

The impact of Air Pollution on Public Health and Tourism in Kosovo

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Abstract: - One of the biggest problems of today is air pollution. Since the beginning of the industrial revolution, air pollutants have continuously and rapidly increased their concentrations in the air, achieving dramatic results in modern life. Kosovo is no exception. Although there has been a decrease in air pollutants in recent years, their concentration in Kosovo is above the EU standards and the World Health Organization guidelines. The aim of this paper is to determine the impact of air pollution in Kosovo on deaths caused by respiratory diseases (since respiratory diseases are the primary, direct and most obvious consequence of polluted air). For this purpose, the paper uses the multiple regression method, which determines the impact of air pollution on the one hand (taking into account the concentrations of six air pollutants as independent variables: PM10, PM2.5, SO2, NO2, CO and Ozone) and deaths due to respiratory diseases on the other hand (as a dependent variable). The analysis showed that there is a huge (almost ideal) direct proportional interdependence between air pollution in Kosovo and the number of deaths due to respiratory diseases, which is shown by the correlation coefficient of 0.995. The coefficient of determination of 0.990 shows that as many as 99% of deaths due to respiratory diseases in Kosovo are due to polluted air. Accordingly, air pollution in Kosovo is a significant predictor of the number of deaths due to respiratory diseases, which can also be seen from the significance level of this analysis (p) which is 0.03. Therefore, it is necessary to take a series of significant measures by both state authorities and industrial facilities, as well as by households, to reduce the concentration of pollutants in the air in order to ensure the protection of the health and life of people, other wildlife and the environment.

Key-Words: - Air pollution, pollutants, respiratory diseases, death, Kosovo.

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1 Introduction

Air pollution is one of the most prevalent phenomena that pose serious environmental risks to public health in Kosovo, as it is linked to various diseases, such as respiratory diseases. Although there has been a decrease in air pollutants in recent years, their concentration in Kosovo is above the EU standards and the World Health Organization guidelines

2 Literature Review

2.1 Air pollution and pollutants

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment, [1].

Air pollution is a complex mix of solid particles, liquid droplets and gaseous chemicals emitted in the atmosphere, [2].

Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that they can produce undesirable effects on man and his environment, [3].

A substance in the air that can be adverse to humans and the environment is known as an air pollutant, [4].

A substance present in the air that can be harmful to humans and the environment is called an air pollutant.

Air pollutants, according to their aggregate state, can be in a solid state (solid emitted particles), liquid state (droplets) and gaseous state (emitted harmful gases), [5].

3 Negative Effects of Air Pollution

Regarding air pollution, Kosovo does not differ largely from the other countries in the Balkan region. Moreover, the people's behavior and awareness in the country in terms of air pollution is not satisfactory, as is stated in the European Quality of Life Survey [6] and Kosovo Mosaic Survey [7]. Less than 23% of Kosovo's population perceive the ambient air quality as poor, and this percentage is much higher among the Pristina agglomeration population, especially Obiliq, due to the proximity to power plants, [8], [9], [10].

Air pollution, in addition to having negative health effects on people and other living beings, also results in numerous negative environmental effects, climate changes and global warming as well as negative effects on economy.

Some of the negative environmental effects are the following: destruction of vegetation, disruption of ecosystems, reduction of the area of fertile land, conversion of fertile land into barren (or desertification), destruction of forests (a process known as deforestation), reduced growth of seedlings, increased susceptibility of the plants to pests and diseases, reduction of the aesthetic value and attractiveness of areas.

Air pollutants released from motor vehicles and industrial facilities can accumulate in water bodies (lakes, seas, oceans) and cause eutrophication (growth and bloom of plants and algae that leads to depletion of oxygen levels in the water and thus makes it unsuitable for the existence of animal species).

The increased concentration of pollutants in the air leads to the creation of fog, which results in reduced visibility.

Greenhouse gases amplify the greenhouse effect, which leads to climate change and global warming, a negative environmental effect that has been particularly felt in recent years across the entire planet Earth.

