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Research Article

Factors Affecting Per Capita Expenditure of Water and Sewerage Administrations in Türkiye

Türkiye'de Su ve Kanalizasyon İdarelerinin Kişi Başı Harcamalarını Etkileyen Faktörler

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Abstract

The per capita expenditure of water and sewerage administrations (WSAs) is an important indicator of their performance and characteristics. In this context, the effects of four parameters were investigated on the per capita expenditure of WSAs of thirty MMs in Türkiye. These parameters were determined as the service time, region, population size and budget of metropolitan municipalities (MMs). According to the results of the study, the WSAs with serving longer time and of high budget MMs had higher per capita expenditures than the others. Moreover, for the region parameter, it was determined that the per capita expenditure of the WSAs was the lowest in the Southeastern Anatolia Region while being the highest in the Marmara Region. A positive correlation was detected between the population size and per capita expenditures of WSAs. Moreover, it was assessed how much of the MMs budget was allocated to the budgets of WSAs for understanding differences among the regions. It was found that similar ratios, approximately 40% of the budgets of the MMs in the other regions except for those in the Black Sea and Central Anatolia Regions were allocated to the budgets of WSAs. On the other hand, a higher percentage of the budgets of Black Sea MMs was allocated to the budgets of the WSAs while allocating a lower percentage of the budgets of Central Anatolia MMs. According to the results, it was proposed that all WSAs should prepare master plans for at least 30 or 40 years to optimize their per capita expenditures and establish a balance between their capital and operating and maintenance costs.

Keywords: *budget allocation, capital cost, operating and maintenance cost, per capita expenditure, water and sewerage administration*

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Öz

Su ve kanalizasyon idarelerinin (SUKİ) kişi başına harcamaları, SUKİ'lerin performansları ve karakteristik özelliklerine dair önemli bir göstergedir. Bu çalışmada, hizmet süresi, bölge, nüfus ve büyükşehir belediyesi (BB) bütçesi olarak seçilen farklı parametrelerin Türkiye'deki otuz büyükşehir belediyesi SUKİ'lerinin kişi başı harcamaları üzerindeki etkileri incelenmiştir. Elde edilen sonuçlara göre hizmet süresi ve BB bütçesi daha yüksek olan SUKİ'lerin kişi başı harcamaları diğerlerine göre daha yüksektir. Ayrıca bölge bazında yapılan değerlendirmeye göre; Güneydoğu Anadolu Bölgesi'nin kişi başına düşen SUKİ harcamalarının en düşük, Marmara Bölgesi'nin ise en yüksek olduğu olduğu tespit edilmiştir. Nüfus ile kişi başına düşen SUKİ harcamaları arasında da pozitif korelasyon olduğu tespit edilmiştir. Aynı zamanda bölgesel farkları anlamak için BB bütçelerinden ne kadarının SUKİ bütçelerine tahsis edildiği değerlendirilmiştir. Karadeniz ve İç Anadolu bölgeleri hariç diğer tüm bölgelerin SUKİ'lere BB bütçesinden yaklaşık %40 gibi benzer oranlarda pay ayırdığı tespit edilmiştir. Karadeniz BB'leri SUKİ'lere en yüksek payda, İç Anadolu BB'leri ise SUKİ'lere en düşük payda bütçe ayırmaktadır. Çalışmada elde edilen sonuçlara göre, kişi başına harcamaları optimize etmek ve yatırım sermayesi ile işletme ve bakım maliyetleri arasında bir denge kurmak için SUKİ'lerin en az 30 veya 40 yıllk master planlar hazırlamaları önerilmiştir.

Anahtar sözcükler: *bütçe tahsisi, yatırım maliyeti, işletme ve bakım maliyeti, kişi başı harcama, su ve kanalizasyon idaresi*

Introduction

As a result of the pressure on infrastructural services caused by rapid urbanization and extreme weather events in the last century, water and sewage management has become outstandingly important. Water services are public services financed by local authorities under the control of the central government in most countries. In recent years, water services tend to get privatized with the practices such as public-private partnership (PPP) projects. Due to the involvement of private initiatives, many organizational structures in the water sector are developed recently depending on the specific conditions of the countries (Cinar, 2009). For instance, German Association for Water, Wastewater and Waste is defined as a politically and economically independent association, which promotes sustainable water management by conducting research and development (Association of Drinking Water from Reservoirs [ATT] et al., 2020). Water and sewerage works in the United States are handled by the Office of Water (OW), which is one of the headquarters offices of the United States Environmental Protection Agency. The OW is responsible to provide safe drinking water and restore and maintain oceans, watersheds, and their aquatic ecosystems to protect human health (The Office of Water [OW], 2022). In France, municipalities are legally responsible for water supply, wastewater and customer services. They are regulated by the state but autonomous to decide on two different possible management models based on the participation of the public sector. In the first model, municipalities choose to manage their water services and charge users

