered the main drivers of litter recorded in our seas. In addition, the morphology of the Mediterranean Sea, which is considered an enclosed basin, the long coastline (about 46,000 km), the presence of numerous islands, sub basin, and mesoscale surface circulation traits, can favor the storage of plastic in the sea [19,23,24]. Italy is a tourist destination for 50 billion of foreign, 60% of which are concentrated in coastal towns. The tourists increase the living population by 1/3, accompanied by an increase of waste production, which overloads the management skills of the municipality [25]. At this purpose, several policy initiatives (European, national, and local) have been introduced in

order to take into account consumption and wastes management. Specifically, the European Union has suggested to increase the threshold of recycling of plastic packaging up to 55% by 2025 [26]. Furthermore, “the European Strategy for Plastics in a circular economy” aims to reach the 100% of recycled packaging by 2030, considering plastic materials among the five priority goals of actions to implement resource efficiency and reduced their dependence on natural capital. The concept of circular economy involves a production system and consumption in which biological material are replenished in the biosphere, while wastes are reduced, reused, or recycled. This strategy will play a crucial role in the resources management policies and in waste prevention. Many governs and international organizations have strongly promoted this approach, although there is still a long way to reach this goal [27–29]. Recycling rate of all plastic packaging, in Italy, is around 43%, confirming to be, in general, a “virtuous country”, because 58.1% of wastes are properly differentiated [30]. Moreover, separate collection of wastes varies according to North and South of Italy, in particular Puglia is below the national average (45.4%) [31]. Furthermore, the province of Lecce, compared to the other municipalities of Puglia, showed an average percentage of waste properly differentiated around 41.0%, of which plastic corresponds roughly to 13% of the total amount of waste [31].

In order to reduce the number of plastic bottles, it is necessary to take into account the main reasons which lead consumers’ choice towards bottled water supply rather than choosing public drinking water. The data from ISTAT [25] estimated that, the 29% of Italian families, about 7 billion and 500 thousand, does not drink water from public network. Although optimal quality standards are achieved, there is an increase in bottled water sales [32].

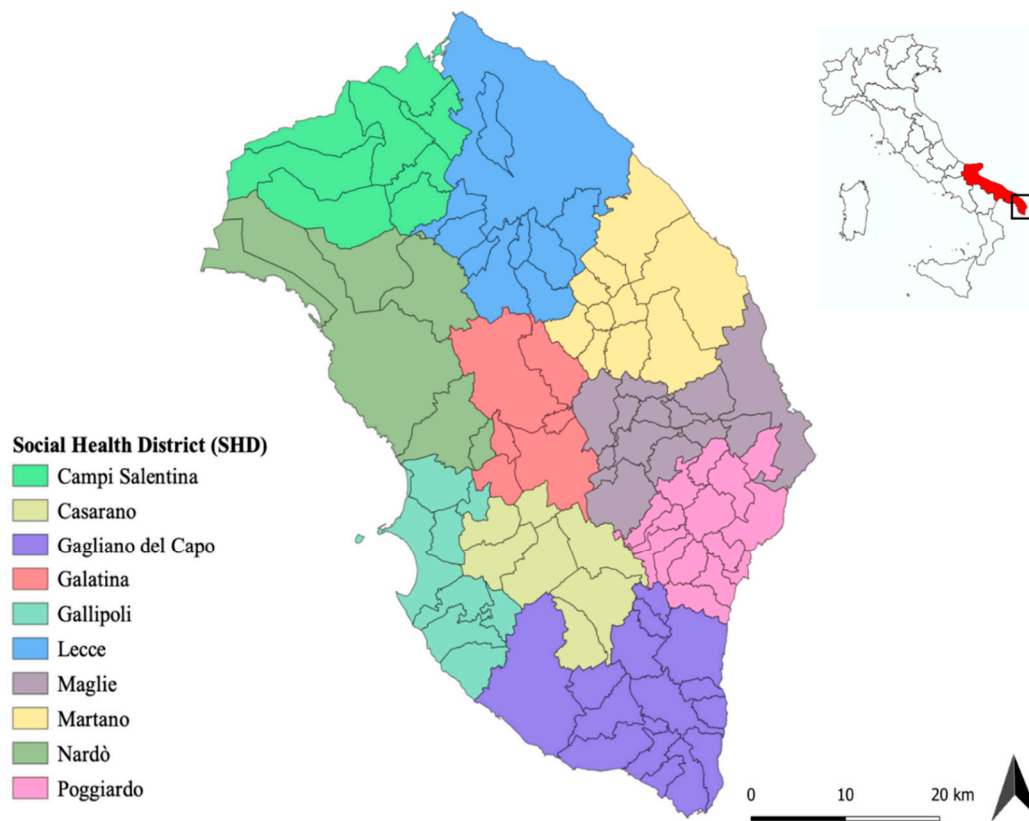
The aim of this study was to investigate the consumption of drinking water by the population living in the Province of Lecce with particular reference to the main supplies used and the factors related to the choice of supply including the consumers’ perception about the quality and safety of the water from public system. Moreover, the consumption of PET-bottled water was taken into account.