About an eightfold increase in global healthcare expenditure is expected due to the global rising trend of air pollution emission from economic growth and increasing energy demand worldwide. Air pollutants such as O₃ decrease the crop yield, which all have adverse impacts on the economy. The OECD expects the combined market cost from health spending, labor productivity, and crop yield to take up 1.0% of global GDP by 2060 compared to 0.3% in 2015 due to the globally increased air pollution trend. The non-market costs are costs that cannot be readily observed as monetary values but affect the quality of life. According to the OECD report, there are two major nonmarket costs associated with air pollution. The first factor is a decrease in the quality of life due to illnesses associated with air pollution such as hospital admission, pain, and inability to continue regular activity (morbidity). The OECD report predicts that the global WTP for morbidity will increase to 2.2 trillion USD by 2060, compared to 280 billion USD in 2015. The second factor is an increase in premature deaths caused by air pollution. The WTP is much higher for premature death as compared to the morbidity since the global WTP for premature death is expected to reach 18-25 trillion USD by 2060 as compared to 3.2 trillion USD in 2015. Such a six-fold to eightfold increase in WTP between those two time frames is attributed to a projected increase in premature deaths. Air pollution poses a significant threat to human health and is considered the largest environmental issue globally. Additionally, it is a preventable factor leading to death and disease development, [11].

4 Methodology

The paper uses data on air pollution, the concentration of individual air pollutants, the number of people suffering from respiratory diseases, deaths due to respiratory diseases and deaths due to air pollution in Kosovo. These relevant data are taken from the Kosovo Agency of Statistics, the Ministry of Environment, Spatial Planning and Infrastructure of Kosovo, as well as from the World Bank.

The impact of air pollution on deaths due to respiratory diseases in Kosovo is specifically analyzed (since respiratory diseases are the primary, direct and most obvious consequence of polluted air), using the multiple regression method.

5 Air Pollution in Kosovo

Air quality monitoring in Kosovo is divided into two zones; the Agglomeration AKS1 and the Zone ZKS1, [5].

In Kosovo, urban centers experience higher air pollution than rural areas, with the highest pollution in industrial areas.

The largest air pollutants in Kosovo are outdated coal fired power plants: Kosovo A - commissioned in the 1970s and Kosovo B – that dates from 1980s; lignite surface mining in Sibovc coal mine; quarries; asphalt production; industrial facilities for metalworking, non-metal, chemical industry, construction material industry, wood industry, paper industry, textile industry, etc.; road, rail and air transport, urban and industrial landfills, agricultural pollution and combustion, household heating and the incineration of waste and other toxic materials.

Table 1 shows the trend in air quality in Kosovo for the period 2013 - 2023, which represents the annual average for the main air pollutants in Kosovo (PM10, PM2.5, O₃, SO₂, NO₂ and CO).

Table 1. Air quality data from 2013-2023

Year	PM10	PM2,5	O ₃	SO ₂	NO ₂	CO
2013	45,71	28,86	59,90	6,37	15,57	0,72
2014	37,52	18,73	41,37	13,6	16,56	1,20
2015	48,91	33,87	38,09	14,7	21,45	2,18
2016	33,86	17,91	47,66	20,63	27,36	2,36
2017	34,71	25,36	26,22	16,19	26,22	1,93
2018	41,57	25,43	45,18	34,65	26,45	1,87
2019	28,94	20,75	43,02	11,05	23,91	1,05
2020	28,47	20,58	48,99	12,55	15,04	0,98
2021	23,10	16,66	50,57	10,64	12,25	0,80
2022	22,21	16,06	47,05	9,40	15,12	0,70
2023	18,97	14,11	47,81	8,53	13,52	0,61

Source: [5]

Based on the data in the table, it can be noted that from 2020 to 2023 there has been a significant improvement (decrease) in the parameters for M10, PM2.5, SO₂, NO₂ and CO, with the exception of ozone which has a slight increase, but it is still within the limits of the prescribed air quality standards, which for ozone is up to 120 µg/m³.

Figure 1 shows the average annual values for pollutants in Kosovo for the period from 2013 to 2023.

