

CONCERNS AND CHALLENGES ON WASTEWATER TREATMENT CAPACITIES DEVELOPMENT IN ROMANIA

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ABSTRACT

Our previous research has highlighted the importance and the problems of the development for the environmental infrastructure, namely of the Romanian water and wastewater networks, in order to attract and capitalize the allocated European funds. Therefore, in the present paper we deal these aspects from a more synthetic and historical outlook. In Romania, one of the most obvious characteristics concerning the general situation of the environment refers to the striking deficiencies in the environmental infrastructure, especially in the field of wastewater in urban areas and water supply and sewerage in rural areas. Nevertheless, historical and conceptual issues in the paper analyse how, despite its current development lag, in Romania, the concern for implementing and developing of wastewater treatment technology began over a hundred years ago. Thus, the objective of the research is to highlight and analyse some economic concerns and challenges of developing the wastewater infrastructure in Romania, in view of environmental protection and sustainable development. As a methodology, the accumulations and the results from the literature and from previous own research, comparative analysis, own data processing and graphics on infrastructure for water protection through Wastewater Treatment Plants (WWTP) will be employed. The conclusions and recommendations refer to the main causes and objectives of the current and historical deficiencies regarding the development of the Romanian wastewater treatment capacities and the due investment for complying with the Urban Wastewater Treatment Directive (UWWTD) in Romania.

Keywords: *sustainable development; investments; infrastructure; Wastewater Treatment Plants (WWTP); Urban Wastewater Treatment Directive*

JEL Classification: *L95, L25, H54*

1. Introduction

In this paper we have resumed our research endeavours dedicated to the topic of environmental infrastructure development issues, in particular the one for water and waste water, from the conceptual and historical outlook enabled in Romania by the Centennial national study.

Therefore, the paper is part of the research project "*Effectiveness of investments in the development of water and waste water infrastructure in Romania*" aiming to evaluate, from a regional and historical perspective, the size and efficiency of the development in water and wastewater infrastructure in Romania, as well as the investment effort requested for a sustainable socio-economic development.

Usually, public investment related to development of infrastructure and provision of public goods can be complementary and not competing private investment. Public investments of this nature enhance opportunities for private capital and increase the productivity as well as the demand for private sector production and related ancillary services through the expansion of aggregate economic activity and saving. Therefore, one can state that the marginal productivity of capital (investment) of the private sector reflects also the rate of public sector infrastructure investment. [5]

The focus of this study is on the urge to develop the wastewater collecting and treatment capacities in Romania, since the poor level of development of water supply and sanitation

networks, especially of the wastewater sewerage and treatment facilities, and hence the relatively low access of the population to these public infrastructure services: nationally, only 67% of the total population is connected to public water supply (only 33.5% of the rural population) while less than 50% is connected to wastewater collecting systems and wastewater treatment, with some regional variations, even nowadays [10]

This is why the development of the wastewater networks and wastewater treatment plants are still high on the list of strategical socio-economic development issues in Romania. There is a more and more urgent need to comply with the European Water Framework Directive 2000/60/EC and the most significant trends as identified in a previous study [6]:

- A sustainable use of water resources;
- The shift from water supply management towards demand management.

Besides, the trend of reclaiming the wastewaters, reusing and adding value to the water utilities is more and more requested at present by the implementing of a green, resource-efficient and circular economy in the European Union.

As analysed in previous recent research, the strategic approach "Towards a Circular Economy" further promotes a fundamental transition in the EU, away from a linear economy for resources to be not simply extracted, used and thrown away, but put back in the loop so they can stay in use for longer. [4]

The conclusion is dedicated to the past, present and permanent importance of the water and wastewater infrastructure for a strong economic growth and a sustainable development of the national economy of Romania.

Whether this development urge was driven, a 100 year ago, by the need to fight the terrible epidemics and misery of the developing cities, by some active and progress seeking municipalities such as Sibiu, or lately driven by the current modern need to protect the environment, to fight the climate change and to provide for a green economy and a sustainable development, these concerns and challenges should be acknowledged and treated properly by all the involved parties and decision-makers.

