

Examining the impact of air pollution on migration intentions: the case study of the City of Belgrade (Serbia)

Milica Langović¹, Zoran Vidović², Vladimir A. Srećković¹, Marko Langović³

¹ Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, Belgrade (Zemun), Serbia

² Faculty of Education, University of Belgrade, Kraljice Natalije 43, Belgrade, Serbia

³ Faculty of Geography, University of Belgrade, 11000 Belgrade, Serbia

*Correspondence: milica.langovic@ipb.ac.rs; Tel.: +381691892111 (M.L.)

Keywords: air pollution; environment; migration; intentions; City of Belgrade; Serbia

Abstract: This research examines the impact of air pollution on migration intentions in the City of Belgrade, one of the most air polluted areas in the Republic of Serbia. The analysis is based on data from a survey conducted among adults who had lived in the City of Belgrade for at least one year. The field research results were analyzed using various statistical techniques (Chi-square (χ^2) test, Cramer's V coefficients, logistic regression, Spearman correlation, and the Kruskal-Wallis test) in R and SPSS Statistics software. The research highlights the connection between air quality and the probability of migration, revealing differences in migration considerations and plans across various socio-demographic categories. The findings show that respondents with higher education express the greatest interest in migrating due to air pollution. Additionally, the study reveals that while air pollution primarily encourages internal migration, international migration has also emerged as a possibility. The research shows that rural areas are more desirable future destinations than urban areas, especially among respondents planning to migrate within the country. The paper discusses whether current trends can provide lessons for more sustainable future development.

1. Introduction

Air pollution is one of the major environmental issues in both developing and developed countries (Liang and Gong, 2020; Singh et al., 2023). Poor air quality affects macro systems, individuals' daily activities, migration patterns, human health (Fang et al., 2021), and has far-reaching consequences for sustainable development. With current trends and projections suggesting that overall air pollution will increase in the future (Castells-Quintana et al., 2021), questions about its causes, consequences, and management are gaining increasing interest in the academic community and the public (Hospido et al., 2023). Although air pollution occurs in various geographical regions, it is a significant environmental concern in urban areas (Piracha & Chaudhary, 2022).

The Republic of Serbia has faced air pollution issues for decades. In many cities, air quality has worsened mainly due to excessive concentrations of PM₁₀ and PM_{2.5} particles. These conditions harm quality of life and affect the population in many ways, especially those living close to pollution sources (Momčilović, 2021; RERI, 2024; RERI, 2024a). For years, the capital of Serbia has been one of the most affected areas by air pollution in the country (Vidaković, 2013; XEco, 2025). At the same time, the city's population is increasing, and it is an area where various types of migration take place. In light of these trends, the aim of this paper is to investigate the impact of air quality in the City of Belgrade on migration intentions.

The paper focuses on the following main research aspects: identifying the link between satisfaction with air quality and migration intentions; analyzing differences in migration intentions (considerations and plans) motivated by air pollution among respondents with different socio-demographic characteristics; defining the geospatial directions of potential migration flows in the context of internal and international migration; and identifying preferences between rural and urban areas.

2. Background of the research

Population migration, as a geographical and social phenomenon, has long been linked to environmental conditions. The history of environmental impacts on population distribution and mobility worldwide demonstrates that the natural environment can serve as a “push” factor for migration when livelihoods are affected. As one of the major environmental issues, air pollution affects society in various ways, shaping both migration intentions and directions (Hunter and Nawrotzki, 2016; IOM, 2009).

In the age of urbanization, the relationship between air pollution and migration is becoming increasingly complex. On one hand, population mobility can negatively affect air quality in urban areas (Wang et al., 2020). As the world experiences accelerated urban growth, the concentration of migrants in urban areas can affect the consistency and availability of services and place additional demands on resources and infrastructure (UN, 2024). Since a larger proportion of migrants settle in cities, this trend is evident in both internal and international migration (Farzanegan et al., 2023; Nourou et al., 2024; Ehler et al., 2024). On the other hand, it is widely recognized that air pollution can encourage migration flows. To avoid the negative effects of air pollution, migrants often choose to migrate to areas with better air quality than their previous place of residence (Shen et al., 2023). Given that numerous studies have shown that air pollution affects life satisfaction (Abed Al Ahad, 2024) and human health (Gul and Kumar Das, 2023), migration serves, among other purposes, as a strategy to improve individuals' overall quality of life. Rural areas, which are predominantly characterized by lower PM_{2.5} levels compared to urban areas (Kilpatrick et al., 2024), could have an advantage.

The impact of air pollution on migration intentions has been examined in numerous scientific studies worldwide, especially in recent years. One group of research focuses primarily on migration intentions and differences in the socio-demographic characteristics of those affected by air pollution. Particular attention is given to the educational and economic backgrounds of respondents. Although migration intentions do not guarantee that migration will occur (Black et al., 2011), they provide important insight into the likelihood of such actions and offer a solid basis for considering future migration trends.

A study from Germany found that income influences the decision to relocate when perceived air pollution increases. It also showed that perceived air pollution has a stronger impact on the likelihood of migration among households with higher income levels (Rüttenauer and Best, 2022). Research across European cities revealed that both perceptions of air quality and actual pollution levels influence migration. Higher dissatisfaction with air quality and higher pollution levels are negatively associated with migration, while greater satisfaction with air quality is positively linked to it (Vontroba, 2024). Studies from the United States show that people usually move to places that are less polluted (Bakhtsiyarava and Nawrotzki, 2017). A study from Italy indicates a clear connection between air quality and population migration, emphasizing the importance of adopting environmental measures. The authors note that proactive environmental policies play a key role in enhancing the attractiveness and livability of municipalities (Bernardo et al., 2024). Similar findings were reported in a study from the Czech Republic, which showed that heavily polluted areas became more attractive places to live once air quality improved. The study also found that individuals with higher levels of education tend to be more sensitive to air pollution when choosing where to live (Mikula and Pytliková, 2021).

The effects of air pollution on migration intentions are a focus of attention in China. One study confirmed the impact of educational and economic factors on migration decisions, showing that people with higher income and education are more likely to migrate from cities experiencing severe air pollution (Yu et al., 2022). Research by Ma et al. (2023) found that air pollution can influence international migration, with individuals with higher education and income more willing to emigrate from China. A study in Hanoi, Vietnam, found that migration intentions are more pronounced among males and young people (Vuong et al., 2021).

Despite this evidence, the literature indicates that environmental aspects are not adequately considered in migration theory, and migration theories pay little attention to the importance of environmental factors in migration decisions. Although migration theories do not exclude the environment as a driver of migration (e.g., the push-pull theory), they focus mainly on social and economic circumstances that drive people to migrate. However, empirical evidence repeatedly demonstrates that environmental aspects encourage population out-migration through various mechanisms, making it increasingly important to include environmental factors in the further development of theoretical concepts. In this context, some researchers (Hunter and Simon, 2022) have noted that future theoretical considerations should inevitably include the environment as a factor that increasingly encourages migration.