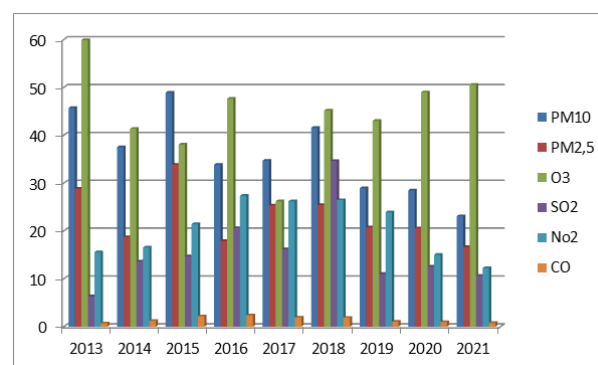


Fig. 1: Air quality data from 2013-2021

Source: [12]

6 Negative Effects Of Air Pollution In Kosovo

In Kosovo, 1150 deaths per year may be attributed to the current level of fine particulate matter 2.5 (PM2.5). A significant number of premature deaths (758 per year) caused by long-term exposure to PM2.5 could be avoided if the values recommended in WHO AQG were met. In 2019, it was estimated that 1127 years of life were lost in adults (aged 30 and over) due to exceedance of the WHO AQG limits, [6].

About 760 people die prematurely every year in Kosovo because of exposure to AAP. Prishtina carries about 11% of this health burden. Of the total number of AAP-related deaths, 90% are from Ischemic Heart Diseases (IHD) and stroke combined. About 53% of IHD and 63% of strokes occur in people of productive age before attaining the age of 70. Population age groups between 50 and 69 years old carry the largest share (about 45%) of the total health burden associated with exposure to AAP, followed by people over 70 years of age.

The estimated economic cost associated mortality from exposure to air pollution in Kosovo is in the range of US\$160–US\$310 million, equivalent to 2.5–4.7% of gross domestic product (GDP) in 2016. The economic costs associated with the health damage from AAP in Kosovo is on average US\$240 million, equivalent to 3.6 % of GDP in 2016. This study updates the cost estimates of an earlier World Bank study [7], by taking into account improvements in air quality monitoring and exposure and background mortality data, as well as the latest methodological advances for calculating age-specific and diseases-specific mortality impacts and for health impact valuation since the previous estimates.

Emissions of key air pollutants have increased by 26% from 2023 to 2024, according to the latest

report by the European Commission for Kosovo. Environmental experts say that the main cause of this is coal-fired power plants. Moreover, health experts warn that the increased release of sulfur dioxide, nitrogen oxides and dust into the air could have permanent consequences for people. Emissions of sulfur dioxide, nitrogen oxides, and dust in the air increased by nearly 26% in 2024, compared to the previous year, the latest European Commission report on Kosovo has shown.

According to this report, the level of sulfur dioxide has increased from 10.495 tons in 2023 to 11,713 tons in 2024. That of nitrogen oxides, from 11,384 tons in 2023 to 16,851 tons in 2024, and that of dust from 4,742 tons to 5,606 tons, [8].

In addition to individual impacts, air pollution also has major consequences for the health system and the economy as a whole. Increased morbidity is associated with a greater number of hospital visits and high healthcare costs. Therefore, it is imperative to take measures to reduce pollution and protect public health, [9].

Table 2 shows the number of deaths in Kosovo due to respiratory diseases for the period from 2013 to 2021.

In 2013, in Kosovo were recorded 161 deaths from respiratory diseases, and in 2021 that number was 812, which represents an increase of as much as 404.35%.

The number of deaths due to respiratory diseases in Kosovo has been continuously increasing in both sexes in the period from 2013 to 2021, with the number of registered deaths being higher among male residents than among female residents.

Table 2. Deaths in Kosovo according to the classification of disease groups – Respiratory system diseases J00 – J99 from 2013 to 2021

Year	Men	Women	Total
2013	90	71	161
2014	133	94	227
2015	214	181	395
2016	369	313	682
2017	334	329	663
2018	170	111	281
2019	313	280	593
2020	365	273	634
2021	439	373	812

Source: [13]

When analyzing the increase in deaths due to respiratory diseases, it is noted that it is far higher among female residents and amounts to as much as 425.35%, unlike male residents where the increase

in the number of deaths in 2021 compared to 2013 is 387.78%.