2. Background and Historical Aspects of Wastewater Treatment in Romania

Although the economic, environmental and social importance of the water and wastewater infrastructure was highlighted in [5]-[6], there is still urge to acknowledge here the role of the wastewater treatment.

The wastewater infrastructure is considered an important part of the water infrastructure, since it has a multiple utility through its functions. The main functions of the wastewater collection and treatment facilities, which will be analysed and detailed in the following are those of:

- a shield for human health protection;
- conserving water as an ecosystem;
- preserving water resources in a quality usable by humans.

We remember first, some of the most important issues concerning the key role of water supply and sewage sanitation (WSS) networks and wastewater treatment plants (WWTP), for the environmental protection and sustainable development.

Decrease and degradation of the water resource, coupled with an increasing interest for hygiene and public health, currently attracts attention over networks and sewerage service. The existence of a coherent system of sewage and sanitation actually determines the quality of the natural environment and life. Sewer and sewage treatment services consist of complex and expensive tasks, but are essential to protect the environment and our health.

The effective management of sanitation service contributes directly to improving the quality of human life. It is not exaggerated the assertion that access to sanitation = access to health.

The existence of a viable system of sewerage and sanitation effectively impacts on:

- the local economic and social development;
- protecting natural resources and
- the fight against diseases related to unsanitary living conditions.

Following the sewage, the wastewater treatment is a very important component of water management, although of lower interest for the general public. There are major risks to the population if the sewage system does not provide sufficient coverage, presents cracks or is undersized. Groundwater aquifers are primarily affected and here one can imagine the further negative effects on animals and plants, in households and cultivated land, and, last but not least, on the entire nature.

So after the waste waters are captured in the sewage system, the next step in water management is treating the sewage in wastewater treatment plants. Here, the toxic substances are neutralized and decanted with the help of very complex equipment, machinery, chemical and physical processes, resulting in a clean water that can be spilled in natural receptors without affecting the environment.

In the following, historical and conceptual issues analyse how, despite its current development lag, in Romania, the concern for implementing and developing of wastewater treatment technology began over a hundred years ago [1].

Table no. 1 Situation of the Romanian urban population in the second half of the 19th century - beginning of the 20th century, before the Great Union (of December 1st, 1918)

City	Urban population (Number of inhabitants)		
	1859	1914	Rate of growth (%)
București	121734	276178	126,87
Brăila	15767	56330	257,26
Buzău	9027	21877	142,35
Bacău	8972	16378	82,54
Craiova	21521	45579	111,78
Iași	65645	77759	18,45
Ploiești	26468	45107	70,42
Pitești	7299	19753	170,62

Source: Own processing of data from table 1, Romaqua nr.2/2018

Among the main premises for improving the sanitation of cities has been the one of an effective elimination of many types of wastewaters. Although in most cities there were street wastewater collection facilities, they were not designed to manage the amount of wastewater produced in the cities of the late nineteenth century. Thus, it has become necessary to build sanitation systems.

An incipient sanitation sewerage system was built in Bucharest in 1828, but the general introduction of the sewerage systems in the most important Romanian cities began after 1878. Table no. 1 shows the evolution of the population in these main cities (generally a dramatic growth rate) while table no. 2 shows the construction dates of the first sewer systems in Romania.

Unfortunately, at the time no particular importance was given to the problem of sewage treatment, although Romanians, as well as citizens of other European countries, were confronted with epidemics caused by poor water hygiene (or even lack of hygiene).

However, as stated in the same speciality study, the Romanian authorities had a timid attempt at regulating the water management at the end of the 19th century. Therefore, in that incipient phase even at European level, the wastewater treatment has also been echoed in the large urban agglomerations in Romania.

As an example, Sibiu was one of the first cities in Romania with a sewerage system connected to the wastewater treatment plant, and since 1908, the sewerage and wastewater treatment plant continued to grow in the city's rhythm.