directly. In the second model, municipalities own the facilities but sign PPP contracts with private companies that run water services (EurEau, 2020). Lee (2009) indicated that lack of funds, technological incapability and insufficient management skills have forced the water sector shift towards PPP model. As it is seen in Italy, there are different management systems for water services. About half of the population is served by the authorized public administration model, 36% by PPP, and 5% by state concessions. Water services are provided to the rest of the population by municipalities. In the United Kingdom, water services are regulated under special management models. Water companies have the right to carry out water management activities in their watersheds according to free market and trade rules. However, the compliance of these management activities with local, national and international legislation (Water Framework Directive, 2000) is monitored and audited by judicial institutions. Although water management in the Netherlands is organized at three levels such as national, state, and local; most powers are vested in local authorities (The Organisation for Economic Co-operation and Development [OECD], 2020).

According to Turkish Statistical Institute (TURKSTAT) projections, the population of Türkiye is forecasted to exceed 90 million in 2050 (Turkish Statistical Institute [TURKSTAT], 2013). The pressure on water resources will inevitably increase due to population increases and climate changes. Therefore, countries like Türkiye, which are not water-rich, should sustain water resources as well as water and sewerage services in the best way (Basa & Kurt, 2017). In the 1980s, the dramatically increasing population especially in her metropolitan provinces caused disruptions in water and wastewater services. Türkiye created and implemented a new service provision model for water in its metropolitan provinces in 1981 to overcome current problems. Water and sewerage administrations (WSAs) as independent budget institutions affiliated to metropolitan municipalities (MM) have been established in order to supply water, dispose wastewater and provide treatment services in their regions (Ozgun et al., 2018).

WSAs operate their activities by Law No. 2560 on the Establishment and Duties of the General Directorate of Istanbul Water and Sewerage Administration (The Law No: 2560, 1981). With a temporary article added to the aforementioned Law, the implementation of this Law was also ensured in WSAs to be established in other MM (Alıcı & Özaslan, 2018). In 2014, with Law No. 6360, the current district municipalities in the provinces of Aydın, Balıkesir, Denizli, Hatay, Malatya, Manisa, Kahramanmaraş, Mardin, Muğla, Ordu, Tekirdağ, Trabzon, Şanlıurfa, and also Van were transformed into MM. Moreover, the borders of the MM of Adana, Ankara, Antalya, Bursa, Diyarbakır, Eskişehir, Erzurum, Gaziantep, İzmir, Kayseri, Konya, Mersin, Sakarya and Samsun were determined as provincial administrative borders with the Law. Therefore, the number of WSAs in Türkiye significantly increased in

2014. The current number of total WSAs in Türkiye reached as thirty with the above mentioned Law (The Law No: 6360, 2012).

Generally, WSAs carry out their duties regarding water and sewerage services within the service areas of the MMs, and also their authorities on these issues are defined under the scope of the task of the related Law. For instance, 1) providing drinking, utility, and industrial water needs from all types of underground and surface water sources and distributing water to those in need; 2) carrying out studies and projects of all kinds of water facilities to transport water from the sources to the end users are some of the important basic duties of WSAs. Moreover, WSAs are also directly responsible for designing and building or causing to design and build facilities according to these projects, taking over and operating the established ones, and maintaining or having them repaired. One of their major responsibilities is carrying out studies and projects of all kinds of facilities to collect wastewater and stormwater. At last, another important duty of WSAs is preventing the pollution of water resources; sea, lake, river shores, and groundwater in the region from municipal and industrial effluents (The Law No: 2560, 1981).

Annual per capita expenditure allocated to water and wastewater management is an important indicator for both countries and provinces. The financial characteristics, geographical structure, climate conditions, and demographic structure of the countries and provinces affect the per capita expenditure allocated to water and wastewater management to different degrees. Moreover, per capita expenditures provide significant pieces of information about the characteristics of the WSAs. The effects of different factors on the per capita expenditures of WSAs in Türkiye have not been evaluated yet in any studies in the literature. In this study, factors affecting the per capita expenditures of thirty WSAs in Türkiye were investigated in detail. Accordingly, those were the service time of WSAs, region, size of population and budget of thirty MMs. In this study, the dynamics of per capita expenditures of WSAs were also discussed and the reasons for differences between them exist were investigated.

Method

Thirty Water and Sewerage Administrations

The WSAs in different regions of Türkiye are given in Table 1. Each WSA has been coded according to and shown by uppercase of the first letter of the name of the region, in which it is located.

