

# THE IMPORTANCE OF AIR QUALITY MONITORING AND THE NEED TO IMPROVE AIR QUALITY MANAGEMENT IN LOCAL SELF-GOVERNMENT UNITS (LGUS) IN THE REPUBLIC OF SERBIA<sup>1</sup>

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## ABSTRACT

The paper will examine the economic impact of Local Self-Government Units (LGUs) on the improvement of air quality and environmental protection in cities and municipalities (one city and one municipality from each district, except Belgrade) in the Republic of Serbia. One of the factors affecting life in cities in the Republic of Serbia is air pollution, which can have a negative impact both on the health of residents living there, as well as on those who come for business or tourism. The subject of research in this paper is general data on air quality in LGUs (cities and municipalities) in the Republic of Serbia, as well as planning and the use of funds by competent LGU institutions for establishing and managing air quality. The aim of this paper is to examine whether the competent LGU authorities apply the planning and legislative framework as a basis for effective and efficient air quality management, implement measures and activities to improve air quality, and whether they collect and allocate funds for this purpose. A survey conducted on a sample of 49 LGUs has shown that most of them do not manage air quality adequately. The research has shown that LGUs insufficiently plan and allocate financial resources in their budgets for maintaining air quality. From the accounting perspective, financial resources that LGUs generate from environmental pollution charges and fees for environmental protection and improvement belong to the budget of the local self-government unit and are

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important in the planning and incurring expenses (costs) for air quality management.

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## 1. INTRODUCTION

Air pollution is one of the ten leading global risk factors for human health. This is a pressing issue in developed countries and, more recently, in developing countries (Aquino, De Lima, Do Nascimento, & Reis, 2018). Planning and allocating financial resources in the budgets of LGUs to air quality management is very important, primarily for improving air quality, but also for ensuring implementation of the prescribed legislation. Based on the legislation adopted in the Republic of Serbia, LGUs are obliged to establish networks of measuring points/stations, assess air quality, adopt an air quality management plan and an air quality monitoring program, and, if it is determined that the air quality falls into the third category, implement measures to reduce air pollution in order to achieve short-term compliance with permissible values and ensure long-term compliance with limit values. The paper will discuss revenue generated from environmental pollution charges and fees for environmental protection and improvement, as well as expenses incurred by implementing measures aimed at reducing air pollution and maintaining air quality.

The subject of the research presented in this paper is the interdependence of air quality in local self-government units (cities and municipalities) in the Republic of Serbia, as well as planning and the use of financial resources by the competent LGU institutions for the establishment and management of air quality. The objective of this paper is to examine whether competent LGU authorities apply the planning and legislative framework as a basis for effective and efficient air quality management, implement measures and activities to improve air quality, and whether they collect and allocate funds for this purpose. The paper additionally focuses on possible proposals for measures to improve air quality. In accordance with the defined subject and objective of the research, the following research questions have been drafted in the paper:

- 1) How does the implementation of the legislative and planning framework for air quality management by LGUs affect the maintenance of air quality?
- 2) How do the monitoring of air pollution levels and measures taken by LGUs to improve air quality affect the maintenance of air quality?
- 3) What is the impact of revenue generated from environmental pollution charges and fees for environmental protection and improvement on the expenditure incurred by maintaining air quality in LGUs?

The social contribution of this research lies in examining the operation of air quality management in the Republic of Serbia and the effects of the adopted methodology on the implementation and monitoring of air quality management. The scientific contribution of this research lies in accurate examination of the role of elements description, organisation, and operation of competent LGU institutions in monitoring and controlling air quality in the Republic of Serbia. Special attention will be given to air quality monitoring within local self-government units and their operation, as well as to expenses incurred by maintaining air quality.

The scientific toolkit used in this paper is a statistical methodology that includes statistical description and statistical analysis. The paper employs general scientific methods, as well as specific scientific methods and logical reasoning procedures. The specific data collection techniques used in this paper are measurement, case study, and survey. In order to determine whether the competent authorities conducted continuous control and monitoring of air pollution levels (air quality monitoring), data obtained through questionnaires were collected and analysed. Questionnaires related to the adopted air quality monitoring programs for the local network, the expenses incurred by monitoring, and the expenses incurred by implementing measures to reduce air pollution were sent to 49 LGUs.

## 2. LITERATURE REVIEW

Air pollution is defined as any atmospheric condition in which substances are present in concentrations high enough above their normal levels to produce a measurable effect on humans, animals, vegetation, or materials (Mina, Singh, & Chakrabarti, 2013). According to Bell & Treshow (2002), air pollutants are all substances in the air with the potential to cause harmful effects on humans, plants, animals, or cultural property.

