THE PERFORMANCE MEASUREMENT OF WATER AND SEWERAGE OPERATORS IN ROMANIA THROUGH THE KEY PERFORMANCE INDEX

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Abstract
Both local communities and the government face a real challenge in measuring and improving the performance of water services. At the local, central, and European level, ensuring the population's access to drinking water and sewage services is an extremely important objective, supported by the significant investments recently made in this sector. The improved performance of businesses in this sector plays a crucial role in achieving this primary objective. Between 2005 and 2010, as a first step in streamlining the activity in this sector, regional water and wastewater operators were established, providing services for the majority of the Romanian population. Although in theory this should have provided the advantage of an economy of scale, in reality it did not produce the expected results; unfortunately, most of these water and wastewater operators remained inefficient. This inefficiency has technical, economic, financial and organizational aspects, which can be monitored and improved with the help of certain key performance indicators. To guarantee access to water in good conditions and in the long term, it is crucial to improve the efficiency of the sector. The average price of drinking water has increased from 2.75 RON/m3 in 2014 to 5.99 RON/m3 in 2023, which means it has almost doubled. In this context, it is crucial to implement a performance measurement system to improve the efficiency and performance of water services. In this article, the authors identify and analyze the economic, financial and technical indicators that can be used as a basis of comparison for regional operators and can contribute to increasing performance. These indicators are designed in such a way as to eliminate the dysfunctions caused by the differences in size between the regional operators, and by creating a performance index suitable for water utilities, they make possible the adequate comparison of their performances.

Keywords
water utility performance, benchmarking system, key performance indicator, performance indicator

JEL Classification

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L95, Q25, M19

Introduction

"Climate changes and the recent population migration from villages to cities have led to an increase in water consumption. To cope with this increased consumption and to ensure an efficient and sustainable use of water resources, as stipulated by the Water Framework Directive (2000/60/EC) of the European Union, water and wastewater operators must become as efficient as possible" (Bakó and Fülöp, 2019).

As shown by the multitude of scientific articles published in the last five years on the topic of water issues in Europe (10,803 in the Web of Science database), and by the fact that the European Parliament and Council have deemed it necessary to reform the existing water directive by issuing the Directive (EU) 2020/2184, which refers to the quality of water intended for human consumption, the water industry is of strategic importance for the future of Europe.

Recent empirical studies carried out in Europe have shown that water utilities need to improve their efficiency (Bakó and Fülöp, 2019 after Berg and Marques, 2011). There are many reasons why water and wastewater operators might underperform. On the one hand, they may be influenced by internal factors, such as the poor management of human resources or equipment, poor planning of maintenance and investment activities, or a lack of innovation and adaptation to new technologies. On the other hand, an inadequate economic policy, such as a low level of investment in infrastructure, for example the maintenance of low (populist) tariffs that do not cover the costs of drinking water production and wastewater treatment, can affect the performance of these utilities (Soppe, Janson, and Piantini, 2018).

In this context, it is important that the authorities take measures to increase the efficiency of water and wastewater operators by increasing public funding for infrastructure investments, improving the legislative and regulatory framework, increasing the transparency and accountability of water and wastewater operators, as well as promoting innovation and the exchange of good practices between operators.

The increase of water tariffs in the last 8 years, reaching levels that greatly exceed the Consumer Price Index (according to Fig. 1), calls for an analysis of this evolution. There are several aspects that can explain the difference between the two indicators.

A first factor can be related to the investments made by water and wastewater operators from EU funds, the state budget and own funds, which have created industrial capacities that comply with the commitments made by Romania upon joining the European Union, but are not in accordance with the unwillingness of rural residents to connect their households to these networks (they are satisfied with their own water wells from which they can procure water free of charge, and are not willing to pay for sewage services, preferring to use their own inadequate septic tanks), a situation which has led to increased expenses and a lack of income generated by the services provided. Another factor that may lead to the widening of the gap between the two indicators (WPI and CPI) is the increasing inefficiency of water and wastewater operators due to factors other than inefficient investments.

Furthermore, a trend towards sector consolidation can have an impact on water tariffs, as less competition can lead to higher prices. In addition, the outdated regulations governing this field, such as those related to the regulation of water tariffs, can contribute to the increase of tariffs.