The city Sibiu can also be proud that it was one of the first cities in Romania with a sewerage system connected to the wastewater treatment plant. Beginning with 1908, the sewerage and wastewater treatment plant of the city continued to grow in the city's rhythm of growth. Without any doubt, Sibiu was among the first cities in Romania with a complete system for collecting, treatment and distribution of drinking water, as well as for the collection and treatment of waste water. Besides, early in 1968 began the construction of the new wastewater treatment plant of Sibiu, located on the territory of Șelimbăr commune, and the works were completed in 1970, the year in which it was put in function.

Table no. 2 presents the first municipal wastewater treatment plants. At the beginning, mechanical equipments such as grills, catcher grits, grease separators and primary clarifiers were used in those primary stage WWTP.

Table no. 2 **Examples of municipal wastewater treatment plants from Romania**

City	Date of inauguration	Method of treatment used
Sibiu	1908	Mechanical stage
Oradea	1910	Mechanical-biological stage
Târgu-Mureș	1911	Mechanical stage
Timișoara	1912	Mechanical stage
Buzău	1965	Mechanical stage
Baia Mare	1967	Mechanical stage
Iași	1968	Mechanical stage
Botoșani	1972	Mechanical stage
Bistrița-Năsăud	1974	Mechanical-biological stage
Cluj	1977	Mechanical-biological stage
Târgu-Jiu	1980	Mechanical-biological stage

Source: Own processing of data from table 3, Romaqua nr.2/2018

It can be noted from table 2 that the first municipal WWTP have been implemented in the cities of Transylvania becoming part of Romania only after the great Union (December 1st, 2018). Oradea had a WWTP with advanced technology of sewage secondary treatment (mechanical-biological stage) since 1910.

A strong relaunching in wastewater treatment while meeting the growing needs of underserved areas can be noticed in (socialist) Romania since the second half of the 1960s. The intense rhythm of industry development in the second half of the 60s and the first half of the 1970s, the process of modernizing agriculture, the continued growth of urbanization, and the living standards of the population, generated considerable pressure on the use of water, the water requirements could not be satisfied from the natural regime of the rivers, imposing the construction of dams, accumulation lakes, ducts and navigation channels.

In 1979, the first general regulations on domestic wastewater discharge issued target-values for parameter BOD₅ and COD (transposing national water and effluent quality standards from countries such as Bulgaria and Poland). [1]

Nevertheless, it was only after 1989 that the general purpose of wastewater treatment has changed from protecting human health to protecting the environment and water as an ecosystem.

Besides, it is interesting that the scarcity of water and wastewater infrastructure development in Romania has manifested and emphasized during the period of the socialist economy, since it was not adequate and sufficient for the industrial production capacity.

In support of this, in the study of (CSDES-ICCE-IES, 1988) there are documented and analysed some concrete examples of shortcomings or ecological accidents, fuelled by the lack or inadequacy of protection capacities of the environment and waters, in some important socialist industrial companies. [2]

It should be noted that, throughout the socialist economy of Romania, „in 1985, most environmental funding continued to be used for maintaining and improving the water quality. They accounted for 50.4% of the total investments for environmental protection ". Investments in the construction, development and modernization of waste water treatment plants (WWTP) recorded especially after 1965, a dynamic development.

In relation to the year 1965, investments for the wastewater treatment plants were in 1985, 7.7 times higher. Investment growth was differentiated on ministries and other central organs, to the advantage of strong polluting activities and with a lower degree of endowment with WWTP.

On the other hand, the granting through the plan of an enhanced volume of environmental investment, given that every year the failures to fulfil the plan were quite high, could not solve the problem of fitting the economic units with specific fixed assets. Consequently, the negative effects of pollution continued to persist in the socialist economy of Romania.

In 1985, the degree of implementation of the environmental investment plan was reported of 82.3%, but this was much lower than the investment plan in the national economy, which was of 87.3%. The biggest failures in terms of environmental protection investments were, in the last decade of the socialist economy in Romania, at the ministries and public areas with high environmental impact, namely the Ministry of chemical industry (MICH), Ministry of Light Industry (MIU) and Popular County Councils. [2]

Although it may be appreciated the fact that there were planned environmental investments in Romania, also in the period of Socialist centralised economy, there are some obvious drawbacks in terms of specific potential environmental and economic efficiency, as this environmental investment program was not correlated with the investment plan for economic development.