## 2. Materials and Methods

### 2.1. Study Area

The study area is part of the Salento Peninsula (Figure 1), located in the southern part of Puglia, which borders the Adriatic Sea to the east and the Ionian Sea to the south and west. It includes 97 municipalities, extends for 2799.07 km<sup>2</sup> and has a total population of about 800,000 inhabitants.

The hydrology of the Salento peninsula is affected by its geological structure mainly composed of karst terrain, which causes the lack of surface water and a high development of underlying aquifers [33]. These comprise a shallow aquifer occupying only 35% of the territory and an extensive deep aquifer, intensively exploited in the past as a source of drinking water [34] and irrigation water [35]. The deep aquifer is supported by seawater from marine invasion which, in the last few decades, produced the increase in its salinity as a consequence of the increase in the extraction of water for irrigation purposes [36,37]. Moreover, deep aquifer is fed by waters mainly from higher layers and rains, which easily reaches it because of tectonic fractures and sandy layers [38,39]. The poor degree of filtration provided by the terrain and the increase in the spread of pollutants on the surface caused also the chemical and microbiological contamination of groundwater so as to interdict in many cases its use for drinking purposes [40–45].



**Figure 1.** The study area subdivided into ten areas corresponding to the Social Health Districts (SHD) of Province of Lecce.

## 2.2. Study Design

The study was part of the M.I.N.O.RE. (Non-Mandatory Regional Water Monitoring) project funded by Apulia Region in order to investigate the qualitative and quantitative state of the groundwater in Salento Peninsula and the consumption of drinking water among the people living in the study area [46].

The survey on drinking water habits was carried out by administering a questionnaire to a sample of citizens living in the Province of Lecce.

A preliminary analysis was performed in order to evaluate the internal consistency of items by the administration of the questionnaire to a restrict group (120 subjects of all ages living in the Province of Lecce). The items that resulted not clear or ambiguous were removed or reformulated. The final questionnaire, drawn up in Italian, included 16 items grouped in 4 main categories: (i) sociodemographic characteristics of the participants (gender, age, educational level, place of residence); (ii) type and daily intake of drinking water (water from public water system, including tap water without any treatment, tap water purified by domestic systems, such as purifier or water softener, and public water cooler, bottled mineral water, water from private wells); (iii) quality and safety perception of drinking water from public supply system; (iv) packaging choice (for bottled water consumers).

In order to verify any differences in relation to the age or geographical origin of the participants, the subjects were grouped into four age groups ( $\leq 16$  years old, 17–39 years old, 40–64 years old,  $\geq 65$  years old) and the territory of the Province of Lecce was divided into ten areas (Campi Salentina, Casarano, Gagliano del Capo, Galatina, Gallipoli, Lecce, Maglie, Martano, Nardò, Poggiardo), corresponding to the Social Health Districts (SHD) (Figure 1).

