THE RELATIONSHIP BETWEEN FINANCIAL RESULTS AND SUSTAINABLE DEVELOPMENT AT WATER AND SEWAGE OPERATORS IN ROMANIA

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Abstract: *The present research focuses on the analysis of the link between the net profit of water and sewage operators in Romania and independent variables related to sustainable development. The data used in the research is obtained from water and sewage operators for the period 2014-2020. The study is based on a statistical analysis and is an extension of the lead author's previous doctoral research. The independent variables considered include the degree of water connection of the population, the degree of connection to sewerage-treatment services, water-related complaints per network kilometer, blockages in the sewerage network per network kilometer, the degree of water metering, losses of unmetered water per day per kilometer of network (NRW), the level of water and sewage employees per 1000 people served, the debt collection period and the number of inhabitants served per kilometer of network (density). The results of the statistical analysis are significant and confirm the existence of some correlations between these variables and the net profit of water and sewage operators in Romania. The results of this research contribute to the understanding of the relationship between sustainable development and the financial performance of water and sewage operators in Romania. The study highlights the importance of variables such as complaints and blockages per kilometer of network, unmetered water losses and the level of employees in influencing the net profit of these operators. The results suggest that improving these variables can have a positive impact on the financial performance of water and sanitation operators, thus contributing to the achievement of sustainable development goals.*

Keywords: *water utility performance, financial performance, water and sewage*

Classification JEL: L95, Q25, M11

Introduction

Access to sanitation and hygiene services is an essential aspect of sustainable development and the well-being of the population, having a significant impact on health and quality of life. However, despite the progress made in most EU member states, there are still significant differences in these aspects across European countries. In this context, Romania faces persistent challenges in ensuring access to adequate sanitation and hygiene for a significant part of its population.

According to official data obtained from the National Institute of Statistics, Romania records an alarming percentage of 21.20% of homes without sanitation facilities, compared to other EU member states, such as Lithuania, Bulgaria and Latvia have values between 6.4% and 7.0%. These values are far above the European average, which is only 1%. The data also reveal that the rate of

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population connection to sewage and wastewater treatment systems in Romania was only 47.64% at the end of 2016 and increased slightly to 57.35% in 2021, compared to other countries that later joined the EU, such as Poland (94.96%), Hungary (79.28%) and Bulgaria (87.39%) in 2017 is very low.

Regarding access to drinking water, Romania also registers values below the European average. According to data from 2021, the drinking water connection rate in Romania was only 74.10%, while other EU member states that are in our proximity, such as Slovakia (88.9%), Poland (92%), Bulgaria (99.42%) and Hungary (100%), recorded significantly higher values (reference date being 2017).

These discrepancies in sustainable development indicators between Romania and other EU member states highlight the need to urgently address this issue and implement appropriate measures to ensure access to adequate sanitation and hygiene services for the Romanian population. In this context, the sustainable development of the water and sewage-treatment sector in Romania is an important concern. There is a significant gap with other EU countries in terms of access to water and sanitation, as well as the financial performance of water and sewage operators. In order to explore the link between sustainable development and the financial performance of these operators, this research focuses on the analysis of data on the net profit of water and sewage operators in Romania, in relation to a series of sustainable development variables.

The data used in the research is obtained from water and sewage operators over a six-year period between 2014 and 2020. The study is based on detailed statistical analysis, extending the lead author's previous doctoral research. Among the independent variables considered are the degree of water connection of the population, the degree of connection to sewage-treatment services, water-related complaints, blockages in the sewage network, the degree of metering of water consumption, unmetered water losses, the level of water and sewage employees, the debt collection period and the density of the population served per kilometer of the network.

The results of the statistical analysis are significant and bring new perspectives to the link between sustainable development and the financial performance of water and sewage operators in Romania. This research contributes to the complex understanding of the factors that influence the profitability of these operators and can provide valuable information for decision-making within public policies and strategies for the development of the water and sewage-treatment sector in Romania.

Paper Body

The method of research used

Our research was based on an analysis of the specialized literature in the field of Water Utilities and sustainable development related to SDG 6, respectively a detailed case study to gain a deep understanding of the subject. In the first phase of the research, we conducted a review of existing literature, including scientific papers, case studies and relevant reports on issues and issues associated with water management.

As a research method, we used comparative analysis, which allowed us to compare the data collected from different Water Utilities in Romania, from different time periods and geographical locations. We assessed how these organizations managed their water resources, infrastructure, production and distribution processes, water management policies and practices, and their involvement in sustainable development projects and environmental protection.