To analyze these issues in more depth, it is important to examine the available data and perform a comparative assessment between different water and wastewater operators, which can help identify solutions to improve their performance and ensure a balance between water tariffs and consumer needs.

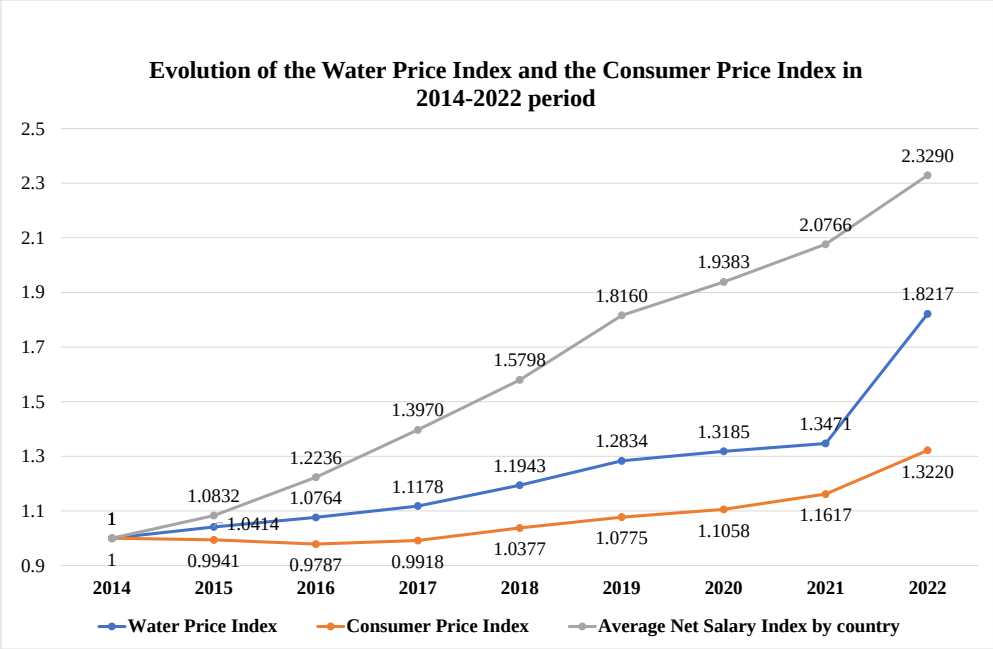

Figure no 1. Evolution of the Water Price Index and the Consumer Price Index in Romania between 2014 and 2022

Source: Own projection based on data from the National Institute of Statistics and the National Regulatory Authority for Community Services of Public Utilities

To find the explanations for the difference between the increase of the water tariff and the Consumer Price Index it is necessary to take a closer look at the performance of water and wastewater operators. Thus, both traditional and new indicators, specific to the water and wastewater industry, can be used to achieve a detailed and reliable overview.

Among the established indicators are ROA (Return on Assets), ROE (Return on Equity) and ROI (Return on Investment), which illustrate how water and wastewater operators are performing in terms of asset utilization, profit generation and return on investment.

On the other hand, to achieve a more in-depth analysis, new indicators can also be used, such as Rate of operating costs (without depreciation) per km of distribution network or EBITDA per km of distribution network. These indicators allow a comparison between the performance of water and wastewater operators, regardless of their geographical area or the size of the enterprise.

Following the analysis of the performance recorded by water and wastewater operators, the factors that have led to the increase of water tariffs and the exceeding of the Consumer Price Index can be identified. These factors can be related to the size of the investments made, the increase in the inefficiency of the operators, the sector's tendency towards consolidation or the outdated regulations in this field. Therefore, using a wide range of indicators ensures a complete overview of the performance of water and wastewater operators and helps identify solutions to improve efficiency and reduce tariffs.

1. Review of the scientific literature

Analyzing the specialized literature, it can be noticed that most authors suggest and use benchmarking systems with complex indicators to measure and improve the performance of water utilities, covering a wide range of aspects, including technical and financial ones (World Bank, 2015; IWA, 2016, Lambert et al. 2014, National Water Commission, 2012; Haider et al., 2015). When analyzing the performance of water utilities, one must consider the significant differences between this sector and other economic sectors. Firstly, the services provided by water utilities are indispensable and their absence could lead to serious consequences for the health and quality of life of the population. Secondly, there are ample opportunities for water utilities to achieve economies of scale, as unit costs decrease when production increases.

