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Domestic water pricing in Greece: a spatial differentiation

Vasilis Kanakoudis, Anastasia Papadopoulou*, Stavroula Tsitsifli

Civil Engineering Department, University of Thessaly, Volos GR-38334, Greece, Tel. +30 2421074156; email: anpapadop@civ.uth.gr

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ABSTRACT

This study investigates the differentiation of the water pricing policies applied by the Greek Municipal Water Utilities (GMWU) in several regions. GMWU are being characterized by individual management framework with a lack of a uniform pricing policy and a significant diversification of the payable amount by region. The export of comparative conclusions regarding the overall pricing policy in Greece, both at GMWU level (a sample of 84 GMWU) and at regional level, is the basic objective of this study. The comparison analysis was performed on a monthly consumption basis of 5–150 m^3, for the year 2007, per water utility population served (five groups) and per administrative region (13 regions). The mean net consumption cost and the mean payable amount are calculated for a monthly consumption, because water utilities do not use the same billing period. Fee for construction and sewer user fees are excluded. Maintenance water meter cost and maintenance projects (fixed charges) charges are also partly included. The study revealed that there is a large spatial differentiation of water prices on regional level.

Keywords: Domestic water use pricing; Nationwide research; Mean net consumption cost; Mean payable amount

1. Introduction

It is a common aspect that, nowadays, water is a valuable resource for our planet. People develop activities highly depending on water consumption such as water supply and product and energy production. It is remarkable that globally 30% of the incoming water is lost due to leaks and breaks, while the maximum acceptable/realistic rate should not be exceeding 10–15% for US and Europe, respectively [1].

The operators of water distribution systems (water utilities) should effectively and continuously monitor their networks and develop socially just pricing policies. They should also ensure sufficient quantities of good quality water, and maintaining a balance between water demand and environmental sustainability. According to the Water Framework Directive 2000/60/EC (WFD), water is a "heritage that must be protected." All member states are obliged to develop effective pricing policies recovering the full water cost (direct, environmental, and natural resource cost).

The present study aims in investigating existing pricing policies in Greece through the calculation of the net payable amount of water services and the mean payable amount of monthly consumption. The basic output is a comparison analysis of the monthly

*Corresponding author.

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consumption from 5 to 150 m^3 (5 m^3 step), categorizing the water utilities into groups according to their size (population), their location (mainland, island, or coastal), and their administrative region.

2. Water pricing policies

2.1. In Europe

Sustainable water management aims in the social, economic, and environmental balance. The WFD 2000/60/EC establishes a new institutional framework —providing guidance for a common approach, common objectives and shared principles, definitions, and measures for water resources and supply management —within EU member states. WFD leads to a major reform in the environmental legislation and the administrative sector. Developing "appropriate water pricing" is a complex issue, since it is influenced by several factors such as local characteristics (including different levels of infrastructure development), different physical parameters (geological and climatic), and different institutional and regulatory framework [2–7].

A general trend in the EU is that tariff structures are developed basically to prevent the risk of revenue variation during low-demand periods [8] since there are a few cases of tariff structures focused on demand management. Therefore, adopting appropriate pricing policies in order to meet environmental goals is not the basic issue.

2.2. In Greece

In Greece, before the administrative reformation of "Kallikratis" in 2011 (1.034 municipalities were merged to 325), 227 water utilities (called DEYA) were officially registered (213 were members of the Hellenic Union of Municipal Water Utilities: EDEYA) including the biggest ones (EYDAP S.A. in Athens and EYATH S.A. in Thessaloniki) that are semi-privatized. Following "Kallikratis" reformation, the number of Greek municipal water utilities was decreased to 142, serving 5,125,618 residents [9]. Nowadays, the water bills in Greece consist of mainly increasing tariffs (separation of the consumed m^3 in scales with different price per scale) including a fixed charge (calculated either in monetary units or in water volume). In a few cases, standard rates exist (same price per consumed m^3 independently from the volume of m^3 consumed).

The water bill of municipal water utilities consists of various charges: (i) value of water consumption, (ii) fees related to the connection to the water and sewage pipelines (well, water meters and fittings), (iii) connection fees to the water network, (iv) sewer usage fee, (v) connection fees to the sewerage network, (vi) fee for the design and construction of water supply and sanitation, and (vii) discounts. In some of these charges, VAT should also be added, varying between the water utilities, depending on the region a water utility belongs to.