3. Materials and Methods

3.1. Study area

The study area is defined by the borders of the City of Belgrade, a special territorial unit established by the Constitution and the law ("Official Gazette of the RS," no. 129/2007, 18/2016, 47/2018, and 9/2020 – other law) in Serbia. Environmental issues affect social and economic conditions in the country (Langović et al., 2024). Air pollution in the City of Belgrade is a significant concern for both the scientific community and the general public. Researchers in Serbia study this issue from various perspectives, emphasizing that it creates diverse social challenges (e.g., Stanojević et al. 2024; Tasic et al. 2008). The public is increasingly concerned and often expresses confusion about this matter, while media in Serbia and abroad frequently report on it (RTS, 2025; The Guardian, 2023).

Population growth, ongoing urban expansion, construction of energy facilities, development of transportation, and intensified industrial activities have led to severe air pollution in the City of Belgrade (RERI, 2023). In addition to having some of the most unfavorable air quality in Serbia, Belgrade also ranks among the most polluted cities in Europe. Official data show that average annual PM₁₀ levels in 2024 at all monitoring stations exceeded the EU value of 20 µg/m³, as did PM_{2.5} levels, which surpassed the EU limit of 10 µg/m³. Moreover, at six stations, the mean annual PM₁₀ value was higher than 40 µg/m³, while at seven stations, the mean annual PM_{2.5} value exceeded 25 µg/m³ (Figure 1). These findings demonstrate that air quality in the City of Belgrade is a serious issue that threatens residents' quality of life in several ways (Bjelajac et al., 2015). At the Western Balkans level, one study indicates that air pollution reduces life expectancy by up to 13–16 months in Western Balkan cities, with the City of Belgrade having the highest number of deaths, and that it poses a serious threat to public health (UN, 2021).

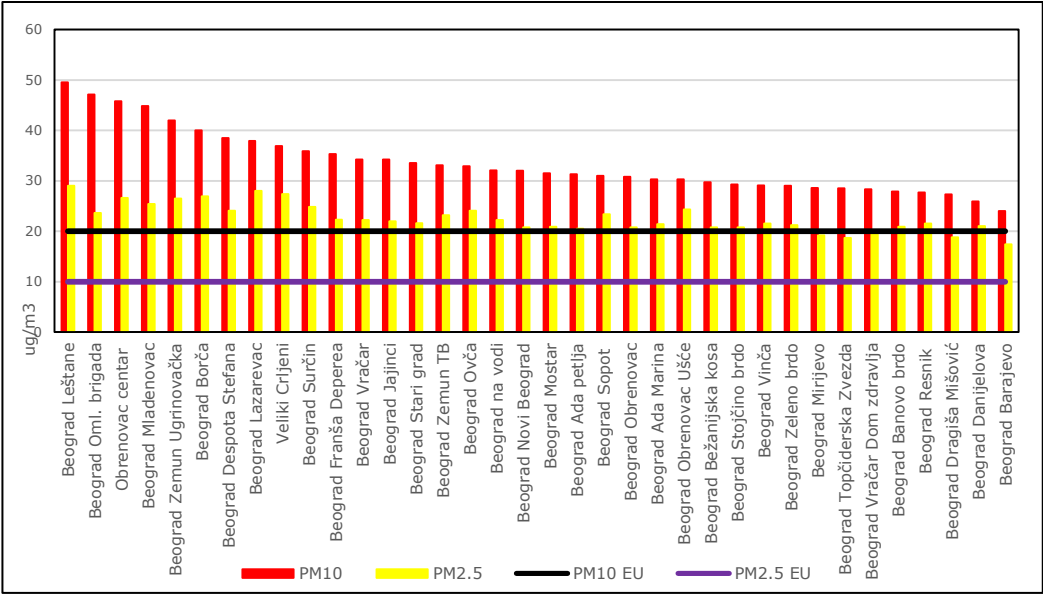


Figure 1. Mean values of PM10 and PM2.5 concentrations at stations in the City of Belgrade, 2024 (µg/m3)
Source: XEco, 2025.

According to the 2022 population census, 1,681,405 inhabitants live in the City of Belgrade. The population of Belgrade is continuously increasing, with migration playing a crucial role in this growth. As the administrative center of the country, the City of Belgrade attracts both internal and international migrants, including both voluntary and forced forms of spatial mobility (Langović et al., 2026). According to 2022 census data, the total number of immigrants was 240,256, while the number of returnees was 84,728 (Lukić et al., 2025). Of all refugees in Serbia in 2024, the largest number (6,155) live in the City of Belgrade, making up 24.7 per cent of all refugees. The total number of internally displaced persons from AP Kosovo and Metohija in the same year was 58,417, which is almost a third of their total number that year (194,171) (KIRS, 2024). Employment opportunities and more favorable economic conditions compared to most other parts of Serbia have contributed to these trends. However, despite some fluctuations and a continued positive net internal migration rate, a decreasing trend is evident. From 2012 to 2024, the lowest total net migration rate (1.7) was recorded in 2024 (Figure 2).

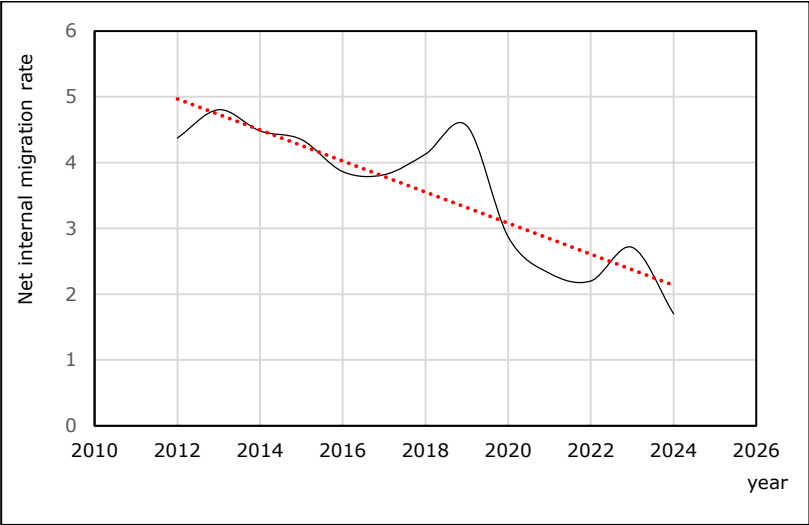


Figure 2. Net internal migration rate in the City of Belgrade, 2012-2024.
Source: SORS, 2013-2024; SORS, 2025.

3.2. Data and methods

Building on concepts from previous research, this paper examines migration intentions influenced by air pollution. In addition to migration intentions, migration attitudes were analyzed as an introduction to the issue. For the purpose of this study, a survey was conducted in the City of Belgrade. The target group consisted of adults who had lived in the City of Belgrade for at least one year. The survey was conducted in 2025 using both printed questionnaires and an online survey. The online questionnaire was created in Google Forms and distributed to respondents via email and social networks. The questionnaire included three sections (socio-demographic characteristics, attitudes toward air quality in the place of residence, and air quality and migration) and a total of 24 questions. The research concept is presented in Figure 3.