Figure 2 presents the number of deaths in Kosovo (total and by gender) due to respiratory diseases for the period 2013 – 2021.

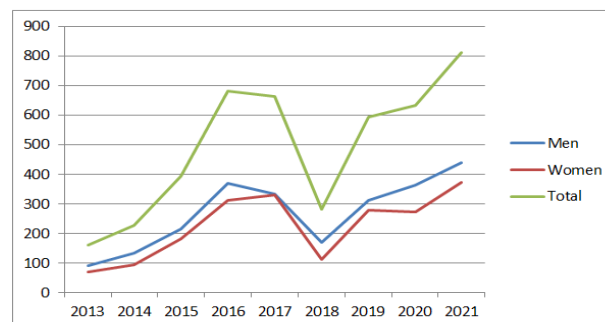


Fig. 2: Deaths in Kosovo according to the classification of disease groups – Respiratory system diseases J00 – J99

Source: [13]

In order to determine the impact of air pollution in Kosovo on the number of deaths due to respiratory diseases, a regression analysis was performed on relevant official data taken from the relevant institutions. The analysis showed that there is a huge (almost ideal) direct proportional interdependence between air pollution in Kosovo and the number of deaths due to respiratory diseases, which is shown by the correlation coefficient of 0.995 (Table 3). The coefficient of determination ($R^2 = 0.990$) indicates that about 99% of the variation in deaths from respiratory diseases in Kosovo is explained by variations in air pollution levels included in the model, suggesting a very strong association between air pollution and respiratory mortality. However, this result does not necessarily imply direct causation, as other factors (e.g., smoking, age, socioeconomic conditions, access to health services) may also play a role. Accordingly, air pollution in Kosovo is a significant predictor of the number of deaths due to respiratory diseases, which can also be seen from the significance level of this analysis (p) which is 0.03 (Table 4).

Table 3. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,995 ^a	,990	,960	46,38301

Predictors: (Constant), CO, PM2.5, O3, SO2, NO2, PM10.

Source: Author calculation

Table 4. ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig
Regression	427474,789	6	71245,798	33,116	,03
Residual	4302,767	2	2151,383		0 ^b
Total	431777,556	8			

a. Dependent Variable: death from

b. Predictors: (Constant), CO, PM2.5, O3, SO2, NO2, PM10

Source: Author calculation

7 Recommendations that Contribute to Reducing Air Pollution in Kosovo

Air pollution is one of the dominant environmental problems in Kosovo, which has a direct and huge negative impact on the life and well-being of the population.

Therefore, urgent and significant measures should be taken to reduce the concentration of air pollutants in order to protect the population of Kosovo, other wildlife, and the environment.

- increased control over industrial capacities by the competent institutions in Kosovo and introduction of legal provisions for maximum sufficient emission of harmful gases into the atmosphere,
- improving the energy efficiency of existing industrial capacities, using modern equipment as well as control devices that can destroy pollutants or remove them from exhaust gases before they are released into the atmosphere (such as mechanical collectors, electrostatic precipitators, particulate scrubbers etc.),
- recycling,
- encouraging the population to use public transport instead of individual transport (cars),
- encouraging the population to use more bicycles instead of cars,
- increase cooperation between relevant environmental institutions, operators and citizens in information, reporting and protection of air pollution.
- improving environmental education in schools,
- supporting education programs for green jobs (including jobs in air quality).

8 Tourism in Kosovo

Tourism constitutes an important and influential sector in the economy, creating multiple uses and benefits. This sector, among other things, generates income, creates jobs, influences the creation of state infrastructure, as well as promotes cultural exchanges between host countries and visitors.