3. The water price map in Greece

3.1. Mean consumption net cost and mean payable amount

The aim of this study is to analyze the pricing policy of the municipal water utilities in Greece. The study sample consists of 84 DEYA serving 1,987,854 people, representing 18.13% of the total served population in Greece (according to the 2001 census). The initial phase of the methodology that was used included the gathering of the necessary data in order to calculate the payable amount. The necessary data were collected via telephone interviews with the relevant department of each DEYA that took place in December and January 2010.

First of all, the cost of consumption each water utility used to charge was calculated. The second step was the calculation of the payable amount. The consumption cost and the payable amount were calculated for a 5 m^3 step of monthly consumption (from 5 to 150 m^3) for all DEYA from the year 2004 to 2007.

The following variables were used for the calculations [9]: (a) the population served, (b) the number of water meters, (c) the fixed charge expressed as a fixed paid amount or as a minimum consumption volume (m^3), (d) the water bill type, (e) the special charge fee (80% of the consumption value), (f) the billing period, (g) the connection fees, and (h) the VAT depending on the administrative region. Charges such as fee for construction and sewer user fees are excluded. Charges such as maintenance water meter cost and maintenance projects are partly included (fixed charges).

The methodology of the present study is based on the calculation of the price that a citizen with the same consuming behavior pays in various Greek cities. The final objective is to compare the spatial allocation of water charges between 84 Greek DEYA. The comparison analysis was performed: (a) per water utility population served (five groups) and (b) per each water utility's administrative region (13 in total) (Table 1) [10–13].

3.2. The methodology

To calculate the consumption net cost, the following methodology is applied for each DEYA:

Table 1
The investigated categories of the study

Population groups (5)	A (0–10,000)	Region (According to "Kallikratis") (13)	Ionian Islands	Thessaly	Southern Aegean
	B (10,001–15,000)		Attica	East Macedonia and Thrace	Epirus
	C (15,001–30,000)		North Aegean	Central Macedonia	Peloponnese
	D (30,001–50,000)		West Greece	West Macedonia	Crete
	E (>50,001)		Central Greece		

$$CNC_{n+1} = CNC_n + (j_{n+1} - i_n) * WPj_{n+1} + (i_{n+1} - j_{n+1}) * WPj_{n+2} \quad (1)$$

where CNC is the consumption net cost; j is the billing scale (BS) according to invoice each DEYA ($j = 1, 2, \ldots n$); i is the analysis step (AS) according to our analysis per 5 m^3 (= 1, 2, … , $n = 5, 10, 15, 20, 25 \ldots 150\ m^3$); and WP is the water price charged.

The next step is the calculation of the payable amount for each DEYA. As mentioned above, the payable amount is the consumption net cost by adding the taxes every DEYA charges. To calculate the payable amount, the following methodology is applied:

$$PA_i = [CNC_i * (VAT_{ws} + 1)] + [CNC_i * SF * (VAT_{SF} + 1)] + [F * (VAT_F + 1)] \quad (2)$$

$$PA_i = [CNC_i * (VAT_{ws} + 1)] + [CNC_i * SF * (VAT_{SF} + 1)] + [F * (VAT_F + 1)] + [MC * WP_{MC} * (VAT_{WS} + 1)] \quad (3)$$

where PA is the payable amount; CNC_i is the cost net consumption for water use, which was divided into 30 levels ($i = 1, 30$) covering a range from 5 to 150 m^3, with a 5 m^3 step; VAT_{ws} is the tax for water supply; SF is the special fee charge (80% of the value consumption); VAT_{SF} is the tax for special fee; F is the fixed charge expressed as a fixed amount of money (€); VAT_F is the tax for fixed charge; MC is the minimum charge expressed in m^3; and WP_{MC} is the water price of minimum charge.

The use of Eqs. (2) or (3) selected is based on the invoice of each DEYA. It is important to mention that each charge has different VAT rates. Finally, because of the fact that the billing period differs from DEYA to DEYA and in order to take comparable results, the cost of net consumption and the payable amount per month is being calculated (VAT was not included).