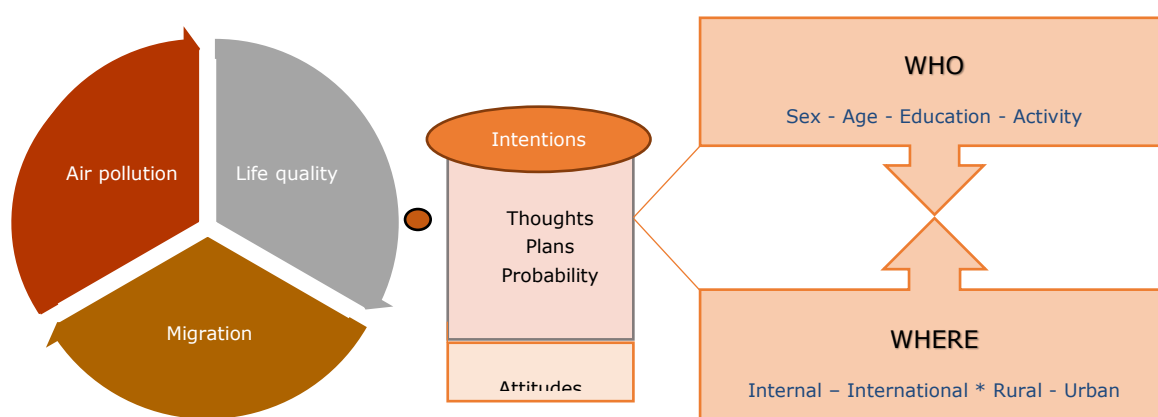


Figure 3. Concept of the research

Examining migration intentions represents the central part of the analysis. The questions in this section of the survey allowed for the determination of the migration potential of the sample. Specifically, this segment focuses on respondents' thoughts and plans regarding migration due to air pollution. The analysis also includes the time frame for the probability of migration. Special attention is given to the potential geospatial directions of migration, specifically whether respondents plan to migrate within the country or abroad. In addition, preferences regarding settlement type – urban or rural areas as future places of residence – are considered. To assess the potential for changing migration decisions, the study examined whether improved air quality would influence respondents to remain in their current place of residence (Table 1).

Attitudes toward migration were analyzed by considering respondents' perceptions of air pollution as a factor in migration in the City of Belgrade. The analysis also includes respondents' general views on the level of air quality in the City of Belgrade and whether air pollution affects their quality of life. An important aspect of this part of the research is respondents' perspectives on whether they know someone who has migrated due to air pollution (Table 1).

Table 1. Categories of analysis

Category	Subcategories	Aim
Migration intentions	• Thoughts on migration due to air pollution	Gaining insight into the potential impact of air pollution on migration (considering socio-demographic characteristics of respondents) in the City of Belgrade, as well as the geospatial directions of possible migration
	• Migration plans due to air pollution	
	• Probability of migration due to air pollution in the next five years	
	• Preferences regarding internal versus international migration	
	• Preferences regarding urban versus rural areas	
	• Would the possibility of improving air quality affect migration intentions? - respondents' perspectives	
Migration attitudes	• Perceptions of air quality at the place of residence	Gaining insight into the population's perception of air pollution on quality of life and migration
	• Perceptions of air quality effects on respondents' quality of life	
	• Assessment of satisfaction with quality of life	
	• Perceptions of air pollution sources	
	• Perceptions regarding the influence of air pollution on migration	
	• Information on whether respondents have acquaintances who have migrated due to poor air quality	

Based on previous research and knowledge of air quality characteristics in the City of Belgrade, the following hypotheses have been defined and will be the focus of this paper:

- Migration intentions motivated by air quality are more pronounced among men, younger individuals, those with a university education, and those with permanent employment.
- The probability of migration is proportional to respondents' satisfaction with air quality in the City of Belgrade.
- Rural areas in Serbia represents more desirable potential future destinations than urban areas.
- The probability of migration is higher among individuals who plan to migrate to rural areas compared to those who plan to migrate to urban areas or those who have not yet decided.

The methodological framework is based on the analysis of descriptive statistics and specific statistical tests performed using the statistical software R and SPSS. To test Hypothesis 1, which examines differences between respondents in socio-demographic characteristics (sex, age, education, and economic activity) and population plans regarding migration potentially influenced by air pollution, the non-parametric Chi-square (X^2) test and the corresponding Cramer's V coefficients were used. In addition, logistic regression models were applied. To test Hypothesis 2, the Spearman correlation was used. The procedure includes: (1) Probability of migration due to air

pollution in the next five years (1 = extremely small; 5 = extremely large), and (2) Rate of air quality at the place of residence (1 = very poor; 5 = excellent). Hypothesis 3 was examined based on respondents' preferences regarding settlement type and additionally through the results of the Chi-square (X^2) test and the corresponding Cramer's V coefficients, which tested the relationship between migration type (internal/international) and settlement type (rural/urban). Hypothesis 4 was examined through the prism of probability of migration and the geospatial dimension of potential migration in the context of three groups: rural areas, urban areas, and a group of residents who are undecided regarding rural/urban areas. The Kruskal-Wallis test was applied to examine the relevance of this hypothesis.

3.3. Socio-demographic characteristics of respondents

The analysis focuses on a sample of 311 respondents. Among the respondents, women make up a higher proportion (61.1 per cent) compared to men (38.9 per cent). Regarding age structure, the sample is dominated by individuals aged 30–39 (37.6 per cent) and 20–29 (30.2 per cent), followed by respondents aged 50–59 (12.5 per cent), 60–69 (10.9 per cent), 40–49 (5.5 per cent), and those over 70 (2.3 per cent). Three respondents (1 per cent) were 18 or 19 years old at the time of the survey. In terms of education, people with tertiary education predominate (60.1 per cent), while about a third have completed secondary education (37.6 per cent). Analysis of respondents' economic activity shows that slightly more than half are employed (55.9 per cent). Students make up 15.8 per cent of the sample, those with seasonal or temporary jobs 11.9 per cent, pensioners 11.3 per cent, and the unemployed 4.5 per cent (Table 2).

Table 2. Socio-demographic characteristics of respondents

	Categories	n	%
Sex	Women	190	61.1
	Men	121	38.9
Age	18-19	3	1
	20-29	94	30.2
	30-39	117	37.6
	40-49	17	5.5
	50-59	39	12.5
	60-69	34	10.9
	<70	7	2.3
Education	Primary education	6	1.9
	Secondary education	117	37.6
	Tertiary education ¹	187	60.1
	Other	1	0.3
Economic activity	Employed	174	55.9
	Seasonal/temporary job	37	11.9
	Student	49	15.8
	Retired	35	11.3
	Unemployed	14	4.5
	Other	2	0.6

¹Included all levels of tertiary education (bachelor, master/magistar, doctoral studies) and individuals with completed High School or Higher School.