Always, the really high speed pace in the development of industry in the socialist economy exceeded that of environmental protection investments, so that pollution control facilities no longer coped with the parameters or new capacities of production; the degree of realization of the investment programme, was very low. Of the 63 environmental objectives scheduled for 1981-1985, only 36 (57%) had been executed, the rest being in progress or not even started at the end of that five-year period.

In addition, the mode of exploiting the existing wastewater treatment plant WWTP stations was not proper and complete in the Socialist Romania. Thus, according to the data from the study cited, from the about 4500 WWTP existing in 1985, a number of 400 (8.8%) have not worked at the design parameters, and 123 stations (2.7%) have not worked at all.

Furthermore, out of the total capacity of the wastewater treatment plant stations of 514 thousand m³/h in the year 1985, a rate of 46% of the capacity was exploited improperly in terms of performance and efficiency parameters. Due to these reasons, in 1982 there have been reported 179 cases of accidental water pollution, the majority (over 70%) having occurred in units belonging to the chemical, energy, and agri-food industries.

Hence, the case study shows that in the socialist economy, the waste water treatment was an activity integrated in the production of material goods, economic units being required to have sewage treatment plants and for water being set the main pollutants limit values permissible or the waste waters indicators of loading before their discharge into water courses.

The specifics of wastewater treatment in Socialist Romania was the fact that these investments and environmental protection activities were mainly in charge of the economic, industrial units and ministries, and they did not pay priority to investments and activities of environmental protection (water) that were often neglected and affected by focusing all resources and means for carrying out the plan.

Although, as we analyse or suggest further, in relation to the size and production capacity of the socialist economy, currently in Romania the industry and thus the amount of industrial pollutants is much narrower, however, the consumption society presented a strong trend of growth,

and with it, the use of increasingly more diverse and harder to neutralise, chemicals, in particular detergents.

3. Challenges and Outlooks of Developing the WWTP in Romania

Since Romania has become a European Union member state (2007) it must comply with the EU Directive 91/271/EC on waste water treatment by the end of 2018, involving huge investment costs of 8 billion Euro. Other current challenges and recent outlooks of the wastewater treatment capacities in Romania are further analysed in this section, as based on recent national and European reporting [3].

Although achieving the collection systems and waste water treatment plants is a task which requires significant financial resources, the benefits can be found both in the quality of water resources and of the aquatic environment and the increasing use value of this resources.

As shown by the “Romanian Waters” National Administration documents [11] water pollution caused by human congestion is mainly due to the following two factors:

1. A low rate of population connected to wastewater treatment and collection systems;
2. Improper operation of the wastewater treatment stations.

Unfortunately, these factors strongly act in Romania, especially the first one, since there is still a shortage of both development of sewer networks, of the capacity of the wastewater treatment plants WWTP but also a low rate of connection to these systems. This is bearing in mind that, in total, in the year 2017, a number of 9978 886 inhabitants had their homes connected to sewage systems, equivalent to only 50.8% of the resident population.

Even after Romania's accession to the EU and access to SCF (SOP Environment), the evolution and expansion of sewerage networks and wastewater treatment plants was slow and insufficient in Romania, as can be seen from table no.3 and the figure related below.

Table no. 3-**The rate of residents with dwellings connected to sewer systems, at national level in Romania**

	2008	2010	2017
The rate of residents with dwellings connected to sewer systems (%)	43	43,1	50,8
The rate of residents with dwellings not connected to sewer systems (%)	57	56,9	49,2