4. Results and discussion

4.1. Results per population served

The study was based on the resident population [14] relating to the 2001 census. Unfortunately, it was not possible to use the population actually served since there was a difference between the population served and the one registered during the census (Table 2). It should be noted that the census takes place every 10 years and does not give the precise number of residents per region. The consumption net cost was calculated per each population group. This cost refers to the amount each consumer pays for water consumption, excluding any additional charges. The payable amount per 5 m^3, from 5 to 150 m^3 monthly consumption is calculated, taking into consideration all taxes, fees, and fixed charges applied by each DEYA. Data refer to 2007 (including all charges and VAT). It should be noted that not all DEYA charge the same VAT on their water bills (according to the Greek legislation, allowing border and island enterprises to charge lower VAT rates). Moreover, the mean consumption net cost and the mean payable amount per month were calculated to develop comparable results based on different groups.

The results showed (Fig. 1) that the mean consumption net cost for a monthly consumption of 5–150 m^3 for group A ranged from 0 to €545.91 (for 150 m^3 monthly consumption), for group B ranged from from 0 to €642.55 (for 150 m^3 monthly consumption), for C from 0 to €519 (for 150 m^3 monthly consumption), for D from 0 to €410.82 (for 150 m^3 monthly consumption), and for group E ranged from 0 to €528.89 (for 150 m^3 monthly consumption). The maximum values of consumption net cost were observed for Group A in DEYA of Epidavros (Peloponniso), for Group B in DEYA of Paros (South Aegean), for Group C in DEYA of Tripolis (Peloponnisos), for Group D in DEYA of Kozani (Western Macedonia), and finally, for Group E in DEYA of Irakleiou (Crete). Similar observations originated from the mean payable amount analysis for all population groups (Fig. 2). Specifically, for group A, the prices ranged from €1.24 to €434.67 (for 150 m^3

Table 2
The resident population served (2001) per DEYA and Group (2001)

Group A1 (20 DEYA)	People served	Group A2 (13 DEYA)	People served	Group B (18 DEYA)	People served	Group C (13 DEYA)	People served	Group D (7 DEYA)	People served	Group E (13 DEYA)	People served
Karpenissi	9,390	S.George Corfu	4,958	Almyros	15,000	Chios	30,000	Kozani	47,451	Patreon	163,446
Exaplatanos	9,140	Asklipieiou	4,804	Igoumenitsa	14,700	Tripoli	28,976	Arta	45,000	Irakleiou	137,711
Ampelonos-Vr	8,920	Livathos	4,663	St. Athanas.	14,387	Megara	28,195	Karditsas	37,700	Volos	114,368
N. Artakis	8,646	Beach of N.Ach	4,465	Thassos	13,765	Edessas	28,000	Corinth	36,555	Serres	102,000
Eretria	8,500	Faloreia	4,090	Hermoupolis	13,400	Sparta	25,000	Ptolemaida	35,632	Kavala	60,809
Platykampos	8,192	Epidavros	4,000	Thermaikos	13,354	NA of Chania	21,168	Argos	33,000	Katerinis	60,000
Vyssas Evrou	8,184	Paleokastriton	3,500	Iraclia	13,173	Agios Nikolaos	19,462	Giannitson	31,442	Lamia	58,601
Amarynthos	7,356	Mykonos	3,360	Loutraki-Per.	13,000	Mesologgiou	17,988	Total	266,780	Kalamata	57,620
Farkadonas	7,093	Sami	2,895	Zacharos	12,910	Amaliadas	17,000	Average	38,111	Drama	55,632
Irakleidon (Kar)	6,963	Alonnisos	2,700	Paros	12,853	Thermis	16,546			Rhodes	55,000
Sofades	6,500	Symi	2,606	Argostoli	12,589	Kalymnos	16,441			Agrinio	54,253
Feakes	6,500	Astipalea	1,253	Aridaias	12,589	Farsala	16,000			Komotini	52,659
Agias	6,458	Oia Kykladon	1,230	Akrotiriou	12,000	Xylokastrou	15,273			Xanthi	52,270
Polydananta	6,412	Total	178,177	Elassona	12,000	Total	280,049			Total	1,024,369
Afantou	6,306	Average	5,399	Epanomi	12,000	Average	21,542			Average	78,798
Elymnion	6,000			Anc. Olymp.	11,069						
Dikaiou	6,000			Kallicratia	10,879			Total groups		1,987.854	
St. George	5,466			Vistonidos	10,174			Average groups		31,376,261	
Aiginiou	5,264			Total	229,842						
Hasia	5,000			Average	12,769						