4. Results

The majority of respondents noticed a change in air quality in the City of Belgrade, with more than 90 per cent reporting that the air quality in their place of residence had changed over the past five years. Most respondents indicated that the air had become worse (62.4%) or significantly worse (29.6%) in the last five years. Respondents' ratings on a scale from 1 (very bad) to 5 (excellent) also reflect their current dissatisfaction with air quality, as almost a quarter (23.2%) gave the lowest rating. The change in air quality, specifically the increase in air pollution, negatively affects the quality of life for most respondents. This is evident from the fact that 73% of respondents selected numbers 1 to 3 on a scale from 1 (completely disrupts) to 5 (does not disrupt at all). These results clearly show that air pollution affects all aspects of society and ultimately disrupts individual lives in the City of Belgrade. Respondents primarily identified traffic, individual combustion plants, and industry as the main sources of air pollution.

It was recognized that changes in air quality affect migration. The fact that most respondents have acquaintances who have migrated due to air pollution (60.8%), compared to those who do not (39.2%), indicates that this type of migration is already occurring in the City of Belgrade. The majority believe that air pollution is one of the most common factors influencing population migration in the City of Belgrade (60.8%), while 2.6% consider air pollution the main reason for migration. Additionally, 21.2% believe that air pollution does not affect migration, and 15.4% selected „I do not know“ option.

The analysis of respondents' migration intentions is based on questions about their thoughts and plans regarding migration due to air pollution. Slightly more than half of the respondents (57.2%) are considering migrating due to air pollution. In contrast, slightly less than a third (29.3%) plan to migrate from the City of Belgrade for this reason, while 70.7% stated that they do not plan to move due to air pollution (Figure 4). Notably, 26.4% of respondents indicated that improving air quality in their neighborhood would influence their decision to migrate, while 8% stated that it would completely change their perspective.

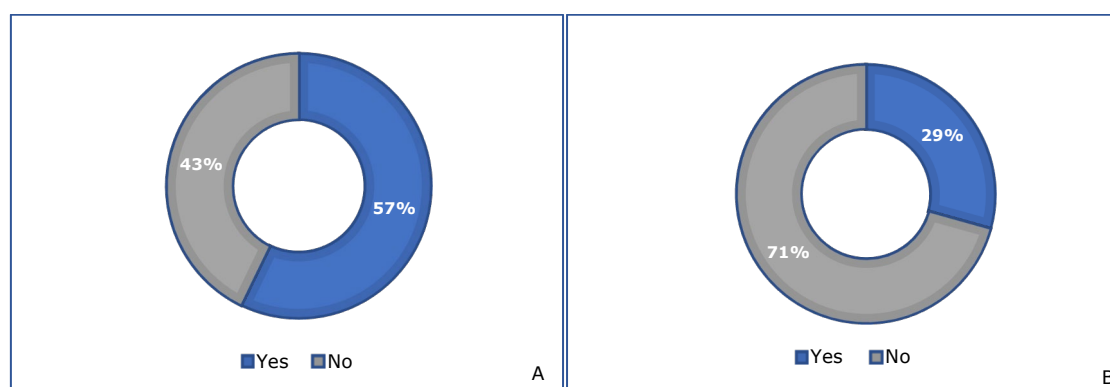


Figure 4. Have you considered migrating due to poor air quality? **(A)** Are you planning to migrate due to poor air quality? **(B)**

The results show no statistically significant differences across sociodemographic groups regarding whether respondents have considered moving due to air pollution. This suggests that dissatisfaction with air quality and the contemplation of migration are relatively widespread across the population. However, when examining actual migration plans, education emerges as a statistically significant factor ($p = 0.0016$). The value of Cramer's V (0.221) indicates a moderate association between educational attainment and migration planning. Individuals with higher education levels appear to be more likely to plan relocation in response to environmental concerns. Age also approaches statistical significance ($p = 0.052$), suggesting that migration planning may vary across life-cycle stages, although the effect remains below conventional significance thresholds (Table 3).

Table 3. Association between migration intentions and socio-demographic characteristics

Outcome	Predictor	χ^2	df	<i>p</i>	Cramer's <i>V</i>
Considered migration	Sex	1.00	1	0.317	0.057
Planning migration	Sex	0.01	1	0.918	0.006
Considered migration	Age	4.02	6	0.674	0.114
Planning migration	Age	12.49	6	0.052	0.200
Considered migration	Education	6.41	3	0.093	0.144
Planning migration	Education	15.20	3	0.0016	0.221
Considered migration	Economic activity	3.75	5	0.585	0.110
Planning migration	Economic activity	7.67	5	0.175	0.157

In addition to the association-based analyses, regression models were estimated in order to evaluate the effect of perceived air quality while controlling socio-demographic characteristics. Logistic regression models were applied to binary outcomes related to migration considerations. In the model predicting whether respondents have considered leaving their place of residence due to air pollution, perceived air quality emerged as a statistically significant predictor ($\beta = -0.588$, $p < 0.001$). When expressed as an odds ratio, the effect corresponds to $OR = 0.56$, indicating that higher evaluations of air quality reduce the likelihood that respondents report migration considerations. In other words, respondents who perceive air quality as worse are substantially more likely to report that they have considered moving due to air pollution.

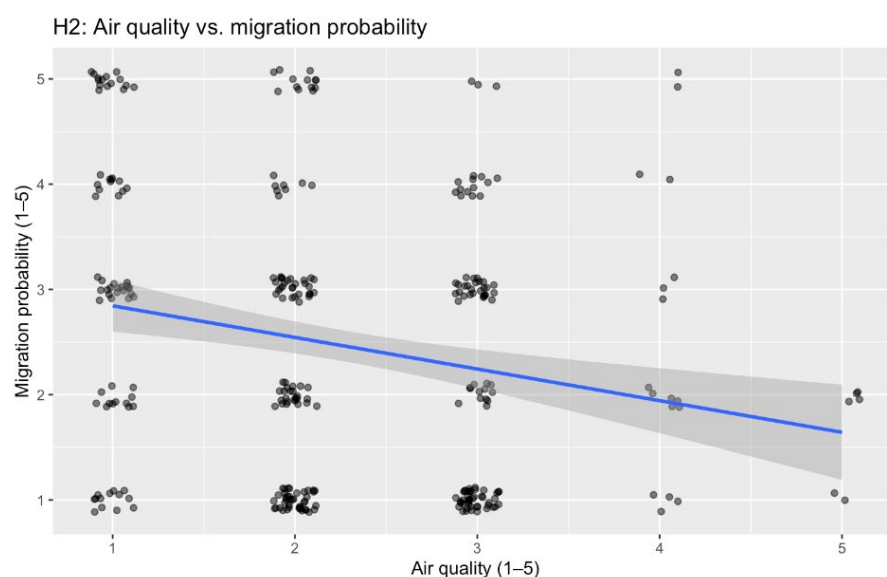
This result confirms that perceived air quality has an independent role in shaping migration considerations, even when socio-demographic characteristics are taken into account. The odds ratio indicates that better evaluations of air quality are associated with a lower probability of considering migration, while poorer perceived air quality increases the likelihood of migration-related thoughts. Therefore, the logistic regression analysis strengthens the previous association-based findings by showing that environmental perception is not only descriptively related to migration intentions, but also acts as a statistically significant predictor within a multivariate framework.