The survey started in June 2019 and finished in February 2020. The questionnaires were administered in two ways: online, through the Google's platform, or in paper form. In the first case the survey was promoted through social media (Instagram, Facebook), instant messaging application,

and our website. Paper questionnaires were administered in meeting places (supermarkets, church) or distributed in school prior authorization of the principal, and in case of underage participants, questionnaires were filled out by their parents. Schools were chosen on the basis of their centrality within each district.

### 2.3. Sampling Distribution

The survey involved 4137 citizens of the Province of Lecce, whose age and distribution per SHD were reported in the Table 1. The total population interviewed was quite evenly distributed among the first three age groups  $\leq 16$ , 17–39, 40–64 (27%, 33%, and 30% respectively), while the age group  $\geq 65$  represented only the 10% of the total. The density of the respondents was similar in all districts with an exception of the district of Maglie, which showed the highest value (11.0%).

**Table 1.** Sample distribution per SHD and age groups.

SHD	$\leq 16$	17–39	40–64	$\geq 65$	Total
Campi Salentina	69	147	118	21	355
Casarano	155	89	100	24	368
Gagliano Del Capo	82	120	118	34	354
Galatina	45	89	87	43	264
Gallipoli	44	71	72	22	209
Lecce	328	262	283	112	985
Maglie	208	175	165	55	603
Martano	35	84	60	20	199
Nardò	107	233	153	58	551
Poggiardo	37	83	85	44	249
Province of Lecce	1110	1353	1241	433	4137

### 2.4. Data Analysis

At the end of the survey, questionnaires were coded and all the information was entered into a Microsoft Excell database. For descriptive statistics and graphical representations data were processed using MedCalc Software version 12.3 (MedCalc Software bvba, Ostend, Belgium). In order to verify if the qualitative and quantitative variables were different distributed among age or geographical groups Chi-square and one-way ANOVA tests were respectively used. A logistic regression analysis was performed to verify any association between the general consumption of tap water (dependent variable) and the negative perception concerning its quality, age group, educational level, house localization and residence area (independent variables); odd ratio (O.R.) and 95% confidence interval (C.I.) were calculated. Differences were considered significant for  $p < 0.05$ . QGIS (Quantum Geographic Information System) software was used for geographical representations.