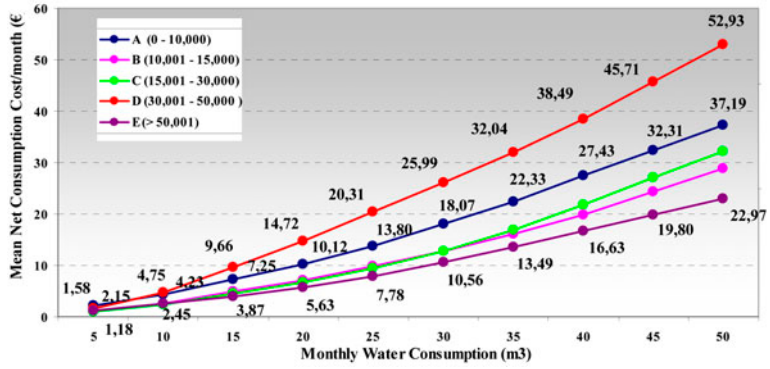

Fig. 1. Mean net consumption cost/month (€).

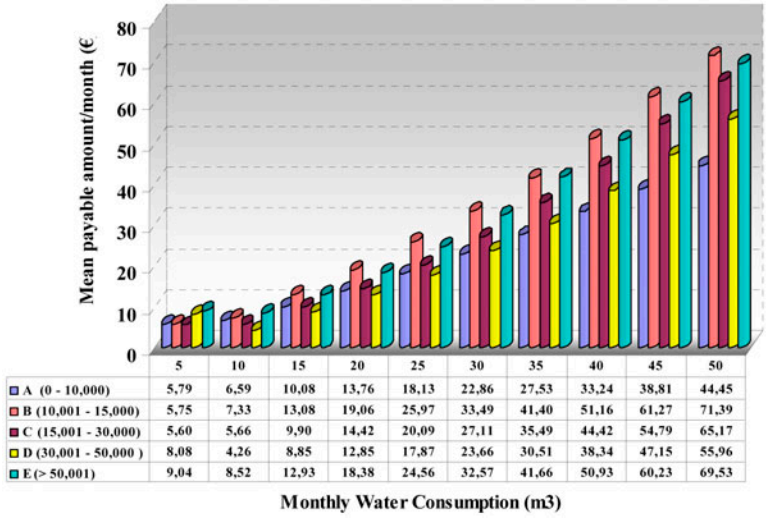

Fig. 2. Mean payable amount/month (€).

monthly consumption), from €1.46 to €1,024.86 (for 150 m^3 monthly consumption) for group B, from €1.65/m^3 to €857.13/m^3 (for 150 m^3 monthly consumption) for group C, from €0.65 to €678.47 (for 150 m^3 monthly consumption) of group D, and finally, from €0.1/m^3 to €880.67/m^3 (for 150 m^3 monthly consumption) for group E. Respectively, the maximum values were observed for Group A in DEYA Mykonos (South Aegean), for Group B in DEYA Hermoupolis of Syros (South Aegean), for Group C in DEYA of Chios (North Aegean), for Group D in DEYA of Argos (Peloponnisos), and finally, for Group E in DEYA of Irakleio (Crete). The analysis indicated that, for all groups, the mean payable amount is increased in accordance with the mean net consumption cost, meaning that when the regional taxes are added, the payable amount is significantly increased, comparing with the net consumption cost. The calculation of the mean payable amount depending on the size of each DEYA also indicated that the fixed rate charged differs between the various water utilities, which are characterized by almost the same population. The same characteristic is also observed with all other charges.

4.2. Results per region

Subsequently, the present study examined the cost of net consumption (Fig. 3) and the payable amount (Fig. 4) for each DEYA within the same administrative region. The monthly mean payable amount for 45 m^3 consumption ranges from €7.33 (Central Macedonia) to €157.50 (Ionian Islands), whereas for 110 m^3, it ranges from €23.90 (Central Macedonia) to €267.13/m^3 (North Aegean), and for 145 m^3, it ranges from €34.33 (Central Macedonia) to €433.60 (North Aegean). It