Moreover, the generation capacities of water utilities are often designed for peak demand, meaning that most of the time they are not used at full capacity. The assets used in the production and provision of water and wastewater services are of high value and not easily replaceable, given that they have a long useful life and are not easily transported (de Melo Baptista, J.F. (ed), 2014).

"Moreover, in Romania, the assets owned by the towns and communes that have delegated their operation to regional water and wastewater operators are only recorded in off-balance sheet accounts, at non-discounted values. Therefore, an analysis based on asset return rates does not provide relevant information on the economic performance of the water utilities" (Bakó and Fülöp, 2019). As such, when analyzing the performance of these utilities, one must consider all the specific characteristics and use evaluation methods that account for all technical and financial aspects relevant.

Although the financial indicators ROA, Economic Value Added (EVA) and weighted average cost of capital (WACC) are generally used to evaluate the performance of companies in different sectors, they are not suitable for evaluating the specific performance of the water and wastewater sector.

Considering the specifics of the sector, specialists of the World Bank Group (2015) proposed the use of an indicator called WUPI for monitoring the performance of water and wastewater operators. This indicator is complex and includes 10 different criteria for analyzing the performance of water and wastewater operators against the best practices in the sector. Performance is calculated based on the distance between the indicator value within the water and wastewater company and the model's minimum and maximum threshold values.

WUPI has the following structure:

Table no. 1. WUPI indicators, Units, and Bounds

N°		Indicators	Water indicators	Wastewater indicators	Unit	Higher bound	Lower bound
I1	Coverage	Water coverage	X		%	100%	0%
I2		Sewerage coverage		X	%	100%	0%
I3		Wastewater treatment coverage		X	%	100%	0%
I4	Quality of Service	Continuity of service	X		hours/day	24 hours	0 hour
I5		Sewerage blockages		X	#/km	0.1	20
I6	Management efficiency	Metering	X		%	100%	0%
I7		Nonrevenue water	X		m^3/km/day	3	80
I8		Staffing level	X	X	#/1.000 water & wastewater population served	1	5
I9		Collection ratio	X	X	%	100%	0%
I10		Operating cost coverage	X	X	%	180%	50%

Source: World Bank, (2015), Water and Wastewater Services in the Danube Region: A State of the Sector, Washington, DC, p.106

The WUPI indicator is an indicator of good practices, as can be seen from table no. 2.

Table no.2. WUPI indicators definition

No.	Indicator	Definition	Unit
I1	Water coverage	Population with access to water services (either with direct service connection or within reach of a public water point) as a percentage of the total population under utility's nominal responsibility	%
I2	Sewerage coverage	Population with sewerage services (direct service connection) as a percentage of the total population under utility's notional responsibility	%

No.	Indicator	Definition	Unit
I3	Wastewater treatment coverage	[[(Wastewater treated w/primary treatment)/2 + Wastewater treated w/ secondary treatment]/Total Wastewater volume collected] x (Population under responsibility of the utility with sewerage services through house connections/Total population under notional responsibility of the utility for sewerage,	%
I4	Continuity of service	Average hours of service per day for water supply	Hours/day
I5	Sewerage blockage	Total number of blockages per year expressed per km of sewers	#//km
I6	Metering level	Total number of connections with operating meter/total number of connections	%
I7	Nonrevenue water	Volume of water "lost" per km of water network per day	m^3/km/day
I8	Staffing level	Total number of staff expressed as per 1.000 people served	#/1.000 water & wastewater population served
I9	Collection ratio	Cash income/Billed revenue	%
I10	Operating cost coverage	Total annual operational revenues/Total annual operating costs	%

Source: World Bank, (2015), Water and Wastewater Services in the Danube Region: A State of the Sector, Washington, DC, p.107

In conclusion, ROA, EVA and WACC can be limited in evaluating the performance of regional water and wastewater operators in Romania due to the specifics of the sector and the non-discounted value of assets. The WUPI indicator, however, is a more appropriate and complex option to evaluate the performance of these operators and compare them with the best practices in the sector.