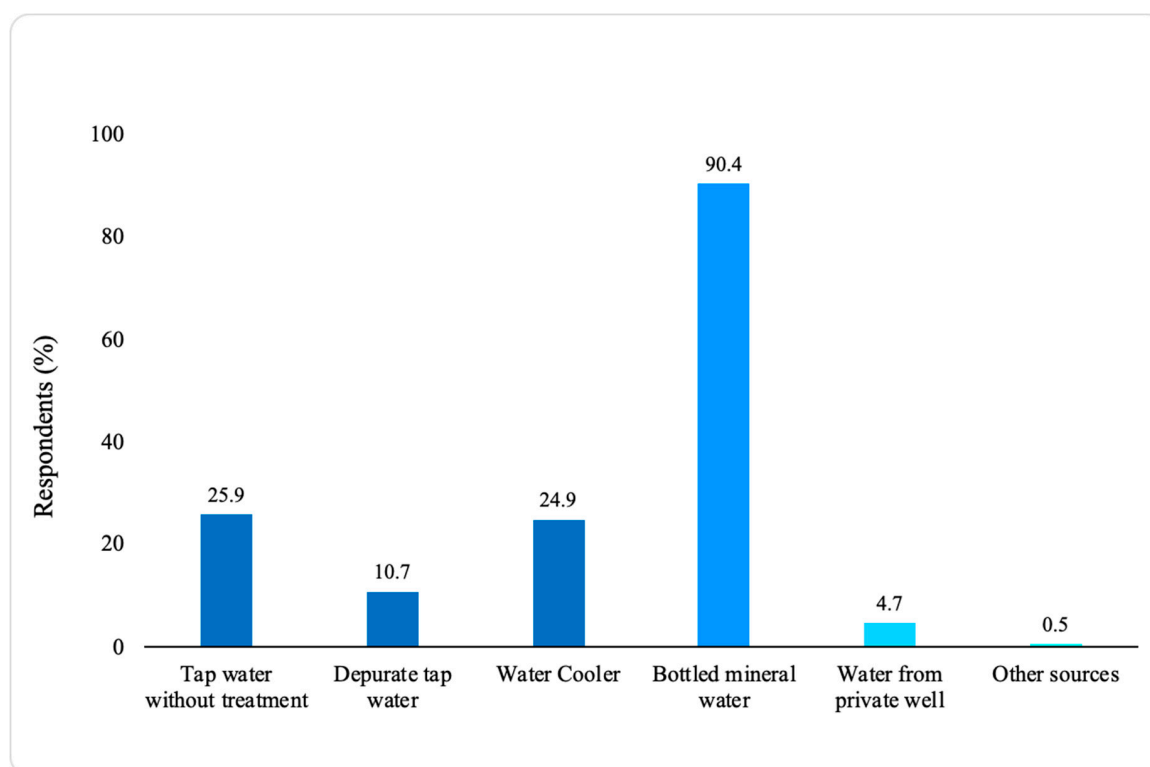
## 3. Results

The characteristics of respondents involved in the survey (gender, education level, and residence) were reported in Table 2. Females represented most of the respondents (60.6%), while males accounted for 39.4%. Participants' educational level appeared quite high, since the main part of respondents had a high school diploma (55.0%), 32.7% had a university degree or higher while 10.9% had a middle school diploma. Lastly, only a small part had a primary educational level or no educational level (1.0% and 0.6% respectively). Lastly, most of the participants (85.0%) said they lived in an urban area while 15.0% lived in the countryside.

**Table 2.** Sociodemographic feature of the sample.

	Respondents	N-(%)
Gender	Male	1628 (39.4%)
	Female	2509 (60.6%)
Educational Level	No Level	25 (0.6%)
	Primary School	41 (1.0%)
	Middle School	451 (10.9%)
	High School	2275 (55.0%)
	Higher levels	1353 (32.7%)
Residence	Countryside	623 (15.0%)
	Urban area	3514 (85.0%)

The results highlighted people's trend towards a massive consumption of bottled water. In particular, bottled mineral water was consumed by about the 90.4% of citizens with an average consumption of 387.7 L/year per capita (375.2 L/year in PET-bottles, 12.5 L/year in glass bottles). Public supply system was used for drinking purpose by the 61.5% of respondents with an average consumption of 169.4 L/year per capita, including tap water without any treatment (25.9%), tap water purified by domestic systems (10.7%), and water from public water cooler (24.9%). Water from private wells was used by a limited part of the population (4.7%) while water from other sources (i.e., tanker) was used only by 0.5% (Figure 2). It is interesting to highlight that 41.9% of citizens living in the Province of Lecce, consumed exclusively bottled mineral water, while 7.7% used only water from public supply system, 0.7% from private wells, and 0.1% from other sources. The rest of the respondents (49.6%) said to drink water from mixed supplies.