Regarding respondents' attitudes toward air quality in the City of Belgrade, the aim was to determine the relationship between the assessment of air quality at the place of residence and the probability of migration in the next five years. The results of the Spearman correlation indicated a statistically significant relationship between these categories ($p = 0.000$; $\rho = -0.201$) (Table 4). The negative Spearman correlation value showed that as the probability of migration due to air pollution in the next five years increases, the assessment of air quality at the place of residence decreases. Although the magnitude of the correlation is moderate, the result is statistically robust and supports the hypothesis that environmental dissatisfaction contributes to migration intentions. Thus, hypothesis 2 was confirmed: the probability of migration is proportional to respondents' satisfaction with air quality in the City of Belgrade. In addition, a weak negative correlation was found between the probability of migration in the next five years and satisfaction with quality of life ($p = 0.004$; $\rho = -0.161$), indicating that as the probability of migration in the next five years increases, satisfaction with quality of life decreases (Table 4).

Table 4. Spearman's correlation results

Variables	<i>p</i>	Spearman <i>p</i>
Probability of migration due to air pollution in the next five years	0.000	-0.201
Rate of air quality at the place of residence		
Probability of migration due to air pollution in the next five years	0.004	-0.161
Assessment of satisfaction with quality of life		

The graphical representation of the relationship between perceived air quality and migration intentions aligns with the correlation analysis (Figure 5). Higher migration probabilities are more frequently observed among respondents who rated air quality lower on the scale, while those who perceive air quality as relatively good tend to cluster in the lower categories of migration probability. Although the association is statistically significant, the magnitude of the correlation indicates a moderate relationship, suggesting that migration intentions are influenced not only by environmental perceptions but also by a broader set of socio-economic and personal factors.

**Figure 5.** Air quality vs. migration probability

Examining the geospatial directions of potential migrations confirms that both internal and international migration are considered by respondents, with a slight predominance of internal mobility. Among respondents who indicated they would migrate due to air pollution, 63.2% would migrate within Serbia, while 36.8% would migrate abroad. Of those preferring internal migration, 3.1% would migrate to another settlement within the same municipality, 17.1% to another municipality within the City of Belgrade, and 43% to a municipality in another part of Serbia. Most respondents stated they would migrate to rural areas (48%) rather than urban areas (29%), while 23% remain undecided, confirming hypothesis 3 (Figure 6).

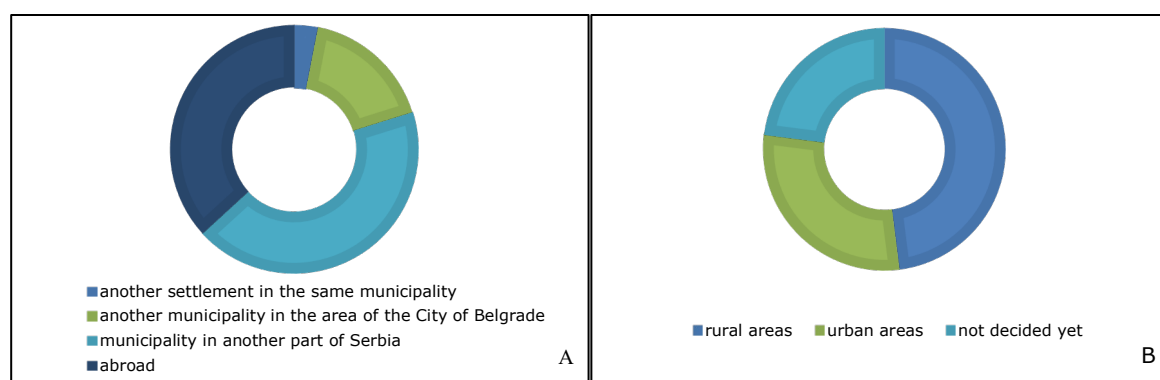


Figure 6. Potential directions of future migration (A) Preferences in the domain of settlement type (B)

To examine spatial preferences related to potential migration decisions, a contingency table was constructed crossing the preferred migration destination (Serbia vs. abroad) with the preferred type of settlement (urban areas, rural areas, or undecided). Respondents who explicitly stated that they do not plan to move due to air pollution were excluded from this analysis, as the question regarding the preferred type of settlement is not meaningful for individuals without migration intentions. The chi-square test of independence revealed a statistically significant association between the preferred migration destination and the preferred type of settlement ($\chi^2 = 43.93$, $df = 2$, $p < 0.001$). The strength of the association, measured by Cramer's V, was relatively high ($V = 0.48$), indicating a substantial relationship between these variables (Table 5). Substantively, the results suggest that respondents considering migration within Serbia more frequently prefer rural destinations, whereas those considering migration abroad tend to prefer urban destinations or remain undecided about the type of settlement. This pattern is consistent with broader migration dynamics, where international migration is often directed toward urban environments with greater employment opportunities and established migrant networks.

Table 5. Chi-square (χ^2) results

Categories	Internal mobility (%)	International mobility (%)	χ^2	df	p	Cramer's V
Urban areas	20.7	45.6	43.93	2	< 0.001	0.48
Rural areas	66.1	16.2				
Not decided yet	13.2	38.2				

Considering the differences in potential preferences regarding settlement type, one of the objectives was to determine whether there are differences in the probability of migration and potential migration routes. The results of the Kruskal-Wallis test did not indicate statistically significant differences in migration probability across the examined groups ($H = 2.45$, $df = 2$, $p = 0.293$). (Figure 7). This finding suggests that although respondents may differ in their spatial preferences (urban versus rural), these preferences are not associated with substantial differences in the reported probability of migration. The boxplots presented in Figure 7 show considerable overlap among the examined groups, with similar median values and dispersion patterns. This indicates that air pollution appears to stimulate migration intentions relatively uniformly, regardless of whether respondents prefer rural areas, urban areas, or remain undecided about their future destination. Therefore, hypothesis 4 is rejected.