Table 1

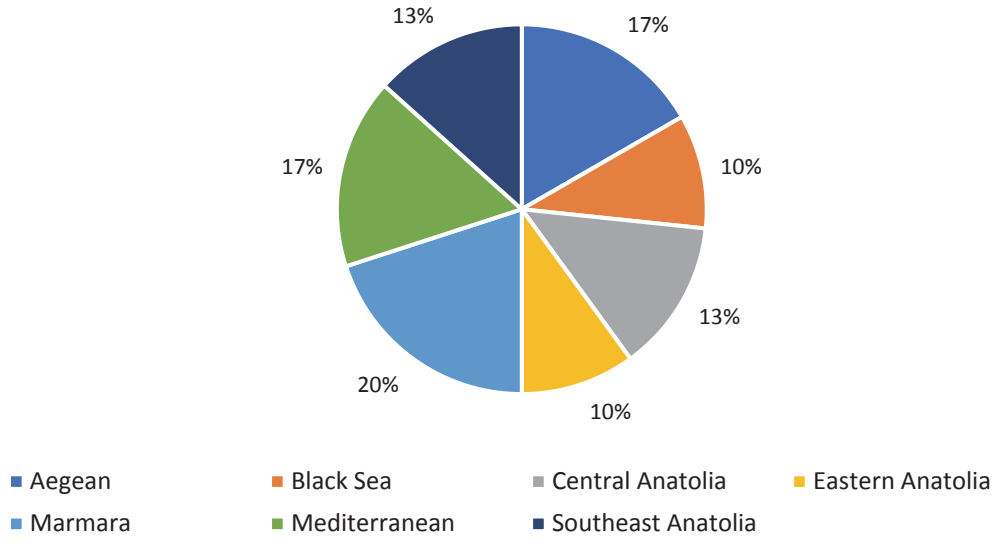
WSAs in Provinces in Different Regions

Regions	Aeagen	Black Sea	Central Anatolia	Eastern Anatolia	Marmara	Mediterranean	Southeast Anatolia
	A_1	B_1	C_1	E_1	M_1	Me_1	S_1
	A_2	B_2	C_2	E_2	M_2	Me_2	S_2
	A_3	B_3	C_3	E_3	M_3	Me_3	S_3
	A_4		C_4		M_4	Me_4	S_4
	A_5				M_5	Me_5	
					M_6		

Moreover, it was calculated how much of the budgets of the MMs were allocated to the budgets of WSAs and average WSAs budgets based on regions, and compared the results. The distribution of the WSAs based on regions is demonstrated in Figure 1 by using a pie chart.

Figure 1

WSAs by Region



Per capita Expenditure Calculation

In this study, different parameters affecting the per capita expenditures of WSAs were taken into account. Accordingly, the total amount of annual expenditures of the WSA was divided by the total population of the province, served by the WSA, to calculate its per capita expenditures (Equation 1). The data used within the study belongs to the 2019 year of TURKSTAT. The total amount of annual expenditure of the WSA includes its capital, operational and maintenance costs of its investments and all other expenditures based on the duties of WSAs.

$$A = \frac{C}{N} \qquad \text{(Equation 1)}$$

where:
A: per capita expenditure of WSA (₺)
C: annual expenditure of WSA (₺)
N: population served by WSA (person)

Investigation of the impact of different elements was carried out by identifying four major factors such as service time of WSAs, region of WSAs, population served by WSAs, and budget of MMs, to which WSAs are affiliated.