The research conducted by Lapko, Panasiuk, Strulak-Wójcikiewicz, and Landowski (2020) showed that one of the detailed elements determining the attractiveness of an urban tourist destination is air quality, analysed through the emission of solid and gaseous pollutants. The level of air quality, as an element in assessing tourist appeal, determines the tourism competitiveness of an urban destination. Information about air quality in a city that is a travel destination can directly affect decisions on tourist travel, travel according to a specific itinerary, as well as travel cancellations.

Li, Wu, and Zhang (2021) conducted a study on the impact of air quality on the audit process and audit outcomes, observing samples from the Chinese

capital market in the period between 2013 and 2018. The results of this study show that client companies located in cities with poorer air quality experience shorter audit delays and lower audit quality. Furthermore, the analyses show that Big 4 auditors can mitigate the effect of air quality on audit delay and audit quality. This study provides a significant contribution to the new literature on behavioural finance by extending the research on ambient air pollution to the audit context and provides new insights into the determinants of audit delay and audit quality. Regardless of the auditing firm in question, its profitability as the sole motive and imperative in business must not be a priority at all costs (Jovković, Karapavlović, & Radojević, 2021).

Awareness of air quality among adults in the USA increases with the number of days with unhealthy air quality warnings. These findings enhance the understanding of the extent to which air quality warnings motivate people to take measures to protect their health amid poor air quality (Mirabelli, Ebel, & Damon, 2020). These experiences have been incorporated into the Air Quality Management Plan (AQMP). An Air Quality Management Plan describes the current situation and what could be done to ensure clean air in a city or region. It sets objectives and prescribes short-term and long-term policies and controls for improving air quality (Sivertsen & Bartonova, 2012).

Furthermore, numerous authors have examined the impact of air pollution in cities on financial markets. Levy and Yagil (2011) and Zhang, Jiang, and Guo (2017) establish a respective negative correlation between air pollution and stock returns in the USA and China. Meyer and Pagel (2017) indicate that poor air quality affects investors' trading behaviour, as they are less likely to log into their investment accounts and make trading decisions. Similarly, Wu, Hao, and Lu (2018) argue that air pollution induces pessimistic sentiment, leading to lower stock returns, liquidity, and volatility. In addition, Dong, Fisman, Wang, and Xu (2019) find a negative correlation between air pollution during analysts' corporate visits and their subsequent earnings forecasts. Analysts who are exposed to air pollution are less likely to issue timely forecasts compared to analysts who are not exposed to severe air pollution (Li, Luo, & Söderström, 2020).

The trend of increasing air pollution in cities persists, which should serve as a warning that the problem of air pollution must be addressed in the near future (Malinović-Milićević, Mihailović, Nikolić-Đorđić, & Jevtić, 2015). Renewable and alternative energy sources emerge as one of the solutions (Santangeli et al., 2016), and as for transportation, solutions include the use of bioenergy, hybrid and electric propulsion, as well as preventing the access of large transport vehicles into central urban areas (Taefi, Kreutzfeldt, Held, & Fink, 2016).

The legislative framework for air quality management consists of the Air Protection Law, the Environmental Protection Law, as well as numerous by-laws. The Air Protection Law defines three categories of air quality (Pejić, 2015), namely:

- Category I – clean or slightly polluted air, where limit values (LVs) are not exceeded for any pollutant;
- Category II – moderately polluted air, where limit values are exceeded for one or more pollutants, but the tolerance values (TVs) are not exceeded for any pollutant; and
- Category III – excessively polluted air, where tolerance values are exceeded for one or more pollutants.

In accordance with the Air Protection Law (Articles 14 and 15), the competence over the national air quality monitoring network at the level of the Republic of Serbia lies with the Environmental Protection Agency, whereas the competence over the local network of measuring points lies with the LGUs (city/municipality). Air quality is measured using assessment criteria in accordance with the Regulation on Air Quality Monitoring and Requirements (Article 14).

The purpose of air quality monitoring is to protect human health, determine the sources and levels of pollution, track the movement of air pollution, assess the vulnerability of specific locations, and identify critical situations for the purpose of public warning and determining protective measures (Arsenović, Đurić, Đurić, & Senić, 2016). Air quality monitoring is performed at the local, national, and global levels. In our country, numerous local communities monitor air quality (Arsenović et al., 2016). Monitoring results are compared with the relevant legislation, and adequate measures are taken accordingly, such as informing the public and providing recommendations for behaviour during air pollution episodes (Đurkić, Grujić, & Laušević, 2015). Results obtained from the air quality monitoring system, which serve as information for government authorities, local administration, and company management, are scarcely published in the scientific literature (Dimitrijević, Kostov, Tasić, & Milošević, 2008). For this reason, continuous monitoring and investing financial resources are important for air quality management.