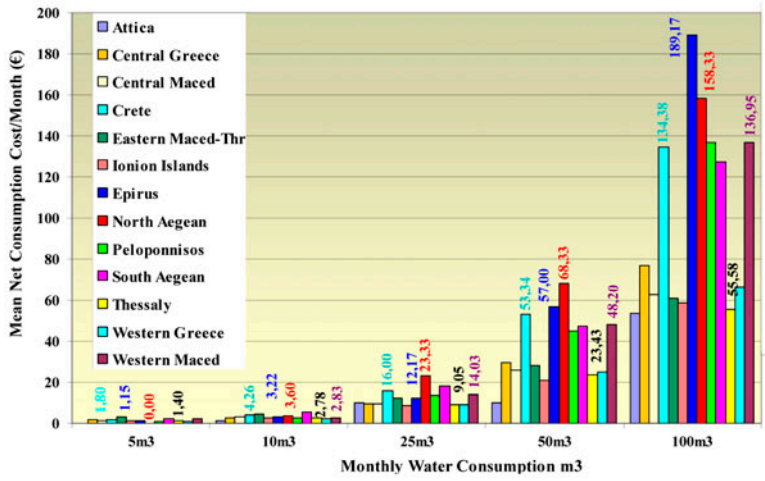

Fig. 3. Mean net consumption cost/month/region (€).

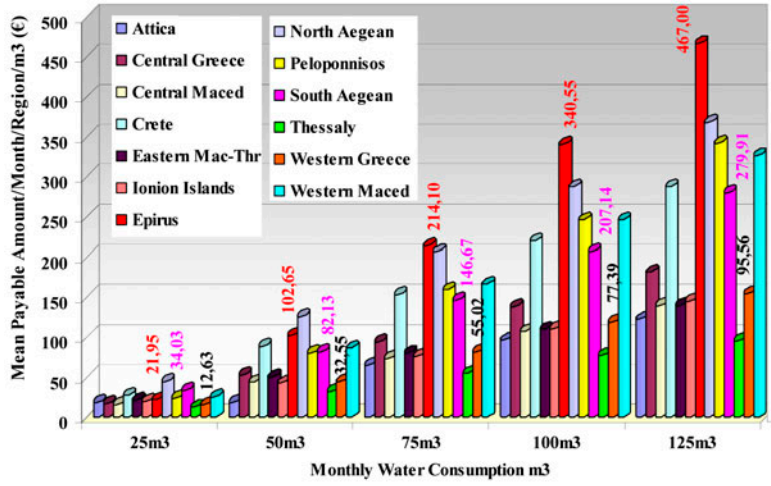

Fig. 4. The mean payable amount/month/m^3/region (€).

should be noted that, in this study, Attica region includes only the water utility of Megara and North Aegean region only the one of Chios Town. As a consequence, the results for these two regions are not representative for the whole region. The analysis showed that, in Epirus region, the net consumption cost is the highest compared with the other regions, while Central Macedonia has one of the lowest. It should be noted that island water utilities charge a VAT rate of 13%, while continental ones charge a 19% VAT rate (2007 rates).

In Ionian Islands, East Macedonia and Thrace, Central Macedonia, and Crete, the maximum average price (both mean cost of net consumption and mean payable amount) appears in the most populated cities (e.g. Iraklion DEYA in Crete) compared with the other regions. For example, in Thessaly, while the city with the greatest population is Volos (population 114,368), the highest average price is met in Karditsa (population 37,700). As an example, in the Thessaly region, there are differences in the mean payable amount within the same region. More specifically, for 20 m^3 consumption, the lowest value is €2.27 in Hasia (Group A) and the highest is €15.39 in Alonnisos (Group A).

The analysis showed that the rate of maximum over minimum payable amount (between regions) is 15:1, for monthly consumption of 20–50 m^3, whereas for monthly consumption of 5–150 m^3 is 12:1. On the other hand, the rate for monthly consumption of 5–150 m^3 is about 2:1. This means that while the monthly consumption does not vary a lot, on the other