Results and Discussion

Assessment of the Budgets of WSAs Based on Their Regions

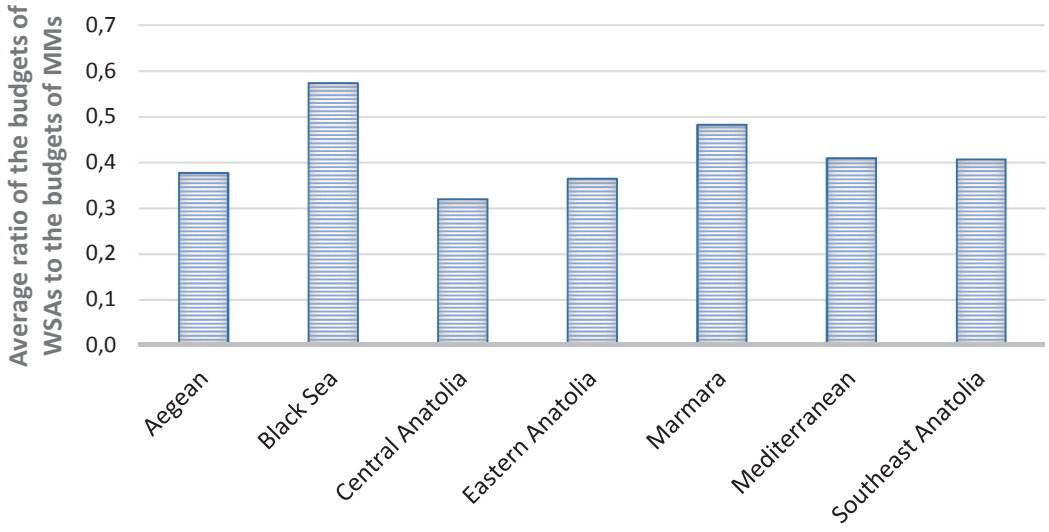
The average ratios of the budgets of WSAs to the metropolitan municipal budgets on a regional basis are given in Figure 2. According to the evaluation, the region with the highest average ratio of the budgets of WSAs to the budgets of MMs was the Black Sea Region. In the Black Sea Region, 57% of the total MMs budget was allocated to the budgets of WSAs. This might be either explained by its geographical conditions that have led to increasing infrastructure costs for transporting water and wastewater and also investment costs for preventing natural disasters such as flooding caused by heavy rain events. Bene et al. (2010) indicated that the cost of the electrical energy of pumping water is the major portion of the total operating cost of waterworks. The amount of energy for pumping water significantly increases when the land areas are rugged or/and the slope of land is steep (Adamiak & Spychalski, 2021). Therefore, the rugged land of the Black Sea Region is one of the most important factors that increase the overall expenditure of WSAs. The Black Sea Region receives the highest average annual precipitation in Türkiye varying from 1250 to 2500

mm/year. Considering the average annual precipitation of Türkiye, which is 574 mm/year, the microclimatic conditions of the Black Sea Region are more evident. On the other hand, the Central Anatolia Region receives the least precipitation in Türkiye with an average annual precipitation of 250 to 300 mm (State Hydraulic Works [DSI], 2022). Therefore, Central Anatolia was the region with the lowest average ratio of the budgets of WSAs to the budgets of MMs. In the Central Anatolia Region, 32% of the total budget of the MMs was allocated to the budgets of WSAs. There is no rugged land and extreme climate condition in Central Anatolia compared to the Black Sea Region. Moreover, Central Anatolia is a region where a high risk of drought exists (Bacanli et al., 2010). Thus, WSAs in the Central Anatolia Region might not need great investments contrary to those in the Black Sea Region. However, it would be important for WSAs in the Central Anatolian Region to make investments in line with the necessary precautions against the risk of drought.

The budget of M_4 in the Marmara Region was 88% budget of its MM due to either the geotechnical properties of the city or the costs caused by the water supply and wastewater disposal of the city. The Marmara Region was detected as the second highest average annual rate of the budgets of WSAs to the metropolitan municipal budgets. However, excluding the M_4 Province, the average ratio of the budgets of WSAs to the budgets of MMs in the Marmara Region was found close to both of those in the Mediterranean and Aegean Regions. As a result of evaluating the budgets of WSAs and MMs together, except for those in the Black Sea and Central Anatolia Regions, and also M_4, the percentage of the budgets of all other regions MMs allocated to the budgets of WSAs were similar (~40%). These results were higher than expectations due to the expenditures of WSAs in Türkiye which are mainly composed of capital costs. The initial capital costs are usually high, which is why the expenditures of WSAs constitute a high percentage of the total metropolitan municipal budget. Contrarily, WSAs expenditures in developed countries include mainly operational and maintenance costs and thus reasonable percentages of their metropolitan municipal budgets are allocated to the budgets of WSAs. It can be expected that this ratio of 40% might be decreased in Türkiye over the coming years.

Figure 2

The Average Ratios of the Budgets of WSAs to the MM Budgets on a Regional Basis



Assessment of Factors Affecting Per Capita Expenditures of WSAs

The average annual expenditures per capita of WSAs by providing services for different period of times are shown in Table 2. According to the results, the average expenditure per capita of WSAs by providing services for a short period of time (0-10 years) was determined as 357.72±132.93 ₺, while WSAs by providing services for a moderate period of time (10-30 years) have per capita expenditure of 415.15±115.83 ₺ on average. In the last category, WSAs with services for a long period of time (>30 years) have spent 472.96±107.27 ₺ per capita on average. According to the results, it was said that per capita expenditures have been increased slightly as the WSAs services for a period of time increases. It is expected that WSA services for a period of time and development level of MM are directly proportional. For instance, WSAs of three major MMs in Türkiye were established a long time ago than the others. The MMs of the three most populous and wealthy provinces have WSAs that have been serving for many years and already completed primary water and wastewater works in the past years. It is obvious that WSAs, that have been serving for many years, should direct their investments to improve their performance by constructing large and mega infrastructures such as advanced biological wastewater treatment plants (WWTPs) or separate sewer systems. Accordingly, WSAs, that have been serving for a short time, should direct their investments to solve urgent waterworks and relatively small infrastructure. In other words, WSAs serving for a long period of time or the

MMs of the three most populous and wealthy provinces have spent more money per capita on water and sewerage works in their provinces.