To ensure a rigorous and objective analysis, we used a critical and interpretive approach to the collected data, identifying emerging trends, patterns and issues.

Literature Review

The lack of access to clean water compromises fundamental human needs, increases social inequalities, and violent conflicts in various countries. Traditional debates in the water sector focus

on the impact of climate change on energy generation, transportation, and food production, ignoring the need to restore rivers, groundwater reservoirs, soil, and related ecosystems. In the face of these and other disputes, it is necessary to emphasize the core values of water for society and guide efforts in this direction (de Paula & Marques, 2022).

In 2002, the United Nations (UN) declared water (and sanitation) as a mandatory precondition for human rights, giving it a specific and central chapter in the Sustainable Development Goals (SDGs). SDG 6 addresses the issue of clean water through its target, detailing eight indicators to highlight the need for an integrated approach and financing (UN ESCAP, 2018).

Apart from SDG 6, other Sustainable Development Goals are closely related to water. Griggs et al. (2017) illustrated the synergy of water resources with hunger and marine life (SDGs 2 and 14) through its dependence on food and nutrients. The 2018 UN report mentions its interdependencies with the sustainability of cities and communities (SDG 11), responsible production and consumption (SDG 12), terrestrial life (SDG 15), and partnerships for goal achievement (SDG 17). The SDG also emphasized its integration throughout the water cycle, including a common concern for conservation, quality, recycling, and resource utilization, recognizing it as a critical theme for governance.

All these sustainable development goals are really linked to water governance, and their long-term resolution can only be achieved through adequate governance of water resources. Water governance means much more than water management, including the decision-making process, planning, and implementation of policies and regulations related to water and its resources, as well as how they are administered and monitored. On the other hand, water management refers to the operational activities related to the collection, treatment, distribution, and use of water (Di Vaio, 2021).

The Organization for Economic Co-operation and Development (OECD) (2010, 2015) and the United Nations Environment Programme (UNEP) (United Nations, 2020) have highlighted the importance of water governance for sustainability issues. The OECD has introduced good governance practices to address water-related crises and emphasized that the lack of adequate governance hinders the implementation of water policies. Water-related sustainability issues are included in the UN 2030 Agenda and its 17 Sustainable Development Goals (SDGs). However, there are discrepancies between the UN 2030 Agenda and UNEP, underscoring the need to align governance with global sustainability challenges. Although water governance is critical for progress towards SDG 6 - ensuring the availability and sustainable management of water and sanitation for all, it is not yet clear what governance models can be considered sustainable (Martinez-Cordoba et al., 2020).

SDG 6 identifies Integrated Water Resources Management (MIRA) as a concrete target for better governance of water resources. Water governance is not the same as water management, which refers to operational activities. The UN 2030 Agenda leaves the identification of solutions to practitioners and national and local governments (Biermann et al., 2014).

The importance of sustainable water governance was also demonstrated by the COVID 19 pandemic, which showed us the difficulties related to water management worldwide. Reports made in 2020 by the International Finance Corporation (IFC) and the OECD show us that the lack of access to water made it impossible to wash hands properly and frequently, which represented an important first measure to stop the spread of the pandemic. In the context of the COVID pandemic, in order to ensure the population's access to water, many governments have decided to suspend the possibility of interrupting the water service for poor payers, even more some governments have imposed on water utilities the suspension of billing for low-income users (Homsy and Warner, 2020) (Marques et al., 2023), measures that can have a negative effect on water utilities and that can lead to the reduction of investments in infrastructure, due to the lack of funds and implicitly to the postponement of the objectives related to SDG 6.