**Figure 2.** Main water supplies of Province of Lecce.

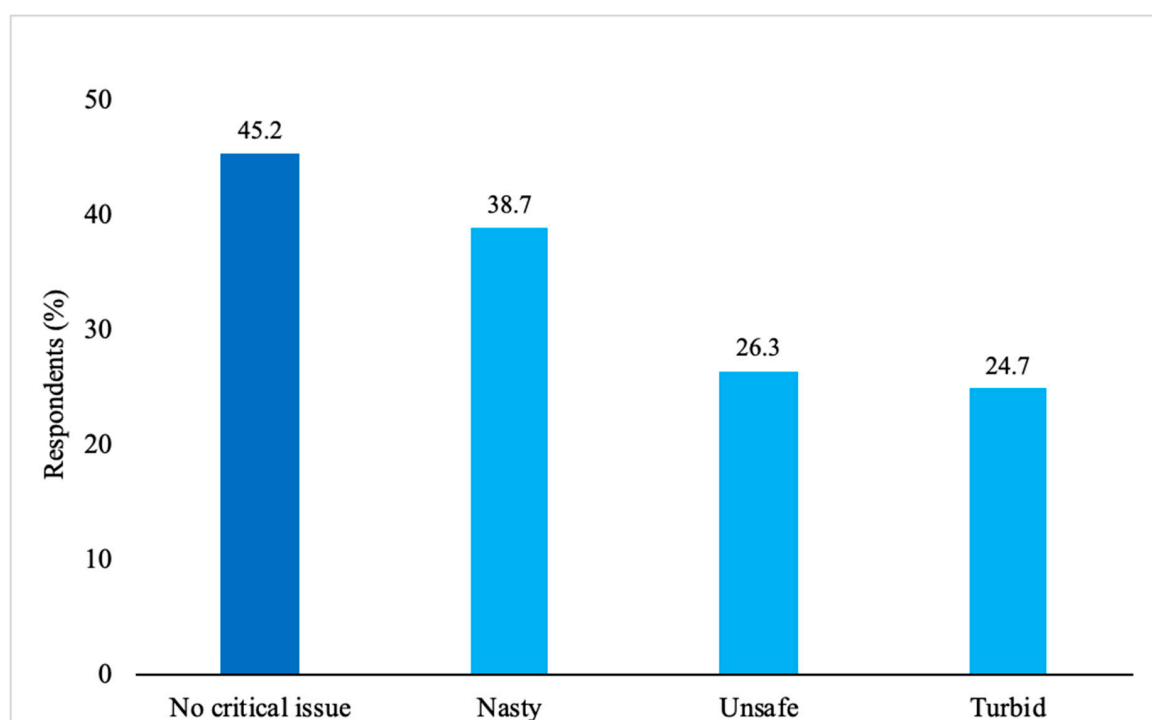
An analysis about the bottled mineral water consumption was carried out. Considering the packaging choice, 96.7% of mineral water consumers (90.3% of total respondents) declared to buy water in PET bottles, 3.1% in glass bottles, and a limited part (0.2%) utilized both packaging.

Table 3 reports the consumption of PET-bottled mineral water by the respondents grouped per age and geographical area. Overall, in the Province of Lecce the average consumption of mineral water in PET bottles was 375.2 L/year per capita with a production of about 200 million plastic bottles per year (considering a population of about 800,000 inhabitants and an average content per bottle of 1.5 L). Significant differences ( $p < 0.05$ ) appeared between age and geographical groups, with a higher average intake in age group of 17–39 (407.1 L/year) and in the district of Lecce (410.1 L/year), while the lowest values were registered in the older age group (331.2 L/year), and in the district of Poggiardo (326.6 L/year).