Table 2

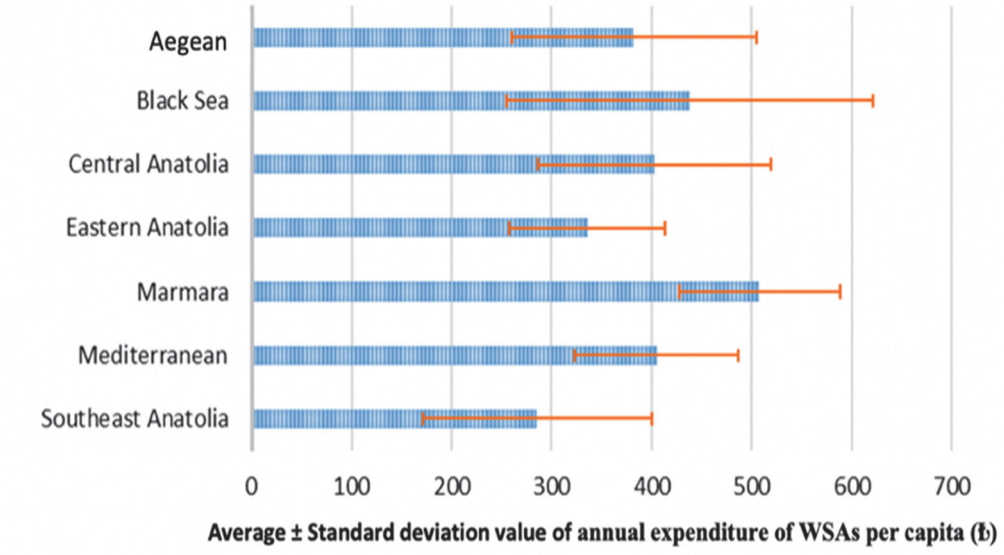
Average Annual Expenditures Per Capita of WSAs by Serving for a Period of Time

Serving time (years)	Average ± Standard deviation value (₺)
0-10	357.72±132.93
10-30	415.15±115.83
>30	472.96±107.27

Average annual expenditures per capita of WSAs on the regions in Türkiye are illustrated in Figure 3. The Marmara Region has the highest per capita expenditure with 507.85±80.05 ₺. Considering the ongoing various wastewater collection, stormwater collection, transmission line projects, and advanced biological WWTP constructions in the Marmara Region, the high per capita expenditure is reasonable. Moreover, land acquisition costs in the Marmara Region are higher than those in other regions. Environmental problems such as eutrophication or mucilage blooms may be caused by the high nutrient introduction to the receiving water bodies attributed to the poor performance of WWTPs. Especially, the coasts of Marmara Sea faced massive mucilage problems in 2021. To prevent such environmental problems in the future, Ozturk and Seker (2021) suggested some measures for WSAs in the Marmara Region. One of the measures was to increase the number of advanced biological WWTPs in the region. Therefore, per capita expenditures of WSAs in the Marmara Region might increase in the future because of the forthcoming possible investments for building advanced WWTPs. The lowest per capita expenditure with 285.50±114.85 ₺ was found for WSAs in Southeast Anatolia. This result is reasonable since the financial development level of Southeast Anatolia is relatively lower than the rest of the regions in Türkiye (Unsal & Sulku, 2020). The results for other regions were similar in terms of the average annual expenditure of WSAs per capita.

Figure 3

Annual Expenditure of WSAs Per Capita on Regions



The average annual expenditure per capita of WSAs on population size was evaluated in three categories: 1) between 0-2 million people, 2) between 2-4 million people and 3) >4 million people. According to Table 3, the average annual per capita expenditures of WSAs for the population size between 0 and 2 million was 375.14±128.60 ₺. For the population size of more than 4 million it was determined as 572.35±7.05 ₺. Therefore, per capita expenditures of WSAs increase in line with the increases in population size. Contrarily, their per capita expenditure is expected to decrease when they serve a great population. For instance, Tuna and Kınacı (1999) calculated per capita wastewater collection system construction costs depending on the population size and showed that the per capita costs have been decreased by the population growth. The opposite situation observed in WSAs showed that the expenditures of WSAs in Türkiye were still about capital investment costs such as constructing WWTPs. In addition, high energy prices and large population in major metropolitan areas cause an increase in per capita expenditures of local governments. Three major MMs of Türkiye have a population of more than 4 million people. Due to wider range of job opportunities in developed provinces, their population is so high. Therefore, the per capita expenditure of WSAs in the least populated cities is reasonable by considering major WSAs located in the most crowded cities. These WSAs should provide more extensive water and sewerage works.