To compare businesses in different countries, one must constrain geographical differences, the number and nature of customers and services, capital structure and tariff regulation (Abbott and Cohen, 2009). The performance of water utilities can be assessed from the perspective of strategic, organizational, human, financial, technical, and commercial resources (Soppe, Nils and Piantini, 2018).

In many articles, researchers have tried to prove that performance is influenced by the nature of the capital, public or private, but studies conducted in the United States of America (Bruggink, 1982; Feigenbaum and Teeples, 1983; Teeples and Glyer, 1987; Bhattacharyya et al. , 1995), in the UK (Shaoul, 1997; Saal and Parker, 2001; Bakker, 2003) and in France have shown that the performance and efficiency of water utilities is more influenced by the applicable regulations and the existence of a well-designed system of benchmarking, rather than the nature of capital (Ménard and Saussier, 2000).

By reviewing the benchmarking models developed by IBNET, IWA, the World Bank, and others, it was found that these models are limited in addressing the issue of comparing performance between water utilities of different sizes and pertaining to different geographic areas (Bakó and Fülöp, 2019).

Alegre et al. (2017), Soppe, Nils and Piantini (2018) and Corton and Berg (2007) proposed new indicators for monitoring the performance of water and wastewater operators by supplementing the models with indicators such as: "Revenue per cubic meter of water sold", "Other income ratio of total income", EBITDA, debt coverage ratio, investment financing ratio over the next three or five years and operating cost per branch (Bakó and Fülöp, 2019). The motivation to carry out this study arose from the belief that the models obtained in this manner can still be perfected and that there is a need to adapt the World Bank model to Romania's specific conditions and use it as a benchmarking model in our country.

To improve the performance of water utilities it is essential that the national benchmarking system is well established. Without such a system, policy makers cannot set reasonable targets for the future and improve the performance of the water sector. As such, it is important for central or local governments to consider such a system when planning and implementing water policies.

2. Research methodology

The present research is based on the analysis of specialized literature and the case study, using comparative analysis as the research method. The study compares the performance data of the Romanian Water Utilities by time and place, while its conclusions are based on a critical and interpretative analysis. A case study was prepared to support the information set out in the conclusions

3. Result and discussions

The case study was conducted by using a database that includes 43 regional operators in Romania, covering the entire territory of the country, in the period 2014-2021. In this context, the WUPI (Water Utility Performance Index) presented above was adapted to the specific conditions in Romania. This adjustment was made relying on the data available in the database and the authors' experience in the field.

Given that there is no available data on sewage and untreated wastewater (variable I3), this variable was removed from the benchmarking formula. As for variable I4, the initial variable was removed and another similar variable was included in its place (to cover a factual situation more frequently occurring in Romania). Since the vast majority of the population served by the regional operators has access to drinking water 24 hours a day, the I4 variable is not monitored as a benchmarking indicator. The new I4 variable introduced is defined according to the number of complaints received by regional operators regarding their water supply activity, so as to include complaints related to water pressure, water continuity, water quality and water supply interruptions, which may be considered similar to the previous I4 variable.

It is important to mention that this modification of the WUPI must be correlated with the specifics of the situation in Romania, such as population density and the length of the distribution networks in the operating areas. These adaptations should help improve the performance of water operators and allow decision makers to set realistic goals for the Romanian water sector. The new defined variables can be found in table no. 3.

Table no.3. New indicators

No.	Indicator	Definition	Unit
I4	Continuity and quality of water service	Total number of complaints per year, expressed in correlation with the length of the water network	No./Km
I9	Collection period	Liabilities/Billed revenue*365	No. days

Source: Own elaboration

The I9 variable in the original model, which refers to the collection rate, was replaced with a variable with similar content that more accurately reflects the management of trade receivables.

Considering the analyzes carried out in this study and those found in the specialized literature, to improve the performance of the study's benchmarking model, two financial indicators were also added: Rate of operating costs (without depreciation) per km of distribution network and EBITDA per km of distribution network (Bakó and Fülöp, 2019).