According to the Environmental Protection Law, one of the basic principles of environmental protection is the ‘Polluter Pays’ Principle. A polluter pays a fee for environmental pollution when their activities cause or may cause environmental burden, i.e., if they produce, use, or market a raw material, semi-finished product, or product that contains substances harmful to the environment (Environmental Protection Law, Article 9). This Law stipulates that the polluter, in accordance

with relevant regulations, bears the total costs of measures undertaken to prevent and reduce pollution, which include the costs of environmental risk and costs of remedying damage caused to the environment. With the entry into force of the Law on Fees for the Use of Public Goods, provisions of Articles 85 and 87 of the Environmental Protection Law, which determine the fee for environmental pollution and the fee for environmental protection and improvement, ceased to be valid on January 1, 2019. The Law on Fees for the Use of Public Goods stipulates the types of fees for environmental pollution, as well as the fee for environmental protection and improvement (Articles 116 and 134). The fees for environmental pollution are: 1) a fee for emissions of SO<sub>2</sub>, NO<sub>2</sub>, particulate matter, and produced or disposed waste; 2) a fee for substances that deplete the ozone layer; and 3) a fee for plastic bags (Law on Fees for the Use of Public Goods, Article 116).

The party liable to pay the environmental pollution fee includes, inter alia, the producer, i.e. disposer of waste for facilities for which an integrated permit is issued. The allocation of revenue generated from the fees for environmental protection and improvement has changed compared to the provision in the Environmental Protection Law (Article 87, Paragraph 10), which stipulated that “funds obtained from the fee for environmental protection and improvement are to be used through the budgetary fund, specifically for environmental protection and improvement, all in accordance with the adopted programs for the use of the budget fund, i.e. local action and remediation plans”. Under the new provision of the Law on Fees for the Use of Public Goods (Article 139), the allocation of revenue generated from fees for environmental protection and improvement shall be as follows: “Revenue generated from fees for environmental protection and improvement belongs to the budget of the local self-government unit”.

### **3. MATERIALS AND METHODS**

The research conducted covers 49 LGUs, with the prepared questionnaire sent by email to 49 LGUs, of which 25 are cities and 24 are municipalities. The research was conducted in the second quarter of 2022. The response rate of respondents in the sample was 100%. The target group included district centres, which can be classified as more densely populated cities, as well as one municipality from each district, classified as less densely populated, except for the capital, which was considered a district centre. The sample units were examined based on the air pollution level, using the prescribed limit and tolerance values, as well as based on their status (city, municipality) and the budget-related size of the LGU.

The questionnaire was completed by the heads of environmental protection departments/services in the LGUs, that is, the first level of operations of the services responsible for air quality within the LGU. The questionnaire consists of 12 questions, which are organised into two main sections. At the beginning, through the first six questions, the LGUs provide basic information on air quality measurements and assessments, as well as the funds spent for this purpose. The second section of the questionnaire also contains six questions, which refer to the implementation of measures to reduce air pollution and funds spent for this purpose. Seven questions are designed as YES/NO questions, whereas the remaining five questions require elaborate responses and refer to revenue and expenditure.

Statistical analysis was performed using the SPSS software package, version 26.0. The mean and standard deviation were used to describe numerical variables, whereas frequencies were used to describe the categorical characteristics of the observations. To analyse differences between groups, the Kruskal-Wallis and Mann-Whitney U tests were used, according to the data obtained after testing the normality of data distribution using the One-Sample Kolmogorov-Smirnov test. In addition, the Chi-square ( $\chi^2$ ) test was used to compare categorical variables. The correlation between individual variables was examined using Spearman's rank correlation coefficient. Results were considered statistically significant if the p-value was less than 0.05.

#### **4. RESULTS AND DISCUSSIONS**

Based on responses obtained, it can be concluded that first-category air, i.e. clean or slightly polluted air, was identified in nine LGUs, all of which are cities. Third-category air, i.e. excessively polluted air, where tolerance values for one or more pollutants were exceeded, was identified in 13 LGUs (cities). Second-category air, i.e. moderately polluted air, was identified in one LGU (city), whereas one LGU (city) did not respond to this question. On the other hand, seven respondents among LGUs classified as municipalities responded to this question, of which five stated that first-category air was identified, whereas one LGU (municipality) reported second-category air and one reported third-category air. Eighteen (18) LGUs (municipalities) did not respond to this question in the questionnaire. Based on the responses, it can be concluded that LGUs having the status of a city, perform air quality measurements, even though the majority reported third-category air. On the other hand, 17 LGUs classified as municipalities did not respond to this question, which indicates that they do not conduct air quality measurements, as shown in Figure 1. Obtained results are presented in Figure 1.