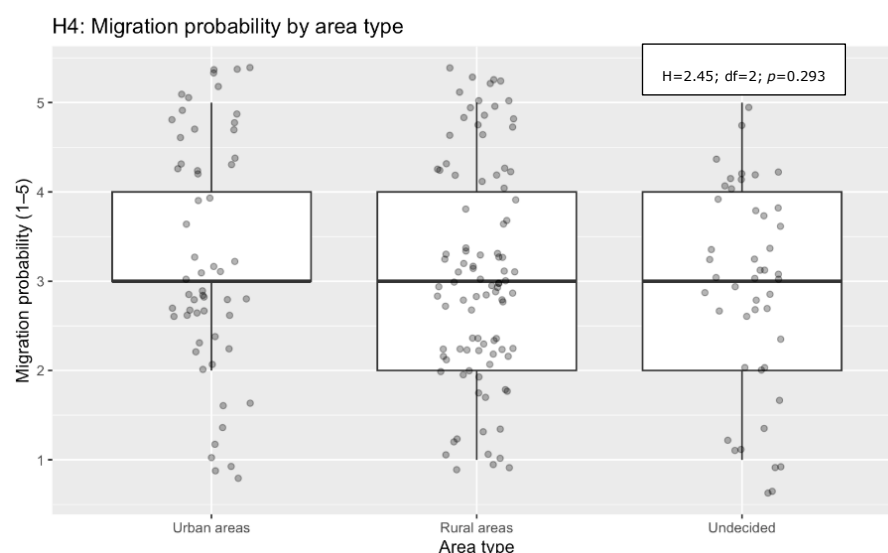


Figure 7. Migration probability by settlement type; Kruskal-Wallis test result

5. Discussion

The Republic of Serbia experiences various forms of spatial mobility that influence its socioeconomic and demographic development. In examining the factors that determine population migration in Serbia, the academic literature primarily emphasizes economic, social, and political factors, as confirmed by numerous studies (Langović et al., 2026a; Todorović et al., 2021; Šantić et al., 2021). Although, to the authors' knowledge, empirical research on the impact of air pollution on population migration has not been conducted in Serbia, the results of our research suggest that this aspect requires greater attention. Considering recent research findings (Langović et al., 2025) indicating a connection between solar activity and population displacement, it is evident that the mechanisms driving population migration in Serbia extend beyond social, cultural, political, and economic frameworks.

Our findings indicate that air pollution affects quality of life of the respondents in the City of Belgrade and plays a meaningful role in shaping their migration intentions. Education appears to be particularly relevant in this regard, possibly reflecting differences in mobility opportunities and access to resources necessary for relocation. Our results align with those of Mikula & Pytliková (2021), who explained that more educated people have better knowledge of the health impacts of air pollution, which is a key reason for migration from areas threatened by it. Additionally, the younger population considers family planning in this context. In the context of the City of Belgrade, it can be assumed that if these patterns persist, they may affect the region's demographic profile. Therefore, it is essential to monitor the entire process in the future to respond efficiently to potential challenges. Although air pollution can predominantly affect internal mobility, some respondents stated they would migrate abroad. This pattern confirms that the effects of air pollution can influence not only the development of individual regions within Serbia but also have broader negative implications for the country's demographic trends.

The outcomes of this study consist with other research (Bakhtsiyarava & Nawrotzki 2017), which showed that potential migrants prefer less polluted destinations than their current places of residence, with rural areas being particularly important for future migration destinations. This raises the question of whether rural areas in Serbia, which currently face various social and demographic challenges, can undergo a transition due to air pollution issues affecting some urban areas. Since sustainable development requires balanced regional growth (Yang et al. 2021), future considerations should take these

possibilities into account and develop policies accordingly. Given that migration interacts with every element of sustainable development (Adger et al. 2024), considering air quality as a predictor of migration would allow decision makers to base future measures and activities as appropriately as possible.

Our findings support the views of Farzanegan et al. (2023), who argue that effective migration management should prioritize addressing air quality challenges by first examining the factors influencing air pollution and then developing measures to improve the situation. In the context of Serbia, special emphasis should be placed on the potential to improve air quality in urban areas. Additionally, the findings of our research, which assessed traffic as a specific cause of air pollution in the City of Belgrade, allows this result to be considered in future discussions of the relationship between population migration and living conditions. Certainly, the City of Belgrade is just one example, investigations of this topic in other areas or municipalities with varying levels of air quality should be a priority in order to create a more comprehensive understanding of the issue.

Although our research provides insight into an important issue, we acknowledge the modest participant pool as a limitation. Therefore, we emphasize that our findings do not represent the general attitudes and intentions of the population on this topic in the City of Belgrade, but are specific to the sample of respondents who participated in the study. We encourage future research to include larger samples to confirm these results and determine whether the observed patterns persist across broader populations. However, the sample in this research allowed for a detailed overview of significant aspects of the issues in the targeted area. By applying established statistical procedures, this study offers important insights into issues that are poorly documented in Serbia and thus fills a gap in the existing literature.

6. Conclusions

In this paper, we examined the relationship between air pollution and migration intentions among individuals in the City of Belgrade, Serbia. The research revealed significant dissatisfaction with air quality in Belgrade, a link between satisfaction with air quality and migration intentions, that predominantly young and educated individuals are the most vulnerable group in this context, and a preference for rural over urban areas as potential destinations. The research showed a clear connection between air pollution, quality of life, and migration, with migration as the final stage in this chain.

Our paper provides insight into issues that could be further investigated to enable a more comprehensive approach and explanation. As the City of Belgrade has faced numerous air pollution issues for years, along with various types of migration, research of this kind offers a new perspective for understanding the connection between these elements. Additionally, this paper suggests that the topic could be explored not only in the City of Belgrade but also in other regions of the country. Research questions such as: *Will migration and migration intentions increase if air quality worsens? Is rural transformation possible as a result of migration from urban areas? Are these types of migration sustainable, or are they temporary?* are crucial for understanding the relationships between air pollution and population mobility, as well as for their practical significance, particularly in the context of sustainable development.

Acknowledgments: This work was funded by the Institute of Physics Belgrade, University of Belgrade, through a grant by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia. This work was also supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract number 451-03-34/2026-03/200091).

Author contributions: Conceptualization, M.L. (Milica Langović); methodology, M.L. (Milica Langović) and Z.V.; formal analysis, M.L. (Milica Langović) and Z.V.; investigation, M.L. (Milica Langović) and M.L. (Marko Langović); writing—original draft preparation, M.L. (Milica Langović),

V.S., Z.V. and M.L (Marko Langović); writing—review and editing, M.L. (Milica Langović), Z.V., V.S. and M.L. (Marko Langović); visualization, M.L. (Milica Langović) and Z.V.