Table 3

Average Annual Expenditure Per Capita of WSAs on Population Size

Population (million people)	Average ± Standard deviation value (₺)
0-2	375.14±128.60
2-4	410.04±102.48
>4	572.35±7.05

Table 4 shows the average annual expenditure per capita of WSAs by the metropolitan municipal budgets. The volume of metropolitan municipal budgets were studied at three intervals; between 0 and 2, between 2 and 4, and higher than 6 billion TRY. Average per capita expenditure was determined as 361.29±127.34 ₺ for MMs, that have annual budget between 0 and 2 billion TRY. On the other hand, it was determined as 572.35±7.05 ₺ for the MMs, that have annual budget more than 4 billion TRY. The results show that expenditures per capita of WSAs increase as the budget of MM increases. In general, the volume of metropolitan municipal budgets is proportional to the economic development of the provinces. It is also expected that the volume of the budgets of MMs is related directly with the average income per capita by provinces. WSAs in provinces that per capita income is higher than the others, might have huge budgets due to the big volume of metropolitan municipal budgets. Therefore, the number of investments and projects conducted by WSAs will increase. Consequently, WSAs of big volume budgets of MMs have higher per capita expenditures than the others having small budgets.

Table 4

Average Annual Expenditure Per Capita of WSAs by Metropolitan Municipal Budgets

Annual budget (billion TRY) of MMs	Average ± Standard deviation value (₺)
0-2	361.29±127.34
2-4	457.65±68.12
>4	572.35±7.05

Even if there are factors affecting the per capita expenditures of WSAs, in some cases it cannot be explained by these factors. The investment and inspection mechanisms for WSAs should be rearranged and their activities should be regulated by the auditing organizations. There are many examples of auditing authorities around the world such as Water Administrations Association-VEWIN in the Netherlands and Water Environment Research Foundation-WERF in USA. This organizational structure is also beneficial in order to optimize per capita expenditures, develop fast

and low-cost solutions, carry out joint Research & Development studies and sharing knowledge and experiences. It is also recommended to establish a WSAs Union to solve their common problems. By the time a WSAs Union will be established in Türkiye, a unit might be established in the Union of Municipalities of Türkiye (Sarıkaya et al., 2019) to facilitate administrative operations, improve their investments and optimize their per capita expenditures.

The WSAs need to prepare a master plan for drinking water, wastewater, and stormwater works in line with their strategic goals and obligations in order to perform their duties more effectively. A well-prepared master plan would be a roadmap for the administrations for the next ~30-40 years. Due to the importance of master plans in water and wastewater management, in some countries, the preparation of master plans is either required or handbooks are prepared at the national level for the aim of support the WSAs. For example, in Bulgaria it is obligatory for Regional Water and Sanitation Associations to prepare a master plan for their region, and in Romania the national handbook provides the principles and procedures for preparing a master plan (Sarıkaya et al., 2022). As it is seen from national and international experiences, the WSAs get many benefits from a well-prepared master plan so the costs of preparing a master plan might be ignored. Preparing master plans by the WSAs should be obligatory as it is practiced in some countries. In addition, considering the investment, operational and maintenance costs to be calculated within the scope of the master plan, the policies for pricing their water and wastewater services will be determined in light of the master plan. There is no guide for the preparation of master plans on drinking water, wastewater, and stormwater management in Türkiye. In this regard, it is recommended to prepare a guide for the administrations to develop their organizational capacity. Moreover, preparing a master plan and transitioning to energy efficiency based on smart water management technologies may contribute to establishing a balance between per capita expenditures and enhancing the performance of WSAs (Sarıkaya et al., 2022).

Conclusions

The performance and characteristics of WSAs are significantly influenced by their per capita expenditures. This study investigated how various factors affect the per capita expenditure of WSAs. The results showed that per capita expenditures are considerably high in WSAs that have been serving for many years and were of large volume budgets of MMs. According to the region-based evaluation, it was found that WSAs in the Marmara Region had the highest per capita expenditures with an annual average of 507.85±80.05 ₺. On the other hand, per capita expenditures of WSAs located in the Eastern Anatolia Region were determined as the lowest value with an

annual average of 285.50±114.85 ₺. Moreover, the population serving by WSA and per capita expenditures of WSAs are positively correlated. When ratios of the budgets of WSAs to the budgets of MMs were investigated, it was found that MMs in the Black Sea Region allocate the highest percentage of their budgets to the budgets of WSAs in the region. On the other hand, MMs in Central Anatolia allocate the lowest percentage of their budgets to the budgets of WSAs in the region. According to the results, it was proposed that the investment and inspection mechanisms of WSAs should be separated and their activities should be controlled by auditing authorities to optimize their expenditures per capita and establish a balance between their services and expenditures. It was also recommended to prepare a master plan which could be a roadmap for the administrations based on 30-40 year periods, so that both per capita WSAs expenditures and the budgets allocated by MMs to WSAs may not significantly differentiate over the years and induce high differences based on the region. In different examples across the world, the benefits of the master plans to the administrations are more than the costs of the resources allocated for the preparation of a master plan. Therefore, it was suggested that the preparation of a master plan should be an obligation for WSAs.