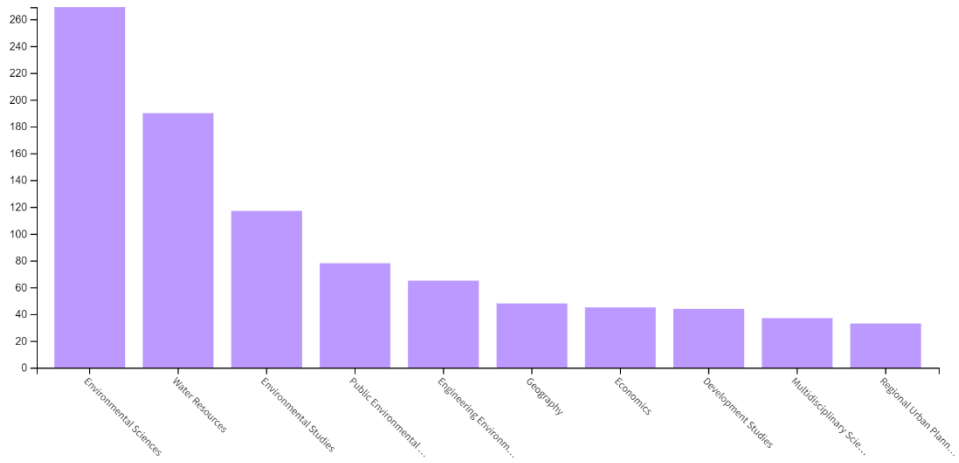

Figure no. 1. Statistics of the domains in which it was published related to access to water in the period 2014-2023

The issue of access to water is very important not only for the big international organizations (UN, OECD) but also for the scientific community. Analyzing the Web of Science database for the period 2014-2023, we find 639 articles related to water access in the Environmental, Economic and Social domains (Figure no.1).

In this study, we used the VOSviewer 1.6.19 software to analyze the keywords from the articles published in the "Web of Science Core Collection" database, in order to identify the main directions of scientific research related to access to water. These directions of research were graphically represented as a network of links in Figure no.2, and the research directions are presented in Table no.1.

Tabel no. 1. Aspects researched in relation to access to water treated in scientific works published in the period 2014-2023

Research cluster	Research directions
Cluster 1 (red)	Treats problems related to adaptation, agriculture, climate change, drought, food security, framework, groundwater, impacts, irrigation, land, management, poli-cy, removal, resilience, resources, sustainability, sustainable development, systems, urbanization, vulnerability, waste-water, water treatment.
Cluster 2 (green)	Addresses topics related to children, consumption, contamination, demand, determinants, developing countries, drinking water, growth, health, household, hygiene, impact, inequality, mechanism, nutrition, quality, risk, sanitation, sustainable development, wash, water, water supply.
Cluster 3 (blue)	Addresses topics such as access, affordability, challenges, community, disparities, environmental justice, equity, governance, human right to water, informality, infrastructure, lessons, participation, performance, politics, poor, poverty, power, services, urban, water governance.
Cluster 4 (yellow)	Research topics such as themes communities, food, insecurity, political ecology, scarcity, security, water access, water insecurity, water management, water quality, water scarcity, water security.

Source: Own projection

Figure no. 2 illustrates the connections between the keyword "water access" and other keywords identified in the analysis of scientific articles. The connections are represented by different colors to highlight the groups of researchers who address these topics. Thus, research

clusters are represented in red, green, blue and yellow. The most strongly connected are those clusters dealing with "drinking water" and "climate change". It can also be seen that the red, green and blue clusters are interconnected with each other, indicating a strong connection between the research directions addressed by these groups.

Effective management of water resources and the provision of good quality drinking water have become vital for the sustainable development of the water sector (Goh and See, 2023). Although water utilities are aware that non-revenue water (NRW) is an important sustainable development issue and has a negative impact on financial performance and quality of service, still in many countries the values remain very high (Liemberger and Wyatt, 2019). The NRW is the difference between the water introduced into the distribution system and the amount billed to customers (Kankoudis et al., 2013). NRW is caused by: physical losses, which are leakages from all parts of the storage and distribution system; commercial losses, which can be caused by under-recording of the customer's meter, data entry errors in non-automated IT systems and water theft in various forms. NRW also includes unbilled authorized consumption, internal uses specific to water utilities and external uses such as water used for firefighting and water provided free of charge to certain consumer groups (van den Berg, 2015).

We consider that water used in technology by water utilities and authorized external uses are not part of NRW and their reduction does not depend on improving existing infrastructure.