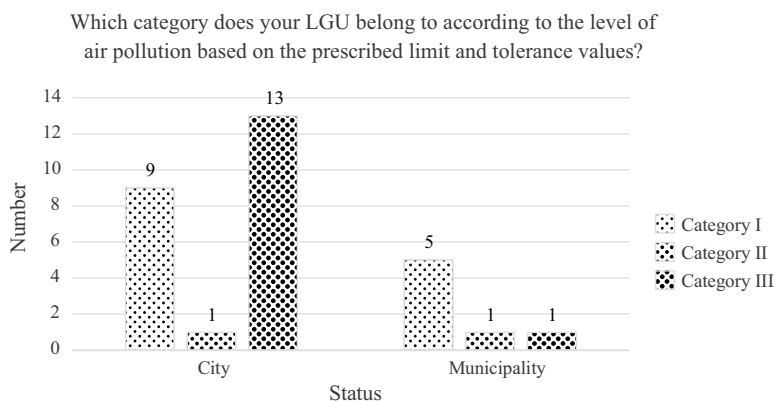


Figure 1: Air quality category by LGU

Source: Author's review

Furthermore, results have demonstrated that there is a statistically significant difference between cities and municipalities in terms of the frequency of positive and negative responses to the questions, except for those questions concerning the adoption of an Air Quality Plan in zones and agglomerations with third-category air quality for the years 2018, 2019, and 2020 (Table 1).

**Table 1:** Frequency of positive and negative responses to questions in relation to the status of LGU

Question	Status	Yes	No	Significance ( $\chi^2$ test value; $\phi$ value)
Did the LGU perform quality assessment in the period 2018–2020?	City	19/25	6/25	$^*p < 0.001^*$ (17.31; -0.594)
	Municipality	4/24	20/24	
Did the LGU, within its competence, provide air quality monitoring in the period 2018–2020?	City	22/25	3/25	$^*p < 0.001^*$ (22.33; -0.675)
	Municipality	19/24	5/24	
Has a local network of air quality measuring stations and/or monitoring points been established?	City	22/25	3/25	$^*p < 0.001^*$ (31.10; -0.797)
	Municipality	2/24	22/24	
Was an air quality monitoring program adopted for the local network for 2018?	City	21/25	4/25	$^*p < 0.001^*$ (24.12; -0.709)
	Municipality	3/23	20/23	
Was an air quality monitoring program adopted for the local network for 2019?	City	21/25	4/25	$^*p < 0.001^*$ (22.22; -0.673)
	Municipality	20/24	4/24	
Was an air quality monitoring program adopted for the local network for 2020?	City	20/25	5/25	$^*p < 0.001^*$ (24.53; -0.715)
	Municipality	2/23	21/23	
Are you implementing measures to reduce air pollution in the zone and/or agglomeration where third-category air quality has been determined?	City	13/21	8/21	$^*p < 0.001^*$ (14.07; -0.593)
	Municipality	1/19	18/19	

Question	Status	Yes	No	Significance ( $\chi^2$ test value; $\phi$ value)
Did you adopt an Air Quality Plan for 2018 if the air in the zones and agglomerations was classified in the third category?	City	7/18	11/18	<sup>a</sup> p=0.095
	Municipality	0/5	5/5	(2.80; -0.349)
Did you adopt an Air Quality Plan for 20198 if the air in the zones and agglomerations was classified in the third category?	City	4/19	15/19	<sup>a</sup> p=0.261
	Municipality	0/5	5/5	(1.26; -0.22)
Did you adopt an Air Quality Plan for 2020 if the air in the zones and agglomerations was classified in the third category?	City	2/15	13/15	<sup>a</sup> p=0.289
	Municipality	0/5	5/5	(0.741; -0.192)

a -  $\chi^2$  – test; \* statistical significance;

Source: Author's review

In the observed period from 2018 to 2020, air quality assessment was performed by 23 LGUs, of which 19 LGUs were cities and 4 LGUs were municipalities, whereas 26 LGUs did not perform air quality assessment, including 5 cities and 21 municipalities. However, air quality monitoring during the observed period was performed by 27 LGUs (22 cities and 5 municipalities), whereas 22 LGUs did not perform air quality monitoring (3 cities and 19 municipalities). It is important to emphasise that 24 LGUs have established a local network of air quality measuring stations and/or monitoring points (22 cities and 2 municipalities), whereas 25 LGUs have not established such a network, of which 22 are municipalities and 3 are cities. Establishing a network of monitoring points and/or stations requires significant financial resources, so municipalities with smaller budgets are unable to finance the supply of a monitoring station without state assistance. An Air Quality Plan in the zone and/or agglomeration, where third-category air quality has been determined, has been adopted by five LGUs which implement measures to reduce air pollution. On the other hand, 36 LGUs responded negatively, i.e. they have not adopted an Air Quality Plan. Additionally, 5 LGUs stated that the air belongs to the first category whereas 3 LGUs indicated that the air is in the second category. In their reasoning, provided next to the given answer, the majority indicated the lack of financial resources as the reason for not adopting an Air Quality Plan, as well as the fact that funds were not allocated in the LGU budget.

When it comes to the comparison of total revenue and expenditure according to the status of LGU (city or municipality), results have shown that there is a statistically significant difference between cities and municipalities with regard to all variables (Table 2).