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Extended Turkish Abstract
(Genişletilmiş Türkçe Özet)

Türkiye'de Su ve Kanalizasyon İdarelerinin Kişi Başı Harcamalarını Etkileyen Faktörler

Artan nüfusun ihtiyacı olan su ve atıksu gibi altyapısal hizmetler, çevre ve insan sağlığı da gözetilerek 2560 sayılı kanunda düzenlendiği şekliyle büyükşehir belediyeleri bünyesinde kurulan su ve kanalizasyon idareleri (SUKİ) tarafından yürütülmektedir. SUKİ yatırım ve hizmetlerinden kaynaklı harcamaların sunulan hizmetin niteliğinden ve öneminden dolayı araştırılması gerekli alanlardan biridir. Yatırım ve hizmetlerinden kaynaklı harcamalarının hizmet ettikleri bölge nüfuslarına oranı SUKI'lerin kişi başı harcamaları olarak tanımlanmaktadır. Kişi başı harcamaları SUKİ'lerin etkinliğini ortaya koyan önemli bir performans göstergesidir. Kurumsal, demografik, iklimsel ve coğrafyaya bağlı koşullar kişi başı harcamaları etkileyen çeşitli faktörler arasında bulunmaktadır. Bu faktörlerin kişi başı harcamalara ayrı ayrı etkileri olduğu ve her bir SUKİ için farklı değerler aldığı gözlenmektedir. Bu doğrultuda; çalışmada seçilen farklı parametrelerin SUKİ'lerin kişi başı harcamalarına olan etkileri incelenmiş ve tartışılmıştır. Bu parametreler SUKİ hizmet süresi, SUKİ'nin hizmet ettiği bölge ve nüfus ile SUKİ'nin bağlı olduğu büyükşehir belediyesi (BB) bütçesi olarak seçilmiştir. Çalışma kapsamında Türkiye'de faaliyetlerine devam etmekte olan otuz SUKİ incelenmiş ve farklı parametreler bazında kişi başı harcamaları değerlendirmeye tabi tutulmuştur. SUKİ'ler %20 ile en fazla Marmara Bölgesi'nde mevcutken, %10 ile en az Doğu Anadolu Bölgesi'ndedir. Kişi başı harcama, SUKİ'nin yıllık toplam harcaması SUKİ'nin hizmet ettiği nüfusa bölünerek Türk Lirası (₺) cinsinden hesaplanmıştır. Bununla birlikte; SUKİ'lerin bölgeler bazında finansal özelliklerinin anlaşılabilmesi amacıyla SUKİ bütçelerinin BB bütçelerine oranları yüzdesel ve bölgesel olarak hesaplanmıştır. Buna göre; Karadeniz Bölgesi'nde bulunan BB'lerin toplam bütçesinin %57'si bölgede bulunan SUKİ'lere ayrılmıştır. Diğer yandan, İç Anadolu Bölgesi'nde bulunan BB'lerin toplam bütçesinin %32'si bölgede bulunan SUKİ'lere ayrılmıştır. Özellikle Karadeniz bölgesinin coğrafi özellikleri ve iklimsel yapısı nedeniyle SUKİ yatırımlarının BB bütçesinde önemli bir yer tuttuğu tahmin edilmektedir. Örneğin; Karadeniz Bölgesi yıllık ortalama 1250 ila 2500 mm yağış almaktadır. Son yıllarda iklim değişikliğinin bir sonucu olarak meydana gelen aşırı yağış kaynaklı sel ve taşkınlar da bölgenin altyapısı üzerindeki baskıyı arttırmaktadır. Sonuç olarak bölgede bulunan SUKİ'lerin altyapıya yönelik yatırımlarının gelecekte de artması beklenmektedir. İç Anadolu Bölgesi'nde gerek coğrafi şartlar gerekse iklimsellik Karadeniz Bölgesi'nde olduğu gibi zorlayıcı ve yüksek yatırım gerektirecek özellikte değildir. Dolayısıyla BB'ler tarafından SUKİ'lere ayrılan bütçe yüzdesel olarak Karadeniz ve diğer bölgelere göre daha düşüktür. Marmara Bölgesi'nde ise çalışma kapsamında M_4 olarak kodlandırılan büyükşehire bağlı SUKİ bütçesinin toplam BB bütçesine oranı %88 gibi çok yüksek bir değer olarak hesaplanmıştır. Bu SUKİ'ye ait veri değerlendirilmeye alınmadığı takdirde; Maramara Bölgesi, Ege Bölgesi, Akdeniz Bölgesi, Doğu Anadolu Bölgesi ve Güneydoğu Anadolu Bölgesi için bölgelerde bulunan SUKİ'lerin bağlı oldukları BB bütçelerine oranlarının %40 civarında olduğu görülmüştür.