The adapted WUPI model is presented in Table no. 4.

Table no.4. Modified WUPI model

N°		Indicators	Water indicators	Wastewater indicators	Unit	Higher bound	Lower bound
I1	Coverage	Water coverage	X		%	100%	0%
I2		Sewerage coverage		X	%	100%	0%
I3	Quality of Service	Continuity of service	X		#/km	0.1	10
I4		Sewerage blockages		X	#/km	0.1	20
I5	Management efficiency	Metering	X		%	100%	0%
I6		Nonrevenue water	X		m^3/km/day	3	80
I7		Staffing level	X	X	#/1.000 water & wastewater population served	1	5
I8		Collection period	X	X	no. of day	25 days	275 days

N°		Indicators	Water indicators	Wastewater indicators	Unit	Higher bound	Lower bound
I9		Operating cost coverage	X	X	%	180%	50%
I10		Operating costs (without depreciation) per	X	X	lei/km	10.000	100.000
I11		EBITDA per km of distribution network	X	X	RON/km	7.000	2.000

Source: World Bank (2015) + own development

In the case of the developed model, each element has the same weight of 6.67% in the final value of the WUPI score.

Table no.5 presents data on the performance of water and sewage operators in Romania in the period 2014-2021. Analyzing it, one can see that, in general, their performance has not undergone significant changes during this period. Specifically, the average WUPI value increased slightly, from 72.27 points in 2014 to 73.37 points in 2021.

It is interesting to note that although there are fluctuations in the minimum and maximum values of the indicator in certain years, they are not very large and do not have a significant impact on the overall performance of water and sanitation operators. Specifically, the minimum values were between 52.74 and 63.81 points, while the maximum values werebetween 84.54 and 93.03 points.

Table no.5. The evolution of the WUPI score for water and wastewater operators in Romania for the period 2014-2021

Year	Average	Minim	Maxim
2014	72.27	60.34	84.54
2015	74.39	52.74	93.03
2016	74.85	63.81	89.03
2017	72.19	61.59	83.39
2018	70.41	53.77	88.37
2019	72.50	54.86	86.67
2020	73.15	62.11	85.97
2021	73.37	60.36	85.76

Source: own elaboration

A detailed analysis leads to the following observations: regarding the evolution of indicator I1 (annex no.1), a gradual increase in water coverage is observed, the percentage rising from 80.73% in 2014 to 84.00% in 2021. However, the variation of this percentage is quite high, with minimum values of 27.71% in 2015 and 51.27% in 2021 and maximum values of 100.51% in 2014 and 98.81% in 2021. It can be

concluded that, in general, water coverage has increased, but there are also significant differences between years. Regarding the WUPI score generated by I1, it has increased from 5.38 in 2014 to 5.60 in 2021, indicating an overall improvement of the I1-related performance.

The values of the I2 indicator have registered a constant increase from 2014 to 2021. In 2014, the average sewerage service coverage was 62.93%, and in 2021 it reached 65.03%. Furthermore, the minimum and maximum values for this indicator varied between 29.95% and 32.34%, and between 94.03% and 100% respectively, thus indicating a rather important fluctuation from operator to operator.

Concerning the evolution of the indicator I7a regarding the staffing level for water services per thousand inhabitants, a downward trend is observed in the period 2014-2021. In detail, staffing level for water services decreased from 1.84 in 2014 to 1.49 in 2021. Also, the minimum values increased from 0.70 in 2014 to 0.88 in 2021, while the maximum values of this indicator decreased from 3.67 in 2014 to 2.77 in 2021. The WUPI score corresponding to this indicator varies from 5.26 in 2014 to 5.85 in 2021, indicating a relatively stable and good performance in terms of staffing levels for water services, despite its decrease over time.

In the case of indicator I8 - Debt collection period (number of days) the data shows that the average debt collection period decreased from 77 days in 2014 to 62 days in 2021, with a significant decrease between 2018 and 2019. Furthermore, the minimum and maximum values for the collection period fluctuated significantly from year to year, indicating a variable level of efficiency in the collection process.