Source: Public utilities of local interest 2017, NIS, 2018

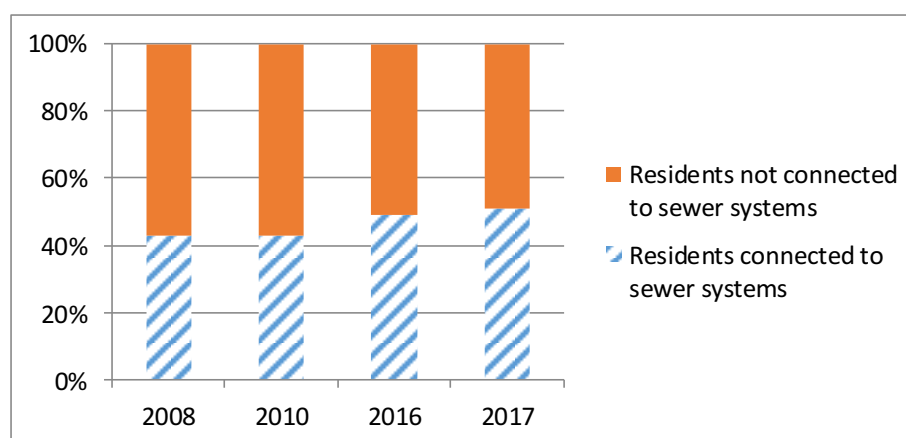


Figure no. 1 - **The rate of residents with dwellings connected to sewer systems,**

at the national level (%)

Population connected to public sewage systems equipped with sewage (wastewater) treatment plants has increased compared to the year 2016, with 294. 553 people. In total, 9710077 people, the equivalent of 49.4% of the resident population of the country was connected to the sewer systems equipped with wastewater treatment plant. [10]

It is noteworthy that, although in our opinion, progress with regard to the extension of sewer networks was very slow and there is an important gap yet between the networks of water supply and sewerage networks from Romania [5], in recent years they have been supplemented by WWTP, such that out of the total number of residents with dwellings connected to sewerage systems, at national level, 97.3% have access to a sewage system equipped with sewage treatment plants, meaning a development with sustainable character.

Progress has been made in developing the wastewater capacities and increasing their efficiency, since the process of regionalization of water/wastewater utilities is almost completed in Romania with Regional Operating Companies, since as analysed in previous research, by aggregating its regional utilities of water and waste water, to obtain economies of scale and purpose that lead to greater economic and financial, technical and managerial performance with regard to water management. [7]

The process of regionalization of the operators of water/wastewater utilities is nearly completed in Romania. Having created regional companies of water and sewage that represent suppliers of integrated services for WSS through the aggregation of the water and wastewater utilities, they should succeed in developing efficient, financially viable and autonomous integrated regional service providers able to plan and implement investments in line with EU policies and practices [6].

Also, from the point of view of environmental protection and ecological efficiency of the environmental investment, it is important that the national economy as a whole, after implementing the (European funded) Sectoral Operation Program Environment projects (2008-2015) in Romania, at the regional operators there was absolute and relative increase in the capacity of secondary and tertiary wastewater treatment plants.

Table No. 4 Structure of WWTP capacity (on stages)

	2008	2009	2010	2011	2012	2013	2014	2015
Total of primary stages	807	730	761	757	866	587	245	268
Total of secondary stages	295	295	375	396	427	500	518	523
Total of tertiary stages	19	31	41	48	50	85	63	73

Source: Own processing of data extracted from the DB on-line NIS [9]: PMI111A - Number of Wastewater treatment plant stages by type of plants

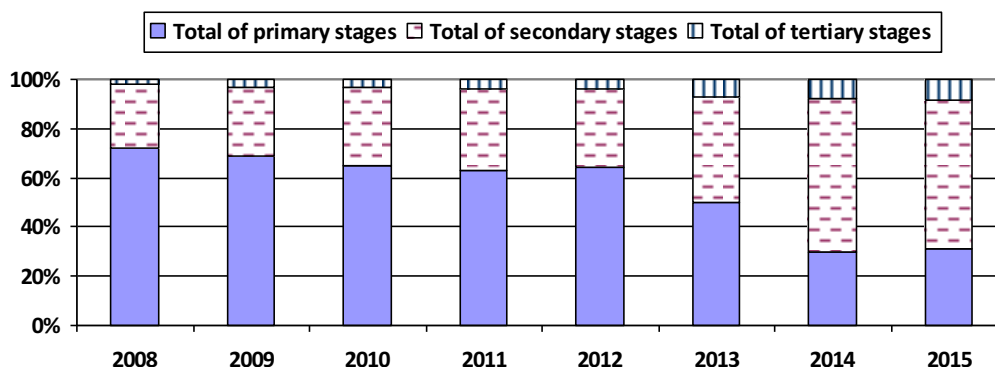


Fig.nr. 2 Structure of WWTP capacity (on stages)

It is a reality that, within the EU, the implementation of the UWWTD (Directive 91/271/EEC concerning urban waste water treatment) since its adoption in 1991 has, in particular, significantly reduced discharges of major pollutants such as organic load and nutrients, main drivers for eutrophication in waters.