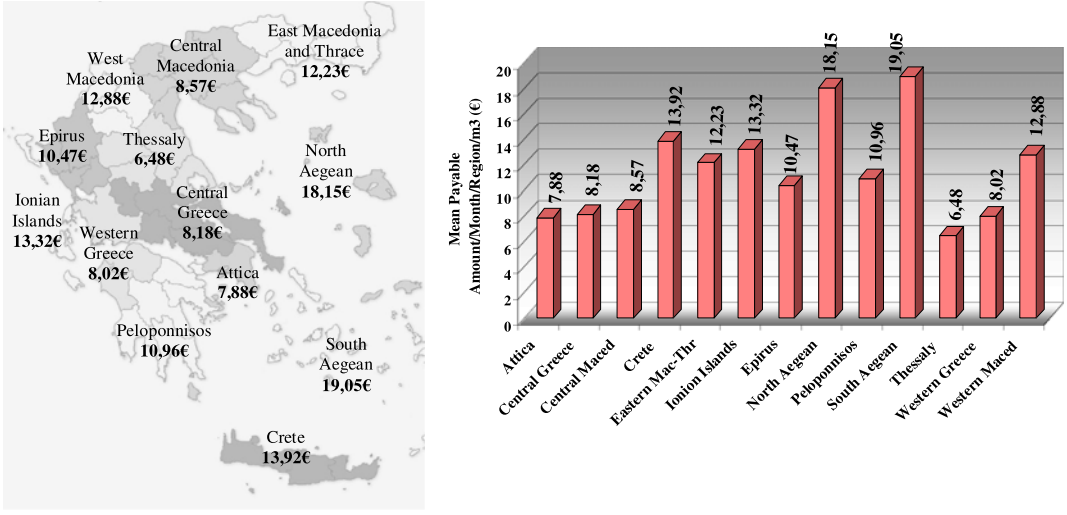

Fig. 5. Regional analysis for monthly mean payable amount (€) for 15 m^3 consumption.

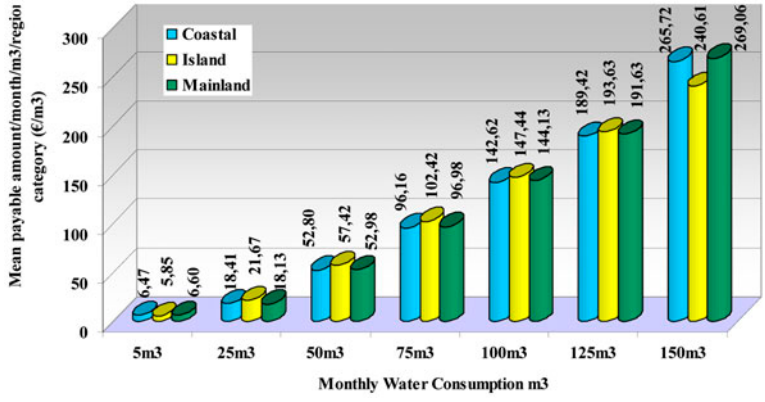

Fig. 6. The mean payable amount per m^3 and region category (coastal, island, and mainland).

hand, the payable amount highly differs between different regions. (Fig. 4).

The highest mean payable amount for a consumption basis of 15 m^3 is being observed in South Aegean region (€19.05), while the lowest is at Thessaly region (€6.48) (Fig. 5). The consumption of 15 m^3 is being used for the present analysis due to the fact that it is the most common in Greece.

Moreover, in the North Aegean region, the mean payable amount gets its largest value compared with all the other regions, especially for large consumptions. In the Ionian Islands region, the mean payable amount does not show great variation in relation to consumption. It is also observed that the smallest variation in consumption is in Thessaly and there is a big variation in the mean payable amount per region category (Fig. 6). The highest amounts are at the island water utilities and the lowest at the mainland ones.

4. Conclusions

The present study focuses on the spatial diversification of the Water pricing policies (WPP) applied by the Greek water utilities. The methodology used is based on the calculation of the net consumption cost and the mean payable amount a consumer pays, assuming that he consumes the same amount of water, regardless of the place he lives. Local factors and consumer behavior influence the final cost of water. In Greece, larger DEYA have higher charges than the smaller ones. Spatial variation of the pricing policy on water supply is also observed. Thus, there is no common pricing policy between the Greek water utilities.

The paradox is that the mean payable amount does not display a great variation between low and high consumption, which means that high consumption and water wasting are not discouraged. Also, paradoxically,

in regions where water balance is deficient, such as Thessaly region, the lowest mean payable charges are observed in comparison with all other Greek regions. It is also remarkable that every DEYA charges different fees and tariffs to their water bills. Hence, Greek water utilities should learn to "speak the same language." The case of fixed charges, which usually occur in water tariffs in Greek water utilities and in a Mediterranean level, is particularly interesting. The consumers pay double the consumption cost because of the fixed charges in their water bills. The case of the fixed charge is an interesting issue and should be re-examined [15]. On one hand, the water utilities only try to balance their expenses, whereas on the other hand, the fixed charge should represent the opportunity cost.

There is considerable scope that the next step is further analysis of the same and additional variables, categorizing water utilities in different groups, aiming to identify the existence of a common understanding in WPP. Hence, the overall objective is the implementation of the appropriate water pricing policy in Greece in order to achieve the EU targets concerning full water cost recovery.

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