In Kosovo, based on the advantages and opportunities that the country has, there is a great

potential for the development of this sector. Seeing this potential, the Government of the Republic of Kosovo, in its governing programs, treats the development of the tourism sector as one of its priorities. In the Government Program 2021-2025, which is considered as a basic document for the work of the government, the development of sustainable tourism is highlighted as one of the priority areas for sustainable economic development. According to this document, the main focus of the Government in this context is expected to be the development of cultural tourism and natural tourism (mountainous and rural), through the expansion of the tourist offer, the improvement of infrastructure, digitization and the drafting of cross-sectoral plans. In order to concretize these government plans and to more clearly define the strategic orientations of the tourism industry, the need to have a state tourism strategy has emerged. The drafting of this strategy is foreseen in the Government's National Development Plan 2023-2025, while it is also harmonized with the Program for Economic Reforms 2023-2025 and the National Program for European Integration 2023-2027. Based on the above commitments, the Government of the Republic of Kosovo, in cooperation with the relevant ministries of the line – Ministry of Culture, Youth and Sports (MCYS), Ministry of Environment and Spatial Planning and Infrastructure (MESPI), Ministry of Agriculture, Forestry and Rural Development (MAFRD), Ministry of Education, Science, Technology and Innovation (MESTI), Ministry of Internal Affairs and Public Administration (MIAPA), Ministry of Foreign Affairs and Diaspora (MFAD), Ministry of Local Government Administration (MLGA), municipalities and with the help of other tourism actors, is committed to drawing up the strategy state tourism, covering the period 2024-2030, [10].

The work for the design of this strategy was guided by the principles of the "Model of St. Gallen for destination management" (SGDM), [14]. This model offers an alternative and innovative approach to understand the complex behaviors and dynamics of tourists. The main focus of this approach is strategic visitor flows. Flow-level analysis explains the factors that influence certain visitor behaviors and the interrelationships they have with demand and supply. This approach has been selected because it allows to reflect the strategic interaction of visitors with the destination and through this to understand more clearly the problems and needs they have. This strategy contains the general methodology and the steps followed for drafting the strategy.

9 The Impacts of Climate Change on Health

Climate change undoubtedly represents one of the main global challenges facing humanity in protecting the environment today.

Data on air temperature in Kosovo, originating from the Hydro meteorological Institute of Kosovo and international institutions, show that in Kosovo since 1900 until today, there have been movements in average annual temperatures with an increasing trend, [15].

In Kosovo, total greenhouse gas emissions range between 9,489 Gg CO₂ eq. (in 2008) and 10,164 Gg CO₂ eq. (in 2016). Emissions depend mainly on energy demand and the activities of the energy sector, which is the main source of CO₂ at the national level, which comes mainly from two coal-fired power plants. Kosovo has higher CO₂ emissions than some of the countries in the region.

Concerned about the effects of the fossil fuel industry, mayors around the globe in the C40 network have agreed to begin “greening” cities in order to expand the uptake and access to clean and affordable electricity for millions of urban residents. Increasing renewable energy sources leads to multiple benefits that result in mitigating the effects of climate change and providing a healthier environment for all, [16]. To join the global effort, the mayors of nine participating municipalities in the Western Balkans (Bosnia and Herzegovina: Banovići, Kakanj, Lukavac, Maglaj, Tuzla; Serbia: Novi Sad, Niš; Montenegro: Pljevlja; North Macedonia: Bitola) have pledged to take voluntary measures aimed at reducing air pollution in their municipalities under the ‘Clean Air Regions Initiative’ (CARI). Cities under the CARI initiative will strive to adopt and implement local air quality action plans with ambitious policies and measures, share their experiences and learn from progress and achievements in other regions. Unfortunately, the city of Prishtina did not join the initiative, but there is still an opportunity to implement measures that clean the air and protect health, [17].

10 Conclusion

Air quality in Kosovo continues to represent a significant health issue as ambient concentrations of PM 2.5 significantly exceed Kosovo’s standards, as well as those of the European Union and WHO. The average PM 2.5 concentration in Kosovo in 2023 is 2,4 times higher than the WHO annual air quality guideline value.

However, the negative effects of these pollutants on the human body depend on the concentration and type of the pollutants (i.e. the level of air pollution), the duration of a person's exposure to individual pollutants, their previous health status and genetics.

Air pollution, in addition to having negative health effects on people and other living beings, also results in numerous negative environmental effects, climate changes and global warming as well as negative effects on economy.

Therefore, it is necessary to take a series of significant measures by both state authorities and industrial facilities, as well as by households, to reduce the concentration of pollutants in the air in order to ensure the protection of the health and life of people, other wildlife and the environment.

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