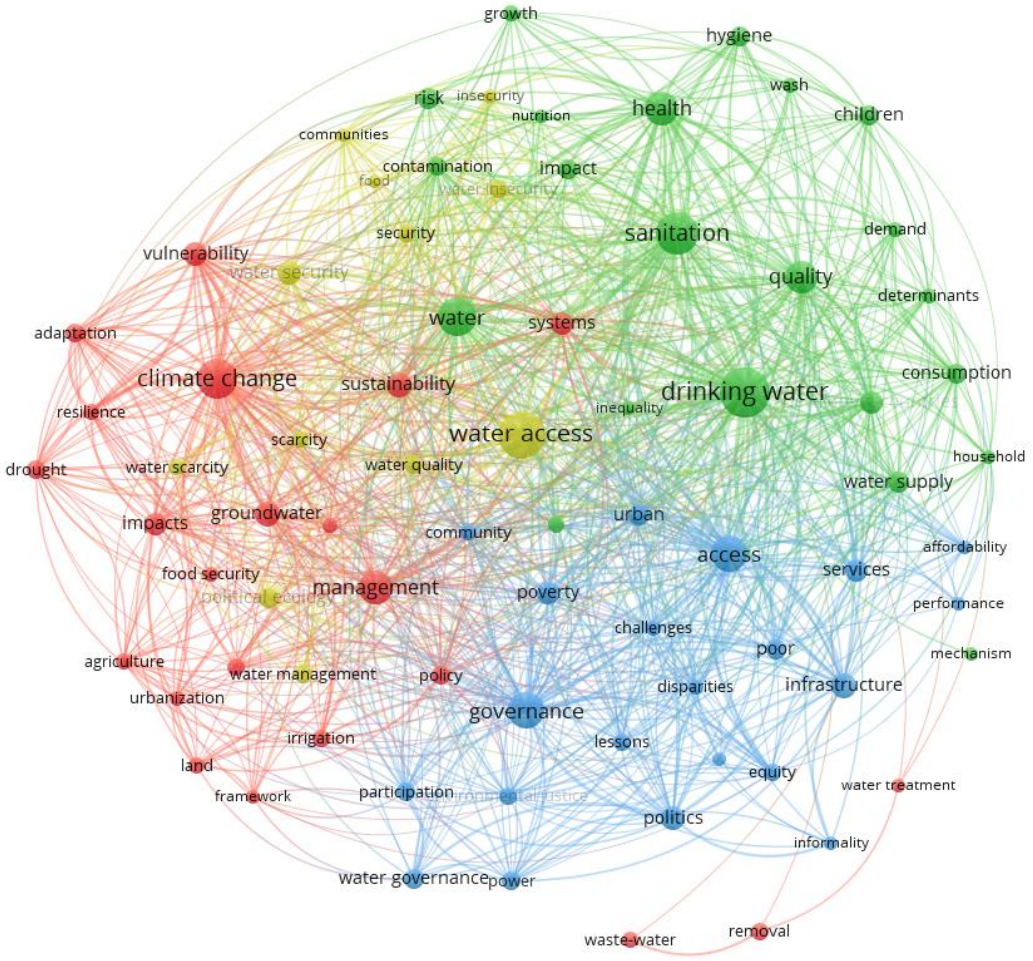

Figure no. 2. The keyword network "access to drinking water" during the period 2014-2023
(Source: Own projection with the VOSviewer)

In the context of the United Nations Sustainable Development Goal 6, which promotes clean water and sanitation until 2030 (United Nations, 2015), it is important to make investments that lead to the reduction of NRW and improve the efficiency of water resources management (Şişman and Kızılöz, 2020). For the use of this indicator in benchmarking exercises, it is preferable to use the form expressed in liters/day/km of network or, if these data are not available at the level of some countries, then in liters/capita/day, so that the data are comparable at the level worldwide (Fülöp, 2022), (Liemberger and Wyatt, 2019), (Bakó and Fülöp, 2017).

However, establishing a target rate for NRW can be problematic due to external factors that may influence NRW levels and due to the lack of consensus on the appropriate indicator for determining this rate (Frauendorfer and Liemberger, 2010), (González-Gómez et al., 2011).

Case study

We conducted a detailed case study, using a database that includes information on 43 regional operators in Romania, operating throughout the country, in the period between 2014 and 2021. The purpose of this study was to evaluate the evolution of development indicators sustainable in the field of water and sewage during this period, respectively the connection between them and the financial result achieved by these water utilities.

Among the sustainable development indicators analyzed were the degree of connection to water networks, the degree of connection to sewerage networks, the number of water-related complaints per kilometer of network, the number of blockages in sewerage networks per kilometer of network, the degree of water metering, water losses (NRW) per day per kilometer of the network, the level of water employees per 1000 people served and the level of sewer employees per 1000 people served, as well as the period of debt collection.

The analysis of these indicators allowed us to assess the performance of regional operators in terms of sustainable development in the field of water and sanitation. We identified trends and patterns in the evolution of these indicators over time and in different geographic locations, as well as significant differences between operators.