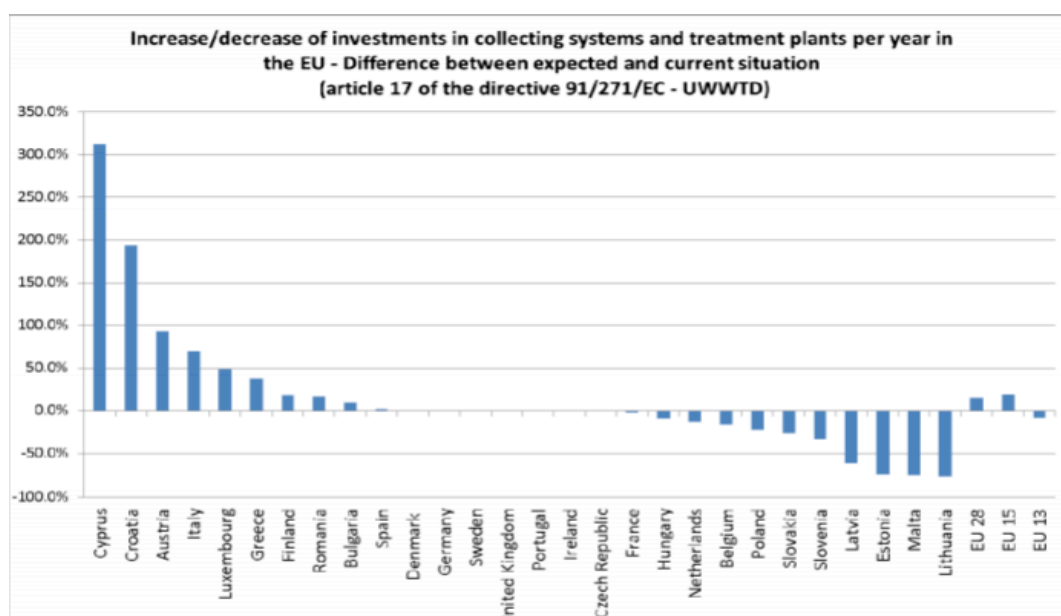
However, not only in Romania, the implementation of the UWWTD is still far from complete. Some of the Member States that joined the EU in 2004 or later face important compliance gaps. Implementation is challenging due to financial and planning aspects linked to the construction of waste water infrastructure [3].

As pointed out in (Frone S., Frone D.F., 2012), one of the threats faced in a strong, efficient and sustainable development of the WSS sector in Romania, especially during times of economic crisis, is the quite low propensity to pay of the population, reflected by the relatively high elasticity of water demand in relation to the price of water.[6]

Nevertheless, efforts to improve and maintain compliance with the UWWTD are essential, and must be continued. This is recognised by the 7th Environmental Action Programme, which states that, in order to protect, conserve and enhance the EU's natural capital by 2020, the impact of pressures on transitional, coastal and fresh water must be significantly reduced in line with the WFD's requirements (Water Framework Directive is the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy).

Therefore, in the period 2015-2018, in the Member States of the EU, about EUR 100 billion will be invested in infrastructure for sewage (wastewater) treatment. On average, this is an investment of almost EUR 25 billion per year according to the plan of implementation, while the value of this investment per capita for the years to come represents 50 EUR.

However trends vary between Member States: while, in some countries, investments will increase or remain stable, investment in other countries will decrease. For Romania, the natural tendency is to increase the estimated level of per capita investments in the water supply and sanitation infrastructure following economic growth and increase of the population connection to collection and wastewater treatment systems.