References

1. Abed Al Ahad, M. (2024) Air Pollution Reduces the Individuals' Life Satisfaction Through Health Impairment. *Applied Research Quality Life*, 19, pp. 1049–1073. <https://doi.org/10.1007/s11482-024-10273-5>
2. Adger, WN.; Fransen, S.; de Campos, RS.; Clark, WC. (2024) Migration and sustainable development. *Proceedings of the National Academy of Sciences of the United States of America*, 121(3), e2206193121. <https://doi.org/10.1073/pnas.2206193121>
3. Bakhtsiyarava, M.; Nawrotzki, RJ. (2017) Environmental Inequality and Pollution Advantage among Immigrants in the United States. *Appl Geogr*, 81, pp. 60–69. <https://doi.org/10.1016/j.apgeog.2017.02.013>
4. Bernardo, G.; Commendatore, P.; Fosco, G. (2024) Revealing the Link Between Air Pollution and Internal Migration: Evidence from Italy. Department of Economics e Management – University di Pisa, Discussion papers n. 312.
5. Bjelajac, Z.; Dukic Mijatovic, M.; Kozar, V. (2015) Impact of air quality in Belgrade on human health and safe environment. *Oxidation Communications*. 38, 4A, pp. 1967–1977.
6. Black, R.; Adger, WN.; Arnell, NW.; Dercon, S.; Geddes, A.; Thomas, DSG. (2011) The effect of environmental change on human migration. *Global Environmental Change*, 21, pp. 3–11. <http://dx.doi.org/10.1016/j.gloenvcha.2011.10.001>
7. Castells-Quintana, D.; Dienesch, E.; Krause, M. (2021) Air pollution in an urban world: A global view on density, cities and emissions. *Ecological Economics*, 189, 107153.2021.
8. Ehler, I.; Bader, F.; Rüttenauer, T.; Best, H. (2024) The air pollution disadvantage of immigrants in Germany: partly a matter of urbanity. *European Sociological Review*, 40(4), pp. 551–565. <https://doi.org/10.1093/esr/jcad046>
9. Fang, Z.; Wu, P-Y.; Lin, Y-N.; Chang, T-H.; Chiu, Y-h. (2021) Air Pollution's Impact on the Economic, Social, Medical, and Industrial Injury Environments in China. *Healthcare*, 9(3), pp. 261 <https://doi.org/10.3390/healthcare9030261>
10. Farzanegan, MR.; Gholipour, HF.; Javadian, M. (2023) Air pollution and internal migration: evidence from an Iranian household survey. *Empir Econ*. 64, pp. 223–247. <https://doi.org/10.1007/s00181-022-02253-1>
11. Gul, H; Kumar Das, B. (2023) The Impacts of Air Pollution on Human Health and Well-Being: A Comprehensive Review. *Journal of Environmental Impact and Management policy*, 3(6), pp. 1–11. <https://doi.org/10.55529/jeimp.36.1.11>
12. Hospido, L.; Sanz, C.; Villanueva, E. (2023) Air pollution: a review of its economic effects and policies to mitigate them. *Documentos Ocasionales / Banco de España*, 2301. <https://doi.org/10.53479/27332>
13. Hunter, LM.; Nawrotzki, RJ. (2016) Migration and the environment. Ch 21, p.465–484. In *Handbook of Migration and Population Distribution*. M. J. White (Ed.). Dordrecht, Netherlands: Springer. https://doi.org/10.1007/978-94-017-7282-2_21

14. Hunter, LM.; Simon, DH. (2022) Time to Mainstream the Environment into Migration Theory? *International Migration Review*, 57(1), pp. 5-35.
<https://doi.org/10.1177/01979183221074343>
15. IOM (2009) Migration, climate change and the environment. International Organization for Migration. Available online
https://www.iom.int/sites/g/files/tmzbd1486/files/2018-07/compendium_climate_change_0.pdf (accessed on 20/January/2026)
16. Kilpatrick, DJ.; Hung, P.; Crouch, E.; Self, S.; Cothran, J.; Porter, DW.; Eberth, JM. (2024) Geographic Variations in Urban-Rural Particulate Matter (PM2.5) Concentrations in the United States, 2010–2019. *GeoHealth*, 8,e2023GH000920. <https://doi.org/10.1029/2023GH000920>
17. KIRS (2024) Migration profile of the Republic of Serbia 2024. Commissariat for Refugees and Migration Republic of Serbia. Available online
<https://kirs.gov.rs/media/uploads/Migracioni%20profil%20Republike%20Srbije%20za%202024-%20godinu.pdf> (accessed on 22/January/2026)
18. Langović, M.; Popović, S.; Dragičević, S.; Stojanović, Ž.; Manić, E. (2024) Assessment of the Economic Consequences of Riverbank Erosion: The Case of the South Morava River, Serbia. *Water economics and policy*, 10(2). <https://doi.org/10.1142/S2382624X24500036>
19. Langović, M.; Srećković, V.; Vidović, Z.; Langović, M.; Mijić, Z. (2025) The nexus between solar activity and population displacement: The case study of Southern Europe. *Journal of the Geographical Institute Jovan Cvijic, SASA*, pp. 1-17.
<https://doi.org/10.2298/IJGI250621017L>
20. Langović, M.; Šantić, D.; Đorđević, D. (2026) Is return migration the end of the migration cycle? Evidence from Serbia. In J. J. Stanković, A. Lue, & C. van der Laag (Eds.), *Regional and Urban Challenges and Opportunities for Data-Policy Interactions: The Western Balkans and Eastern European Countries* (pp.85-99). Springer Nature.
https://doi.org/10.1007/978-3-032-08592-4_5
21. Langović, M.; Srećković, V.A.; Vidović, Z. (2026a) Trend Analysis of Internal Migration in Serbia. *Mitteilungen der Österreichischen Geographischen Gesellschaft*, 167. Jg., S. 255-277, (Annals of the Austrian Geographical Society, Vol. 167, pp. 255-277) Wien (Vienna) 2025,
<https://doi.org/10.1553/moegg167-112>
22. Liang, L.; Gong, P. (2020) Urban and air pollution: a multi-city study of long-term effects of urban landscape patterns on air quality trends. *Scientific Reports*, 10(1), 18618.
<https://doi.org/10.1038/s41598-020-74524-9>
23. Lukić, V.; Lović Obradović, S. (2025) Srbija kao odredište: ko se doseljava, a ko se vraća?. Statistical Office of the Republic of Serbia. ISBN 978-86-6161-272-5.
24. Ma, S.; Li, X.; Li, D.; Guo, H. (2023) Does air pollution induce international migration? New evidence from Chinese residents. *Economic Modelling*, 120, 106176,
<https://doi.org/10.1016/j.econmod.2022.106176>
25. Mikula, Š.; Pytlíková, M. (2021) Air Pollution and Migration: Exploiting a Natural Experiment from the Czech Republic. *IZA Institute of Labor Economics*. IZA DP No. 14863.
26. Momčilović, P. (2021) Vazduh kao zajedničko dobro. Rosa-Luxemburg-Stiftung Southeast. ISBN: 978-86-88745-50-5.