Tabel no. 2. The evolution of average values for sustainable development variables in Romania during the period 2014-2021

Year	Water connection rate	Sewerage connection rate	Water-related complaints per kilometer of network	Blockages in the sewage network/km of network	NRW/Day/Km	Level of water employees/1000 people served	Level of sewage employees/1000 people served	Debt collection period	No. inhabitants served/km of network (density)	No. TAU[3]	No. inhabitants on TAUs /km of network
2014	82.90%	63.31%	1.13	4.60	20.78	1.87	1.63	75.62	302.02	23.71	12.74
2015	82.56%	62.53%	1.19	3.69	19.95	1.78	1.66	73.36	303.12	24.90	12.17
2016	82.61%	62.64%	1.08	3.45	20.22	1.76	1.69	66.96	293.29	26.32	11.14
2017	82.57%	62.43%	0.90	5.30	19.82	1.69	1.67	67.75	282.85	27.68	10.22
2018	83.00%	64.13%	0.96	6.25	19.22	1.67	1.57	66.85	270.49	29.02	9.32
2019	84.20%	64.36%	0.98	6.12	18.81	1.61	1.51	57.31	264.93	29.41	9.01
2020	85.30%	65.33%	0.93	4.95	18.74	1.54	1.54	60.95	255.07	29.78	8.57
2021	85.37%	65.38%	0.90	5.06	18.58	1.51	1.49	60.17	252.12	31.41	8.03

Source: own development based on data from http://h2obenchmark.org

[3] The number of Territorial Administrative Units (TAU) that have a centralized drinking water system, are members of the Intercommunity Development Association (IDA) and are served by the regional operator (RO)

The degree of connection to the water network has increased steadily over the years, from 82.90% in 2014 to 85.37% in 2021. This trend indicates an improvement in the population's access to drinking water, which can be considered a positive aspect. The degree of connection to the sewage network registered a slight increase from 63.31% in 2014 to 65.38% in 2021. This trend indicates a gradual expansion of the sewage infrastructure, which can contribute to the improvement of wastewater management and the reduction of pollution. The evolution of these indicators represents a positive aspect from the SGDs point of view, but it is important to note that regional operators serve only 66.80% of the Romanian population. Two large operators are not included in the study, Apa Nova Bucharest and Ploiești, which operate with private capital and do not provide data in the benchmarking system.

Water-related complaints per network kilometer varied by year, with an overall downward trend from 1.13 in 2014 to 0.90 in 2021. This may indicate an improvement in the quality of water supplied and water services. Sewage blockages per kilometer of network fluctuated, with the highest level in 2018 (6.25) and the lowest level in 2016 (3.45). However, the overall trend shows a slight increase from 4.60 in 2014 to 5.06 in 2021, which may indicate the need for additional measures to reduce blockages in the sewer network.

The NRW (Non-Revenue Water) indicator per day per kilometer of network, which measures water losses in the network, has seen a steady decrease from 20.78 in 2014 to 18.58 in 2021. This trend indicates an improvement in the efficiency of water management in the network, with the reduction of losses and unrecorded consumption.

The level of water and sewer employees per 1000 people served registered a constant downward trend during the analyzed period. This may indicate an optimization of human resources and an efficiency of the operation of water and sewage systems. The receivables collection period showed an improvement trend from 68 days in 2014 to 56 days in 2021. This trend may indicate a better management of the invoicing and receivables collection process, which may contribute to improving financial sustainability of the water and sewage service.

In the continuation of the research, we analyzed the correlations between the variables used. As shown in part in table no. 2.

Table no. 3. Correlations between net profit and other variables

Variables		**Net profit**
Water connection rate	Pearson Correlation	0.056
	Sig. (2-tailed)	0.355
	N	273
Sewerage connection rate	Pearson Correlation	0.070
	Sig. (2-tailed)	0.248
	N	273
Water-related complaints per kilometer of network	Pearson Correlation	,173**
	Sig. (2-tailed)	0.005
	N	269
Blockages in the sewage network/km of network	Pearson Correlation	0.075
	Sig. (2-tailed)	0.226
	N	265
NRW/Day/Km	Pearson Correlation	-0.047
	Sig. (2-tailed)	0.441
	N	273
Level of water employees/1000 people served	Pearson Correlation	-,387**
	Sig. (2-tailed)	0.000
	N	273