**Table 2:** Total revenue-expenditure ratio according to the LGU status

Question	Status		Significance (Test value; z statistics; effect extent)
	City $\bar{X} \pm SD$	Municipality $\bar{X} \pm SD$	
Expenditure incurred for air quality monitoring in 2018	3,084,400.79 ± 5,774,972.91	156,714.38 ± 476,287,391	<sup>a</sup> p<0.001* (75.00; -4.79; 0.68)
Expenditure incurred for air quality monitoring in 2019	4,033,666.37 ± 6,636,842.63	151,057.71 ± 435,658.97	<sup>a</sup> p<0.001* (54.00; -5.19; 0.74)
Expenditure incurred for air quality monitoring in 2020	4,502,982.48 ± 7,517,514.12	142,605.00 ± 543,511.25	<sup>a</sup> p<0.001* (62.00; -5.16; 0.74)
Total expenditure incurred for implementing measures to reduce air pollution in 2018	37,172,677.83 ± 111,036,269.41	28,007.61 ± 100,446.85	<sup>a</sup> p=0.001* (162.50; -3.21; 0.46)
Total expenditure incurred for implementing measures to reduce air pollution in 2019	54,316,611.93 ± 161,166,308.11	33,901.09 ± 113,757.14	<sup>a</sup> p<0.001* (139.50; -3.64; 0.52)
Total expenditure incurred for implementing measures to reduce air pollution in 2020	52,244,218.38 ± 156,433,191.27	0.00 ± 0.00	<sup>a</sup> p<0.001* (126.50; -4.14; 0.60)
Total revenue generated from charges and fees in 2018	143,663,855.48 ± 243,773,679.28	12,322,465.8 ± 16,773,707.57	<sup>a</sup> p<0.001* (77.00; -4.46; 0.64)
Total revenue generated from charges and fees in 2019	113,276,629.70 ± 247,509,443.44	5,511,691.71 ± 7,102,691.74	<sup>a</sup> p<0.001* (100.00; -4.00; 0.57)
Total revenue generated from charges and fees in 2020	80,408,274.76 ± 135,111,861.34	5,435,693.48 ± 5,560,358.90	<sup>a</sup> p<0.001* (32.00; -5.36; 0.77)
Total expenditure incurred for environmental protection in 2018	128,432,542.31 ± 268,167,179.82	12,354,208.70 ± 13,146,376.83	<sup>a</sup> p<0.001* (98.00; -4.04; 0.58)
Total expenditure incurred for environmental protection in 2019	134,488,647.75 ± 261,809,809.76	21,558,324.26 ± 59,169,677.66	<sup>a</sup> p<0.001* (97.00; -4.06; 0.58)
Total expenditure incurred for environmental protection in 2020	127,238,859.77 ± 271,371,047.16	18,199,448.45 ± 44,852,778.60	<sup>a</sup> p<0.001* (106.00; -3.88; 0.55)

a – Mann – Whitney U test; \* statistical significance

Source: Author's review

The expenditure incurred for air quality monitoring and the total expenditure (costs) of implementing measures to reduce air pollution, in relation to the revenue generated from charges and fees (for environmental pollution and for environmental protection and improvement), for the observed period from 2018 to 2020, is not financially significant, as LGUs do not plan and allocate financial resources in their budgets specifically for air quality management, which affects the population living in cities and municipalities. The total expenditure incurred for environmental protection, in relation to the revenue generated from charges and fees (for environmental pollution and for environmental protection and improvement) for the observed period from 2018 to 2020, is not financially

significant, since financial resources are not planned and allocated in budgets on the basis of environmental protection, including the maintenance of air quality, even though LGUs generate revenue from the said charges and fees.

When it comes to revenue generated from various types of environmental protection charges and fees and expenditure and costs incurred for environmental protection related to monitoring and implementing measures to reduce air pollution, results show that there is a statistically significant difference between small, medium, and large LGUs (Table 3).