27. Nourou, M.; Freddy, YHM.; Benguella, W-I.; Ignace Eric, A. (2024) Effects of International Migration on Air Pollution in Developing Countries. *Research Square*. <https://doi.org/10.21203/rs.3.rs-4183772/v1>
28. Official Gazette of the RS, no. 129/2007, 18/2016, 47/2018 and 9/2020 – other law. Available online https://www.paragraf.rs/propisi/zakon_o_teritorijalnoj_organizaciji_republike_srbije.html (accessed on 20/January/2026)
29. Piracha, A; Chaudhary, MT. (2022) Urban Air Pollution, Urban Heat Island and Human Health: A Review of the Literature. *Sustainability*, 14(15), pp. 9234. <https://doi.org/10.3390/su14159234>
30. RERI (2023) Analiza primene plana kvaliteta vazduha za Grad Beograd. Renewables and Environmental Regulatory Institute. Available online <https://reri.org.rs/wp-content/uploads/2023/09/Analiza-primene-Plana-kvaliteta-vazduha-z-a-Grad-Beograd-1.pdf> (accessed on 02/February/2026)
31. RERI (2024) Analiza godišnjeg izveštaja o stanju kvaliteta vazduha u Republici Srbiji za 2022. godinu. Regulatorni institut za obnovljivu energiju i životnu sredinu. ISBN-978-86-81830-13-0.
32. RERI (2024a) Analiza stanja kvaliteta vazduha u Republici Srbiji za 2024. godinu. Regulatorni institut za obnovljivu energiju i životnu sredinu. ISBN-978-86-81830-18-5.
33. RTS (2025) Beograd jutros drugi najzagađeniji veliki grad na svetu. Radio Televizija Srbije. Available online <https://www.rts.rs/lat/vesti/drustvo/5659995/beograd-vazduh-zagadjenje.html> (accessed on 22/January/2026)
34. Rüttenauer, T.; Best, H. (2022) Perceived pollution and selective out-migration: revisiting the role of income for environmental inequality. *Journal of Ethnic and Migration Studies*, 48(15), pp. 3505–3523. <https://doi.org/10.1080/1369183X.2022.2030211>
35. Šantić, D.; Todorović, M.; Perišić, N. (2021) The 'New Normal' in Migration Management in Serbia in Times of the COVID-19 Crisis. *Journal of Balkan and Near Eastern Studies*, 24, pp. 557–575. <https://doi.org/10.1080/19448953.2021.2015659>
36. Shen, F.; Wang, Q.; Zou, J.; Yan, H.; Wang, B. (2023) Air Pollution and Migration Decision of Migrants in Low-Carbon Society. *Int. J. Environ. Res. Public Health*, 20, 870. <https://doi.org/10.3390/ijerph20010870>
37. Singh, AK.; Kumar, M.; Baudh, K.; Singh, A.; Singh, P.; Madhav, S.; Kumar Shukla, S. (2023) Environmental impacts of air pollution and its abatement by plant species: A comprehensive review. *Environmental Science and Pollution Research* 30, 79587–79616. <https://doi.org/10.1007/s11356-023-28164-x>
38. SORS (2013–2024) Demographic Yearbooks 2005–2023. Statistical Office of the Republic of Serbia. Available online <https://www.stat.gov.rs/publikacije/?a=18&s=&d=14&r=> (accessed on 10/January/2026)
39. SORS (2025) Internal migration 2024. Statistical Office of the Republic of Serbia. Available online <https://www.stat.gov.rs/sr-latn/vesti/statisticalrelease/?p=17038> (accessed on 10/January/2026)

40. Stanojević, G.; Malinović-Milićević, S.; Brđanin, E.; Milanović, M.; Radovanović, MM.; Popović, T. (2024) Impact of Domestic Heating on Air Pollution—Extreme Pollution Events in Serbia. *Sustainability*, 16(18), 7920. <https://doi.org/10.3390/su16187920>
41. Tasic, M.; Rajsic, S.; Tomasevic, M.; Mijic, Z.; Anicic, M.; Novakovic, V.; Markovic, DM.; Markovic, DA.; Lazic, L.; Radenkovic, M.; Joksic, J. (2008) Assessment of Air Quality in an Urban Area of Belgrade, Serbia. In: *Environmental Technologies*, Ed. E. Burcu Ozkaraova Gungor. <https://doi.org/10.5772/5307>
42. The Guardian (2023) Belgrade: the city where dirty air is seen as a 'consequence of economic growth'. The Guardian. Available online <https://www.theguardian.com/world/2023/sep/22/belgrade-serbia-air-pollution> (accessed on 02/February/2026)
43. Todorović, M.; Javor, V.; Radić, N. (2021) Emigration Potential of Youth in Serbia. *Migration and Ethnic Themes*, 36(2-3), pp. 155-171. <https://doi.org/10.11567/met.36.2.2>
44. UN (2021) Air Pollution in the Western Balkans Key messages for policymakers and the public. United Nations Environment Programme. Available online <https://www.ccacoalition.org/resources/air-pollution-western-balkans-key-messages-policy-makers-and-public> (accessed on 10/February/2026)
45. UN (2024) International Migration and Sustainable Development. United Nations. Available online https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/un_desa_pd_2024_megatrends3-international_migration.pdf (accessed on 10/February/2026)
46. Vidaković, DM. (2013) Multicriteria analysis of air quality in urban areas depending on climatic factors. University of Belgrade - Technical Faculty in Bor. Doctoral thesis. Available online <https://nardus.mpn.gov.rs/bitstream/id/16755/Disertacija.pdf>
47. Vontroba, J. (2024) Does the opinion of residents matter? An analysis of migration in European cities. Proceedings of the International Scientific Conference, 285-294. <https://doi.org/10.2478/9788367405973-025>
48. Vuong, Q-H.; Le, T-T.; Nguyen, Q-L.; Nguyen, Q-T.; Nguyen, M-H. (2021) Escaping from air pollution: The psychological process of domestic migration intention among urban people. *Physics and Society*. Available online <https://arxiv.org/abs/2108.00497>
49. Wang, G.; Shi, X.; Cui, H.; Jiao, J. (2020) Impacts of Migration on Urban Environmental Pollutant Emissions in China: A Comparative Perspective. *Chin. Geogr. Sci*, 30, pp. 45-58. <https://doi.org/10.1007/s11769-020-1096-1>
50. XEco (2025) EU AQI Rang lista. XEco. Available online <https://xeco.info/xeco/vazduh/Beograd%20Palilula-Divljih%20jabuka-1013817> (accessed on 10/January/2026)
51. Yang, B.; Ding, L.; Tian, Y. (2021) The influence of population agglomeration on air pollution: An empirical study based on the mediating effect model. *OP Conf. Series: Earth and Environmental Science*, 687, 012014. <https://doi.org/10.1088/1755-1315/687/1/012014>
52. Yu, X.; Liang, J.; Zhang, Y. (2022) Air Pollution and Settlement Intention: Evidence from the China Migrants Dynamic Survey. *Int J Environ Res Public Health*, 19(8), pp. 4924. <https://doi.org/10.3390/ijerph19084924>



© 2021 by the authors. Licensee UAIC, Iasi, Romania. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY-NC-ND) license (<https://creativecommons.org/licenses/by-nc-nd/4.0>).