Source: Fig. nr.8 from (COM (2016) 105 final)

Fig. no.3 **Current versus expected yearly investments in urban waste water collecting systems and treatment plants, in the European Union**

It may be observed that in the figure (no.3) above, Romania is situated in the left group of States needing to increase their annual investment amount/capita for wastewater infrastructure (sewer systems-collection and waste water treatment plants).

Another aspect of economic efficiency of investments in the infrastructure of water supply and sanitation, worthy of being noted and analysed, is bound to the opportunity of creating jobs and promoting economic growth, through these investments for water-related services. Thus, the construction and operation of infrastructure to provide quality services related to waste water requires a great deal of investment and operation, which contributes in an important measure to the creation of jobs and economic growth, in the water sector.

Indeed, in study [5] based on regression analysis, there is evidence on the positive correlation between the increased access to wastewater infrastructure and the regional economic growth, proving the importance and opportunity of implementing the investments in water infrastructure in Romania, with European Structural and Cohesion funding.

The implication was that the development of sewerage (wastewater collecting) infrastructure and so an increase in the share of population connected to this service can lead to economic growth (GDP growth / capita) at the regional (county) level. The value of the elasticity coefficient (0.57177) however, is debatable, but it is certain that the coefficient is different from zero and positive, as shown by all statistical tests and probabilities attached to the estimated coefficients which validate the regression equation and the correlation shown.

The ultimate strategic implication is that development of sewerage and wastewater treatment infrastructure, combined with a rise in the share of the population connected to the service may result in economic growth (GDP/capita) at regional (county) level.

4. Conclusions

The research showed that in Romania there have been concerns on collecting and treating the wastewater in municipalities and enterprises, but the actual effectiveness in developing and using these wastewater utilities was often hindered by several specific historical, political and economic issues.

First we observe that in the Romanian principalities, concerns and technologies for water management have been relatively modest at first, due to the relatively low degree of urbanization of the 19th century. However, in the 20th century, after the Great Union and with the process modernization and industrialization, urban population increased rapidly and so the need for developed water supply and sanitation services.

On the other hand, in the socialist economy, the absence of appropriate wastewater treatment capacity correlated to the numerous production units, scattered throughout the territory and constantly developing in the socialist economy, was a particularly serious fact, with historic consequences, especially in areas where rivers displayed a pronounced degree of pollution, and in waters with lower quality classes.

On such rivers, as will be analysed and exemplified in future research, the location of a new economic objective or the development of existing production capacity without investing in WWTP, has resulted in a total degradation of the water for a certain portion of the river, so that negative effects spread downstream and that river became unsuitable for other water uses considered.

In the case of Romania, after the adhesion to the UE, large investments in consolidating and expanding water and sewer services were and are still required, as was the increase in efficiency of the water operators. Nevertheless, these WWT capacities will still have to grow in Romania, in order to fully comply with the European environmental acquis and to support a sustainable and green economic development.

There was made indeed a significant progress, related to the implementation of the UWWTD 91/271/EEC by the increasing, at national level, the capacity of the WWTP, particularly in the secondary and tertiary stages, as illustrated in this paper.

However, considering that Romania has declared its entire territory as a sensitive area, these capacities for wastewater treatment will need to grow, to fully comply with the directives of the European environmental acquis and to support a sustainable economic and ecological development.

As water is a quasi-public good, and currently in Romania, only a little over 50% of the population has access to the public utilities of water supply and sanitation (due to still insufficient water/waste water infrastructure development), an economic effective pricing policy for water/waste water services should reduce and prevent waste or loss of water supplied to the public while ensuring the further development and maintenance of the WSS networks and operators as well as increasing the rate of the population connected to the water and waste water utilities. [8]

In addition to current efforts for the development of networks and services of water supply and sanitation, for a sustainable development of the water sector, our national and European water policies need a mechanism to allocate water where it is most needed, and a financing mechanism to generate revenues and leverage additional sources of finance.

These issues shall be the subject of our further research and publications in the area of the sustainable water sector development in Romania.

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