**Table 3.** Bottled water consumption on average L per capita/year.

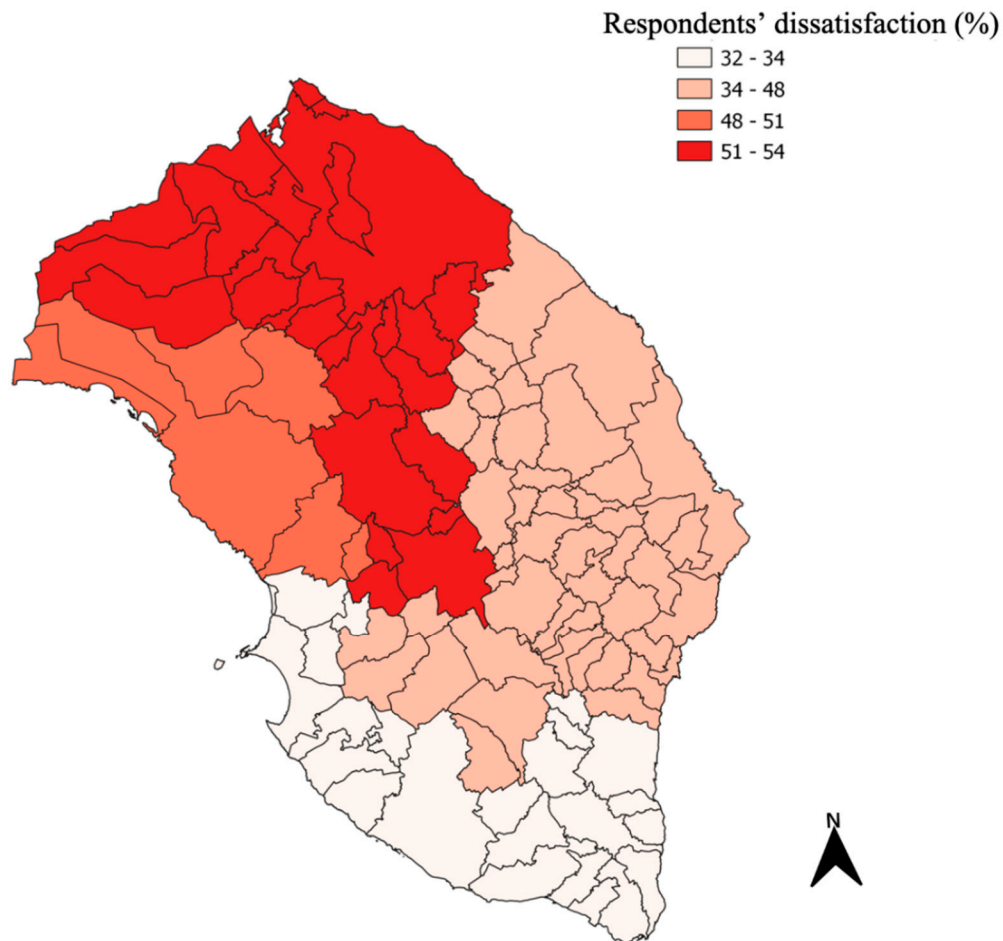
SHD	≤16	17–39	40–64	≥65	Total
Campi Salentina	326.1	396.2	380.2	343.6	374.1
Casarano	357.0	404.1	395.8	314.1	376.1
Gagliano Del Capo	340.8	388.6	370.0	299.0	362.7
Galatina	356.6	424.8	390.3	356.8	390.7
Gallipoli	385.0	389.5	369.6	247.2	366.7
Lecce	368.4	474.3	414.0	372.2	410.1
Maglie	311.3	374.2	363.2	379.3	349.9
Martano	317.0	397.7	351.3	284.2	358.1
Nardò	389.0	389.5	361.1	306.5	372.8
Poggiardo	296.8	368.3	330.1	266.2	326.6
Province of Lecce	349.6	407.1	378.8	331.2	375.2

Concerning the public water supply network, 45.2% of the all respondents did not find any critical issue while 54.8% declared one or more problems: 38.7% considered tap water nasty, 26.4% unsafe, and 5.1% turbid (Figure 3).



**Figure 3.** Consumer perception of public water supply.

Data of drinking water perception were further evaluated on the basis of geographical division of the municipalities in their belonging health districts (SHD). The perception about the quality of public water supply was considered according to the residence of respondents (Figure 4). The prevalence of negative features (nasty, unsafe, or turbid) was not equally distributed among the different SHD ( $p < 0.005$ ), with the highest level of negative perception in the SHD of Lecce (54.1%), Campi Salentina (54.0%), and Galatina (53.4%).



**Figure 4.** Representation of respondents' dissatisfaction (%) in Socio Health District (SHD).

PET bottled water consumption, on the base of this distribution, showed a homogenous trend in the SHD: on average the 90.4% of respondents confirmed to avail of it. By contrast, drinking water by public supply has heterogeneous distribution ( $p < 0.01$ ) in the districts.

The choice of the drinking water typology was likely conditioned by the perception that consumers had about the quality of tap water. In particular, the logistic regression (Table 4) highlighted a negative association between the general consumption of water from the public aqueduct and the perception of its bad organoleptic characteristics or unhealthiness (O.R. 0.4077; 95% C.I. 0.2681–0.6202).