**Table 3:** Total revenue-expenditure ratio according to LGU budget size

Question	LGU size according to budget			Significance
	Small $\bar{X} \pm SD$	Medium $\bar{X} \pm SD$	Large $\bar{X} \pm SD$	
Expenditure incurred for air quality monitoring in 2018	30,692.86 ± 105,015.86	1,030,982.67 ± 1,155,328.91	6,166,892.68 ± 8,311,188,342	<sup>a</sup> p<0.001*
Expenditure incurred for air quality monitoring in 2019	37,147.62 ± 118,845.94	1,190,461.05 ± 1,060,237.02	8,225,864.54 ± 9,111,895.20	<sup>a</sup> p<0.001*
Expenditure incurred for air quality monitoring in 2020	37,593.38 ± 172,274.51	1,723,194.61 ± 1,788,345.61	8,419,011.81 ± 10,818,076.43	<sup>a</sup> p<0.001*
Total expenditure incurred for implementing measures to reduce air pollution in 2018	32,227.50 ± 107,502.13	3,051,141.24 ± 11,489,857.44	87,439,602.86 ± 167,190,435.77	<sup>a</sup> p=0.003*
Total expenditure incurred for implementing measures to reduce air pollution in 2019	39,005.00 ± 121,620.25	5,102,485.31 ± 12,921,867.21	126,607,018.76 ± 243,480,930.89	<sup>a</sup> p=0.014*
Total expenditure incurred for implementing measures to reduce air pollution in 2020	39,473.05 ± 176,528.85	6,181,763.28 ± 17,216,657.59	119,404,425.95 ± 237,404,255.45	<sup>a</sup> p=0.003*
Total revenue generated from charges and fees in 2018	9,954,684.94 ± 17,570,473.19	50,285,510.71 ± 64,749,808.60	277,314,798.92 ± 342,901,614.06	<sup>a</sup> p=0.006*
Total revenue generated from charges and fees in 2019	3,022,657.87 ± 4,114,542.28	23,909,119.94 ± 34,658,184.76	247,035,636.93 ± 357,683,145.30	<sup>a</sup> p=0.021*
Total revenue generated from charges and fees in 2020	3,579,491.78 ± 2,778,601.98	18,401,167.44 ± 8,993,918.99	173,427,317.12 ± 180,283,368.92	<sup>a</sup> p<0.001*
Total expenditure incurred for environmental protection in 2018	10,232,011.13 ± 11,088,169.04	41,924,725.49 ± 39,277,412.77	253,779,727.40 ± 399,913,158.87	<sup>a</sup> p<0.001*
Total expenditure incurred for environmental protection in 2019	22,824,703.43 ± 63,436,041.84	35,259,028.73 ± 30,180,057.34	276,563,468.66 ± 379,292,489.33	<sup>a</sup> p=0.027*
Total expenditure incurred for environmental protection in 2020	17,216,670.47 ± 47,747,473.79	38,482,987.86 ± 39,364,068.62	256,351,439.54 ± 403,374,164.06	<sup>a</sup> p<0.024*

Kruskal-Walli's test; \* statistical significance

Source: Author's review

No statistically significant difference was found between medium and large LGUs with regard to the total expenditure and costs incurred for environmental protection in 2018, nor between small and medium LGUs with regard to the total expenditure incurred for implementing measures to reduce air pollution in 2018, 2019, and 2020 (Table 4).

**Table 4:** Intergroup comparisons of LGUs of different sizes in relation to revenue and expenditure

Question	LGU	Medium	Large
Expenditure incurred for air quality monitoring in 2018	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p<0.001*
Expenditure incurred for air quality monitoring in 2019	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p<0.001*
Expenditure incurred for air quality monitoring in 2020	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.001*
Total expenditure incurred for implementing measures to reduce air pollution in 2018	Small	<sup>a</sup> p=0.478	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.003*
Total expenditure incurred for implementing measures to reduce air pollution in 2019	Small	<sup>a</sup> p=0.196	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.014*
Total expenditure incurred for implementing measures to reduce air pollution in 2020	Small	<sup>a</sup> p=0.346	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.003*
Total revenue generated from charges and fees in 2018	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.006*
Total revenue generated from charges and fees in 2019	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.021*
Total revenue generated from charges and fees in 2020	Small	<sup>a</sup> p<0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p<0.001*
Total expenditure incurred for environmental protection in 2018	Small	<sup>a</sup> p=0.002*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.08
Total expenditure incurred for environmental protection in 2019	Small	<sup>a</sup> p=0.004*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.027*
Total expenditure incurred for environmental protection in 2020	Small	<sup>a</sup> p=0.001*	<sup>a</sup> p<0.001*
	Medium		<sup>a</sup> p=0.021*

a Mann – Whitney U test; \* statistical significance

Source: Author’s review

Based on the data presented above, there are certain deviations in incurring expenditure among large, medium, and small LGUs, which is understandable, since the size of the LGU also determines the level of revenue generated from environmental pollution charges and from fees for environmental protection and improvement. Results further show that there is a statistically significant, moderately strong correlation between the total revenue generated and

expenditure incurred in 2018, 2019, and 2020, considering both municipalities and cities (Table 5).