Kişi başı harcamalara SUKİ hizmet sürelerinin etkilerinin de incelendiği çalışmada, SUKİ'ler düşük (0-10 yıl), orta (10-30 yıl) ve uzun (30 yıldan daha fazla) hizmet süreli olmak üzere üç grupta sınıflandırılmıştır. Hizmet süresi düşük SUKİ'lerin (0-10 yıl) yıllık kişi başına ortalama 357.72±132.93 ₺, orta hizmet süreli SUKİ'lerin (0-30 yıl) yıllık kişi başına ortalama 415.15±115.83 ₺ ve son kategori olan uzun hizmet süreli SUKİ'lerin (>30 yıl) ise yılık kişi başına ortalama 472.96±107.27 ₺ harcadığı tespit edilmiştir. Dolayısıyla hizmet süresi arttıkça SUKİ'lerin kişi başı harcamalarının arttığı sonucuna varılmıştır. Bunun en önemli sebeplerinden biri; uzun hizmet süreli SUKİ'lerin düşük maliyetli birincil yatırımlarını tamamlamış olmaları ve örneğin ileri biyolojik atıksu arıtma tesisleri ya da ayrık toplama sistemleri gibi daha büyük bütçeli yatırımlar yapıyor olmalarıdır. Kişi başı harcamalara bölge etkisi ise Türkiye'de bulunan yedi farklı coğrafi bölge üzerinden incelenmiştir. Sonuçlara göre; Marmara

Bölgesi'nde bulunan SUKİ'lerin kişi başı harcamaları yıllık ortalama 507.85±80.05 ₺ ile en yüksek olarak tespit edilmiştir. Bununla birlikte; Güneydoğu Anadolu Bölgesi'nde bulunan SUKİ'lerin kişi başı harcamaları yıllık ortalama 285.50±114.85 ₺ ile en az yatırım yapan idareler olarak tespit edilmiştir. Bu farklılığın en önemli nedenlerinden birinin bölgeler arasındaki ekonomik gelişmişlik farkı olduğu öne sürülmüştür. Nüfus etkisini incelemek için SUKİ'ler hizmet verdikleri nüfusa göre üç farklı kategoride değerlendirilmiştir. Buna göre; hizmet verdiği nüfus 0-2 milyon kişi arasında olan SUKİ'ler kişi başı 375.14±128.60 ₺, 2-4 milyon kişi arasında olan SUKİ'ler kişi başı 410.04±102.48 ₺, 4 milyon kişiden daha fazla olan SUKİ'ler kişi başı 572.35±7.05 ₺ harcamaktadır. Dolayısıyla daha fazla nüfusa hizmet veren SUKİ'lerin kişi başı harcamalarının daha yüksek olduğu sonucuna varılmıştır. Son olarak BB bütçesinin etkileri incelenmiş ve daha yüksek bütçeli BB'lere bağlı SUKİ'lerin kişi başı harcamalarının da daha yüksek olduğu sonucuna varılmıştır. BB bütçesi ve SUKİ kişi başı harcaması arasındaki pozitif korelasyonun ana nedenlerinden birinin ekonomik gelişmişlik seviyesinden kaynaklı hayata geçirilen yüksek yatırımlar olduğu sonucuna varılmıştır.

Çalışma kapsamında elde edilen sonuçlara göre, kişi başı harcamaların optimize edilmesi ve harcamalar arasında bir dengenin kurulması için SUKİ'lerin yatırım ve kontrol mekanizmasının ayrıştırılması ve faaliyetlerinin oluşturulacak merkezi bir yönetim altında kontrol edilmesi önerilmiştir. Kişi başı SUKİ harcamalarının ve BB'lerin SUKİ'lere ayırdığı bütçelerin yıllar içerisinde aşırı artışlar göstererek bölge bazında yüksek farklılıklar yaratmaması amacıyla 30-40 yıllık dönemler için idareye yol gösterecek master planlar hazırlanması tavsiye edilmiştir. Dünyadaki farklı örneklerden de görüleceği üzere master plan çalışmasının idareye kattığı faydalar, master plan hazırlama maliyetinden daha fazladır. Dolayısıyla SUKİ'lerin master plan hazırlamasının zorunlu olması sonucuna varılmıştır.