Moreover, the consumption of tap water was negatively associated with the age group 40–64 (O.R. 0.9542; 95% C.I. 0.6932–1.3134) and the SHD of Lecce (O.R. 0.6202; 95% C.I. 0.5369–0.7163); while it was positively associated with the age group  $\leq 16$  years old (O.R. 1.2237; 95% C.I. 1.0624–1.4095) and the SHD of Maglie (O.R. 1.474; 95% C.I. 1.2285–1.7686), Nardò (O.R. 1.3585; 95% C.I. 1.2161–1.6387), Poggiardo (O.R. 1.6536; 95% C.I. 1.2521–1.8939). No association was identified with the educational level and house location.

**Table 4.** Simple logistic regression between water consumption from public aqueduct and quality perception, educational level, age groups, house location, and residence areas of respondents.

Independent Variables	O.R.	95% C.I.	p-Value
Negative Perception	0.0477	0.2681–0.6202	<0.0001
Degree	1.076	0.7878–1.4696	0.6451
Age group (years old)			
≤16	1.2237	1.0624–1.4095	0.0051
17–39	1.0123	0.8870–1.1553	0.8560
40–64	0.8115	0.7094–0.9283	0.0023
≥65	1.0238	0.8358–1.2540	0.8204
House Location (Urban Area)	0.9828	0.5513–1.7519	0.9531
Social Health Districts (SHDs)			
Campi Salentina	1.1719	0.9363–1.4668	0.1661
Casarano	0.8491	0.6844–1.0534	0.1369
Gagliano del Capo	0.8261	0.6635–1.0285	0.0876
Galatina	0.9057	0.7041–1.1650	0.4407
Gallipoli	0.9116	0.6882–1.2075	0.5188
Lecce	0.6202	0.5369–0.7163	<0.0001
Maglie	1.474	1.2285–1.7686	<0.0001
Martano	1.1531	0.8596–1.5466	0.3418
Nardò	1.3584	1.1261–1.6387	0.0014
Poggiardo	1.6536	1.2521–1.1839	0.0004

O.R.: Odds ratio; C.I.: Confidence Interval.

#### 4. Discussion

This survey allows for the evaluation of the consumption of drinking water by the residents in the province of Lecce, in relation to the supplies they used and the factors influencing their choice.

The data collected by the administration of a questionnaire to 4137 citizens highlighted an annual consumption of bottled water in the Province of Lecce of 387.7 L/year per capita, mostly packaged in PET bottles for a total of 375.2 L/year per capita, while the consumption of water from public supply system (including tap water without treatment, depurated tap water, and water cooler) was 169.4 L/year per capita.

Our results appeared higher if compared with those of other surveys carried out at national and international level and confirmed the general concerns regarding the lack of consumers' faith in public aqueduct and the increase of plastic bottled water consumption. In particular, according to International Bottled Water Association (IBWA) [47], in Italy the annual per capita consumption of bottled water in 2019 was 201.8 L/year with an increase of 12.5% compared to 2014. Other Italian surveys reported an annual per capita consumption of bottled water of 206 L/year in 2015 [48] and 221 L/year in 2018 with a percentage of PET bottled water of 82% [8]. Finally, Tosun et al. [49], reviewing data from several studies, stated that Italy held the first place in Europe for bottled water consumption and the lower position for tap water consumption.

Furthermore, the growth of bottled water consumption might pose serious problems to the management of plastic wastes in the Salento peninsula also in relation to the environmental impact deriving from the close connection of the territory with the sea.

As reported by other authors, understanding why people are preferring plastic bottles is important to reduce harmful habits [50]. In addition to the well-known factors influencing the consumer's choice in favor of PET packaging, such as its low cost and its practical use [51], in the Province of Lecce, there may be other possible explanations regarding the high consumption of PET-bottled water. First of all, the perception of the quality and safety of tap water seemed to be an important factor that influenced the choice of consumers regarding the supply of drinking water. Indeed, most of respondents consider nasty or unsafe water supplied by public network and this resulted in a lower consumption of tap water and higher consumption of PET-bottled water.

This relation between bad quality perception and consumption of tap water has been confirmed too by Tosun et al. [49], in Germany. In addition, the poor quality of groundwater available in the Salento peninsula, which feeds the local public aqueduct [37], could condition the perception of tap water safety and, consequently, the consumers' preference for mineral bottled water. Probably, citizens are not informed about the real quality of tap water and their choice is on the basis of what they perceived as healthier.