Variables		**Net profit**
Level of sewage employees/1000 people served	Pearson Correlation	-,226**
	Sig. (2-tailed)	0.000
	N	273
Debt collection period	Pearson Correlation	-,225**
	Sig. (2-tailed)	0.000
	N	272
No. inhabitants served/km of network (density)	Pearson Correlation	-0.066
	Sig. (2-tailed)	0.280
	N	273
No. TAU	Pearson Correlation	,353**
	Sig. (2-tailed)	0.000
	N	273

Source: own development in SPSS

The analysis of the data in table no. 3 shows that some variables show significant correlations with the net profit, such as complaints related to water per kilometer of the network ($r = 0.173$, $p < 0.005$), the number of water employees per 1000 people served ($r = -0.387$, $p < 0.001$), the number of employees at the channel per 1000 people served ($r = -0.226$, $p < 0.001$), the receivables collection period ($r = -0.225$, $p < 0.001$), and the number of UATs served by OR ($r = 0.353$, $p < 0.001$). These correlations indicate that these variables have a significant relationship with the net profit of the water and sewerage system.

On the other hand, other variables such as the degree of connection to water ($r = 0.056$, $p = 0.355$), the degree of connection to sewage ($r = 0.070$, $p = 0.248$), blockages in the sewage network ($r = 0.075$, $p = 0.226$), water losses ($r = -0.047$, $p = 0.441$), and population density served ($r = -0.066$, $p = 0.280$) do not show a significant correlation with net profit, having p-values greater than 0.05.

Overall, the data analysis suggests that water complaints, water and sewer staffing levels, claim collection period and number of UATs served can have a significant impact on the operating result of the water and sanitation organization, while the degree of grid connection and blockages in the sewage network do not appear to have a significant influence on this outcome. Variables that have significant correlations with net profit can be used to supplement the existing financial model developed by the first author, making this model more universal and comprehensive.

Unfortunately, indicators of sustainable development such as the degree of connection and NRW do not correlate the net profit of water utilities. In this line of ideas statistically there is no direct link between water losses and the financial result of a water utility, even if logic would dictate otherwise. Probably if we had information on how much of this NRW is due only to physical losses in the network we could find a correlation between the financial result and NRW.

Conclusions

Our detailed study, based on an analysis of 43 regional operators in Romania, active in the field of water and sewage between 2014 and 2021, highlighted the evolution of sustainable development indicators and their connection with the financial results of these water utilities.

Our findings show that the degree of connection to the water network has increased steadily during this period, indicating an improvement in the population's access to drinking water, which is a positive aspect from the perspective of the Sustainable Development Goals (SDGs). Also, the degree of connection to the sewage network showed a slight increase, reflecting a gradual expansion of the sewage infrastructure, which can contribute to more efficient wastewater management and pollution reduction.

Our analysis also revealed significant differences between regional operators in terms of performance in sustainable water and sanitation development. Thus, there are opportunities to improve performance in certain geographic regions or in certain specific indicators.

Overall, our results indicate progress in the sustainable development of water and sanitation in Romania, but also the need for continued efforts to achieve the sustainable development goals set by the UN. Our study provides a useful database and relevant information for decision-making at the public policy level and the efficient management of water resources in Romania.

In conclusion, the data analysis shows that the water and sanitation infrastructure has seen significant improvements in recent years, with an increase in the degree of connection to networks, a reduction in water losses and an improvement in financial sustainability. However, there are also persistent challenges, such as blockages in the sewerage network and the continued need for infrastructure investment, which require attention and appropriate solutions in the planned future of the water and sanitation service.

It is important to promote collaboration between regional operators and local authorities, as well as the active involvement of local communities in the process of sustainable development of water and sewage services, to ensure an integrated and participatory approach to problems in this field, to have a management of water resources and not just "simple" water management.

Our study provided a detailed picture of the current state of sustainable development in the field of water and sanitation in Romania, highlighting both the progress made and the existing challenges. The implementation of our recommendations could contribute to improving the performance of regional operators and ensuring sustainable and quality access to water and sewage services for all citizens of Romania.

It is important to note that the evolution of these indicators can be influenced by a number of factors, including infrastructure investments, water resources management policies, demographic and economic changes, as well as technical and technological aspects. The detailed analysis of these indicators and the identification of long-term trends can provide valuable information for optimizing the management of water and sanitation services and improving their quality.

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