However, the WUPI score for this indicator has remained relatively constant at around 5.5, indicating an average efficiency of the debt collection process. Therefore, additional analysis may be necessary to identify and address any potential problems in the collection process that could be responsible for the increase of the debt collection period and for the significant fluctuations of the minimum and maximum values in the table (annex no.1).

The values of the indicator I9a refer to the coverage of operating costs for water services. The values in the table (annex no.1) show that, in general, the average operating cost coverage has decreased over the years, reaching 1.04 in 2021. However, the minimum and maximum values for this indicator vary significantly, which suggests a wide variation in the financial performance of water service providers.

On the other hand, the WUPI score related to this indicator has remained relatively constant around the value of 2.8-2.9 throughout the analyzed period. This suggests that although water service providers had different financial performances, the efficiency and quality of services provided remained relatively constant.

The values of indicator I10a represent the operating costs (without depreciation) per km of water distribution network. A slight increase in the average value can be seen between 2014 and 2021. Also, the minimum and maximum values vary significantly from year to year, suggesting that there are significant differences in operating costs per

km of water distribution network between different regions or water companies. In general, the WUPI score for this indicator is relatively low, around 4.5-4.8, which indicates that there is still room for improvement in the operational cost efficiency of water distribution networks.

The indicator I11a, EBITDA per km of water distribution network, measures the profitability of a water company in relation to the length of its distribution network.

Analyzing the data in the table, we can see that the average values of the indicator vary between 4,197 RON/km and 5,796 RON/km, the minimum values vary between 2 RON/km and 844 RON/km, and the maximum values vary between 10,845 RON/km and 16,450 RON/km. It can be seen that, in general, the average and maximum values have decreased since 2016, except for the years 2019 and 2021, while the minimum values have fluctuated over the years.

The WUPI score generated by this indicator varies between 3.12 and 4.06, with an average value of 3.60. Also, an increasing trend of the WUPI score can be observed in the years 2016 and 2019, with fluctuations in the other years of the study period.

Table no.6. Correlation between WUPI and the operational result

		Operational result
WUPI	Pearson Correlation	.340**
	Sig. (2-tailed)	0.000
	N	287

**. Correlation is significant at the 0.01 level (2-tailed).

Source: own elaboration with SPSS

Analyzing whether there is a correlation between the WUPI score obtained and the operating result the following results emerged: the Pearson correlation coefficient between the two variables (Table no.6) shows a moderate positive correlation (r = 0.340), which means that there is a direct link between the operating result and the WUPI score obtained by the water and wastewater operators in Romania. Also, the p-value (0.000) suggests that this correlation is statistically significant, meaning that this relationship is unlikely to have occurred by chance. This correlation demonstrates that the indicators chosen in the WUPI model essentially influence the results obtained by a water utility.

Conclusions

Analyzing the performance of water and wastewater operators, it can be noted that it has not undergone significant changes during the analyzed period. Although there have been fluctuations in the minimum and maximum values of the indicators, they did not have a significant impact on the overall performance at the level of the water sector. In terms of water coverage, it has steadily increased from 80.73% in 2014 to 84.00% in 2021, but with significant variations between years. Also, sewer service coverage increased from 62.93% in 2014 to 65.03% in 2021, but with significant fluctuations between operators.

Staffing levels for water services have steadily declined from 1.84 in 2014 to 1.49 in 2021, but overall performance has remained relatively stable. The average debt collection period has decreased significantly from 77 days in 2014 to 62 days in 2021, but significant fluctuations in the minimum and maximum values indicate a variable level of efficiency in the collection process. The WUPI score at sector level remained relatively constant for all indicators, suggesting the average performance of water and wastewater operators.

The robustness of the WUPI indicator is further underlined by the significant correlation it has with the operating result.

Indicators used in the model include key elements such as coverage of water and sewerage service, continuity of water service, blockages in sewerage service, measurement of sold water and unbilled water (water losses) and coverage of operational expenses, a model that in the future can be supplemented by other factors such as the regional and economic characteristics of the area served, the availability and accessibility of water resources, and other regulatory and environmental issues.

Additionally, for a more comprehensive assessment of the performance of water and wastewater operators, it may be useful to compose a set of indicators that also reflects other key aspects such as energy efficiency, water quality, sustainability, innovation and social engagement, and community.

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