Some geographical features also linked to sociocultural factors could influence the choice of drinking water typology. In fact, people living in bigger city as Lecce, consumed less tap water than people living in other areas of the province. This aspect should be investigated through further research in other metropolitan areas to verify whether this trend is typical of large cities.

Age could also influence the type of drinking water. The younger age group consumed tap water in greater quantities and would seem more sensitive to environmental problems probably because they were more involved in school messages regarding waste reduction, with particular reference to plastic waste.

An important concern regarding the PET-bottled water consumption is that, if not properly disposed, the plastic bottles may have a significant environmental impact, especially for the sea. This aspect is particularly relevant for the Province of Lecce, which extends for over 280 km of beaches and coastlines. Moreover, Salento peninsula has become, in the last 10 years, one of the most popular destinations, particularly for foreign tourists, which presumably involves an increase in the production of plastic waste especially close to the coast and in the summer months. At this purpose changing the global habits towards a sustainable choice, such as buying glass packaging or drinking public supply water, may be useful for the reduction of marine plastic pollution.

Consumers should be better informed about drinking water in order to make the right and informed choice between tap and bottled water. Information conveyed to citizens about the good quality of water supplied by public network should be combined with information about environmental impacts of plastic packaging especially in areas where plastic recycling is low. Providing the right information is a good strategy to induce people to adopt conscious, conscientious, and eco-friendly habits [46].

Actually, a negative impact on human health caused by the overuse of plastics bottles has been demonstrated [52–54]. Therefore, the awareness of the impacts produced by plastic, at human and environmental level, should bring people to adopt lifestyle choices in line with circular economy, limiting single-use plastic and promoting action to reduce, reuse, and lastly recycle the packaging.

These recommendations are included in the European Directive 2018/851 [55]. It indicates a waste management, based on an operational hierarchy, which gives top priority to prevention with respect to wastes disposal, by including all those processes aimed to reduce the amount of waste production, negative pressures on human health and the environment, and lastly toxic chemical compounds in products. In this perspective, efforts should be focused on promoting virtuous behaviors and increasing responsibility, encouraging the use of alternative supplies as well as the reusability and recyclability of packaging, rather than their production from raw material. Moreover, in order to induce a shift towards tap water, the EU commissions proposed: to improve access to water, upgrade drinking water standards, and increase the transparency of benefits of tap water [48].

## 5. Conclusions

Our results highlighted that:

- the consumption of PET bottled water in Salento was very high, much higher than the Italian and European average; this situation leads to concern both for public health and the environment;
- the perception of poor quality of tap water appeared to be decisive in the choice of consumers regarding the type of drinking water;
- the younger age group consumed more tap water than the adult age groups;

- in the area of the main town of the province (Lecce), a city with about 100,000 inhabitants, people consumed less tap water than in the smaller towns;
- the cultural level of citizens did not seem to affect their choice.

These results lead us to affirm that effective communication strategies must be developed in order to promote the consumption of tap water and implement good practice of circular economy. These strategies must take into account the age of the population less sensitive to the problem, the perception regarding the quality of tap water, and the different social contexts to which they are addressed (i.e., population living in large cities or small municipalities), ensuring at the same time the best quality and safety of water supplied through public aqueduct.

**Author Contributions:** The following authors contributed in full to this work. I.G. and B.C. conceived the study, analyzed the sources and the literature and drafted the manuscript. F.B. and I.G. developed the framework and design methodology. P.P. and F.B. contributed to data collection and analysis. F.D.L., G.D.F. and B.G. helped to draft the manuscript. T.G., P.P. and F.D.L. supervised the research project and carried out a detailed revision. All the authors wrote the body of the paper, read, and approved the final manuscript. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was part of the M.I.N.O.RE. (Non-Mandatory Regional Water Monitoring) project funded by Apulia Region funded with Deliberation of the Regional Council August 2nd 2017, n. 1316.

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

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