**Table 5:** Correlation between total generated revenue and incurred expenditure according to the LGU status

Question	Status	Total expenditure incurred for environmental protection in 2018	Total expenditure incurred for environmental protection in 2019	Total expenditure incurred for environmental protection in 2020
Total revenue generated from charges and fees in 2018	City	$r_s = 0.618$ ; $p = 0.001^*$		
	Municipality	$r_s = 0.548$ ; $p = 0.006^*$		
Total revenue generated from charges and fees in 2019	City		$r_s = 0.646$ ; $p < 0.001^*$	
	Municipality		$r_s = 0.482$ ; $p = 0.017^*$	
Total revenue generated from charges and fees in 2020	City			$r_s = 0.685$ ; $p < 0.001^*$
	Municipality			$r_s = 0.419$ ; $p = 0.041^*$

$r_s$  – Spearman’s rank correlation coefficient; \* statistical significance

Source: Author’s review

In other words, Table 5 shows that the relationship between generated revenue and expenditure is directly proportional. This means that both cities and municipalities invested more funds during the observed three-year period if their revenue from environmental protection fees and environmental improvement fees were higher.

The research has shown that LGUs follow the legislative framework and align their regulations with the adopted legal provisions, but in practice do not implement the enacted legal acts. Furthermore, this research has shown that LGUs having the status of a city have established a network of monitoring stations and regularly monitor air quality. They have also adopted a monitoring program and an Air Quality Plan. Contrary to that, the majority of LGUs having the status of a municipality have not established these structures and procedures, which indicates that they do not have adequate measures for monitoring and improving air quality. Nevertheless, the research has indicated that LGUs do not pay sufficient attention to the importance of air quality management and maintenance, as in one half of the surveyed LGUs air was classified as Category

III, i.e., excessively polluted air, with tolerance values that were exceeded for one or more pollutants, whereas in one third of the LGUs it was not determined at all which category the air belongs to. In other words, LGUs apply insufficiently the legislative and planning framework for air quality management in their local communities.

The research has shown that LGUs having the status of a city have a more organised approach to air quality management than LGUs having the status of a municipality, primarily in terms of air quality monitoring and adopted Air Quality Plans if in zones and agglomerations the air is classified as Category III. Air quality monitoring in the Republic of Serbia provides early warning in cases of exceeding air pollutant limit values. Therefore, it is very important to implement air quality monitoring measures in order to ensure timely response and prevention aimed at reducing exceedances of limit values. Air quality monitoring is not performed in one half of the surveyed LGUs classified as cities, although continuous monitoring is necessary in order to achieve results, primarily with regard to reducing air pollution.

Based on the research conducted, it can be concluded that LGUs insufficiently plan and allocate funds in their budgets for environmental protection costs, i.e. for maintaining air quality. In addition, revenue generated from (1) environmental pollution fees and (2) fees for environmental protection and improvement in 2020 were lower by 44.93% compared to 2018 and lower by 27.78% compared to 2019. LGUs generate revenue from environmental pollution fees and from fees for environmental protection and improvement. However, as of 2019, the revenue generated from these fees accrue to the budget of the local self-government unit, unlike the earlier period when funds generated from these fees were used by LGUs through a budgetary fund, earmarked for environmental protection and improvement, all in accordance with the adopted programs for the use of budgetary fund resources, i.e. local action and remediation plans. Thus, until 2019, the purpose of these funds was clear because they were collected and spent for a specific aim. However, since 2019 these funds generated from fees have belonged to the budget of the local self-government unit and, therefore, do not necessarily have to be used for environmental protection, including air quality management. This change in the party obliged to pay environmental pollution fees and the modification of the method for calculating and determining the fee for environmental protection and improvement have led to a significant decrease in LGUs revenue generated from this source, which in turn has caused lower expenditure (costs) for maintaining air quality.

The research has shown that LGUs classified as cities and district centres, having a larger population, more developed industry, and higher traffic frequency, generate higher revenue and also plan and allocate greater funds for expenditure (costs) in their budgets for air quality management compared to LGUs classified as municipalities, having smaller population, less developed industry, and lower traffic frequency.

## 5. CONCLUSIONS

A healthy environment, including clean air, is the foundation for life within an LGU. Therefore, the competent authorities of an LGU should strive to ensure a high-quality and healthy life or to improve it. Based on the research conducted, it can be concluded that not all LGUs (cities and municipalities) with Category III air quality fulfil the legal obligation to adopt measures to improve air quality, which sends a poor message to citizens about the importance of protecting their health from excessive concentrations of air pollutants. In zones and agglomerations where air has been classified as Category III, the competent authorities of LGUs have not required operators to develop plans for reducing air pollution, in the form of adopting an Air Quality Plan and air quality monitoring programs for the local network, which is a legal obligation. Although most LGUs have established an air quality monitoring system, certain elements of the monitoring system are not fully developed, that is, half of the LGUs do not perform air quality monitoring regularly, which is a legal obligation. Continuous air quality monitoring is necessary, especially in LGUs with high levels of air pollution, along with the adoption of measures to reduce it.

Based on the research conducted, an answer can be provided to the first research question: *How does the implementation of the legislative and planning framework for air quality management by LGUs affect the maintenance of air quality?* Although LGUs follow and align their regulations with the legislative framework, the insufficient practical implementation of adopted legal acts significantly reduces the effectiveness of preserving and improving air quality. This gap between the normative framework and the actual situation highlights the need to strengthen the capacity and accountability of LGUs in enforcing regulations. Effective implementation of the legislative and planning framework by LGUs is crucial for maintaining air quality. It is necessary to work on improving the enforcement of laws and strategies, as well as on raising awareness about the importance of environmental protection in local communities.

The answer to the second research question – *How do the monitoring of air pollution levels and measures taken by LGUs to improve air quality affect the maintenance of air quality?* – indicates that LGUs with the status of a city have better organised approach to air quality monitoring and management compared to LGUs with the status of a municipality, which is crucial for timely response to pollution. However, a significant portion of LGUs do not implement adequate measures, leading to excessive pollution and inefficient air quality management.

Finally, an answer can be provided to the third research question – *What is the impact of revenue generated from environmental pollution charges and fees for environmental protection and improvement on the expenditure incurred by maintaining air quality in LGUs?* Based on the research conducted, it is concluded that LGUs invest insufficient efforts to plan expenditure for environmental protection, which leads to reduced effectiveness in maintaining air quality. In addition, a significant decline in revenue generated from environmental pollution fees since 2019 further hampers financing of measures to improve air quality in local communities.

The theoretical contribution of the paper lies in supplementing the existing literature on air quality in LGUs in the Republic of Serbia. According to the author's knowledge, there are few studies in Serbia that address air quality. In addition to its theoretical contribution, this paper also offers a practical contribution. Empirical research results enable the competent authorities within LGUs to understand benefits of implementing air quality management. Air quality monitoring and reporting should be observed as means to improve life in the local community, yet the research shows that LGU institutions are not sufficiently committed to the importance of this matter. Additionally, research results can be useful to the general public in understanding the matter of air quality in LGUs. At the local and national level, the objective of reducing air pollution could be achieved by engaging a team of environmental protection experts, specifically air protection experts, who would conduct a detailed analysis of the causes of air pollution and determine ways to eliminate it. Organising educational training for the population, on the need to preserve and monitor air quality in the future, is one of the priorities of every local community.

The paper is subject to limitations that point to areas for future research. The main limitation in the conducted research is the sample size. Therefore, in addition to LGUs within the country, future research should include competent government institutions dealing with air quality matters, and potentially also LGUs from neighbouring countries that border our state. Furthermore, future research should address the issue of air quality reporting in LGUs and also engage the population

living within the territories of these LGUs. Future research may also examine the financing, i.e. planning and allocation of financial resources in the budgets of LGUs, particularly with regard to controlling the use of funds for this purpose. Appropriate mechanisms should be identified at both local and national levels.

### Conflict of interests

The authors declare there is no conflict of interest.

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## **ЗНАЧАЈ ПРАЋЕЊА КВАЛИТЕТА ВАЗДУХА И ПОТРЕБА ЗА УНАПРЕЂЕЊЕМ УПРАВЉАЊА КВАЛИТЕТОМ ВАЗДУХА У ЈЕДИНИЦАМА ЛОКАЛНЕ САМОУПРАВЕ (ЈЛС) У РЕПУБЛИЦИ СРБИЈИ**

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### **САЖЕТАК**

У раду ће бити размотрен економски утицај Јединица локалне самоуправе (ЈЛС) на унапређење квалитета ваздуха и заштиту животне средине, у градовима и општинама (из сваког округа по један град и општина, осим Београда) у Републици Србији. Један од фактора који утичу на живот у градовима у Републици Србији јесте загађење ваздуха, које може имати негативан утицај како на здравље становника који живе у њима, тако и на оне који долазе пословно или туристички. Предмет истраживања у раду су општи подаци о квалитету ваздуха у ЈЛС (градови и општине) у Републици Србији, као и планирање и коришћење новчаних средстава од надлежних институција ЈЛС за успостављање и управљање квалитетом ваздуха. Циљ овог рада јесте да испита да ли надлежни органи ЈЛС примјењују плански и законодавни оквир као основу за ефективно и ефикасно управљање квалитетом ваздуха, спроводе мјере и активности на побољшању квалитета ваздуха, као и да ли прикупљају и издвајају новчана средства за ту сврху. Спроведећи анкетно истраживање на узорку од 49 ЈЛС, утврђено је да највећи број њих не управља адекватно квалитетом ваздуха. Истраживање је показало да ЈЛС у буџетима недовољно планирају и издвајају финансијска средства за одржавање квалитета ваздуха. Посматрано из угла рачуноводства, финансијска средства која ЈЛС остварују по основу накнаде загађивања животне средине и накнаде за заштиту и унапређивање животне средине припадају буџету јединице локалне самоуправе и имају значај код планирања и извршења расхода (трошкова) за управљање квалитетом ваздуха

**Кључне ријечи:** *квалитет ваздуха, загађење ваздуха, мониторинг квалитета ваздуха.*

