Potential Strategies to Improve Air Quality in Tirana for Current and Future Generations

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Abstract

Tirana, the capital of Albania, faces severe air pollution, posing significant health risks and environmental concerns for its residents. Referring to the data for the year 2023, KTA admits that Tirana exceeds the European Union norms for PM10 and nitrogen dioxide. Annual average concentrations of PM10 and NO2 in Tirana are above the limit values of National Air Quality Standard and World Health Organization. This paper looks at the several issues that lead to Tirana's air pollution and considers ways to lower pollution levels and enhance air quality. The problems with Tirana's air pollution are intricate and varied, resulting from a confluence of elements including as topography, industrial processes, burning of biomass, vehicular emissions, and insufficient monitoring programs. Addressing these challenges requires regulatory interventions, technological innovations, public awareness campaigns and stakeholder engagement to improve air quality. Tirana has a population of 528,000 inhabitants, with a surface area of 40 km² and a population density of 13.2 thousand inhabitants. Tirana has the capacity to develop more resilient, sustainable and habitable urban areas. To realize innovative ideas, enhance green areas, and improve air quality for present and future generations, cooperation amongst urban planners, legislators, community organizations, and citizens is imperative. We identify critical actions for policy makers, urban planners, and stakeholders to mitigate air pollution and build a healthier and more sustainable urban environment in Tirana based on pollution sources, regulatory frameworks, and ongoing initiatives. This paper's goal is to offer solutions for enhancing air quality while advancing environmental sustainability and public health.

Keywords: *air pollution, urban environment, health risks, sustainability, pollution reduction strategies*

1. Introduction

Tirana's air quality has deteriorated as a result of growing urbanization, increased vehicle emissions, and industrial operations. The air quality in Tirana has been a major public health concern in recent years. As the city grows, so does the level of air pollution, which is mostly caused by traffic emissions, industrial activity, and urban sprawl. The negative effects of air pollution on human health and the environment call for rapid action. This paper investigates the current situation of Tirana's air quality, identifies the key causes of air pollution, and recommends feasible mitigation solutions for

current and future generations. The methods suggested include the introduction of stronger emission standards, promotion of sustainable public transportation, and enhancement of green spaces.

2. Current State of Air Quality in Tirana

Tirana experiences frequent episodes of poor air quality, particularly during the winter months when particulate matter (PM2.5 and PM10) levels often exceed the World Health Organization (WHO) guidelines. In 2023, the air quality in Tirana fluctuated all year. The average Air Quality Index (AQI) ranged from "Good" to "Moderate," depending on the season and environmental conditions. (Figure 1,2).

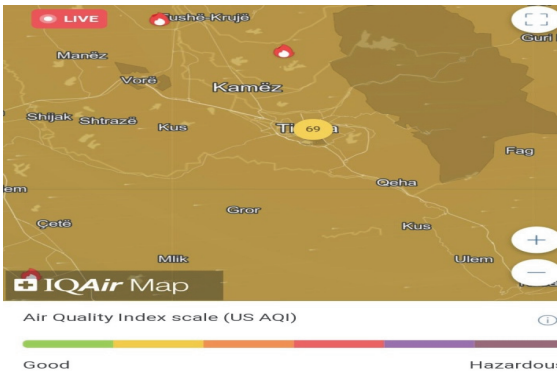

Figure 1: Air pollution air map of Tirana

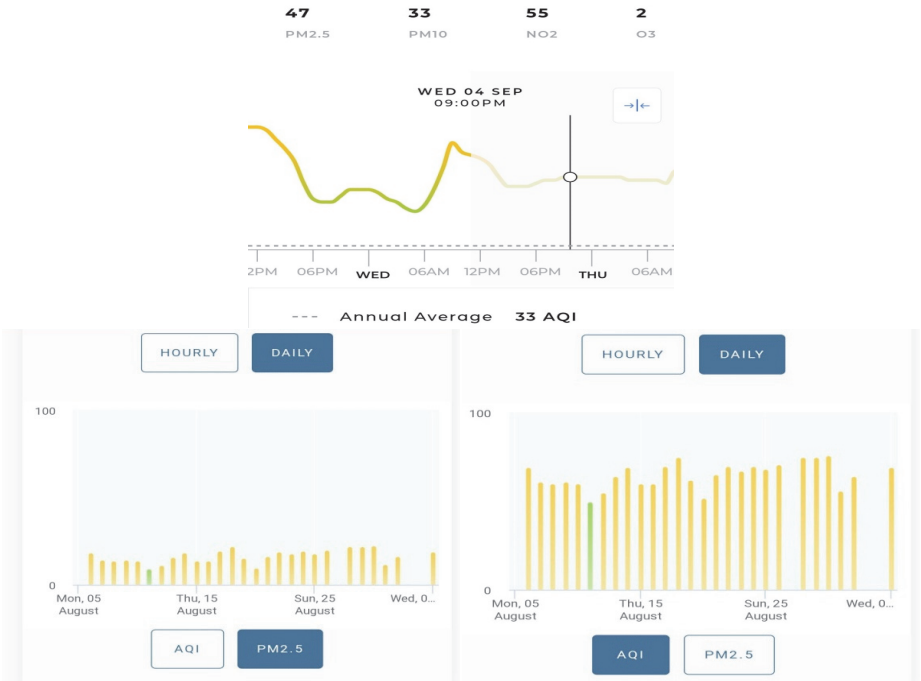

Figure 2: AQI city ranking. Real- time Albania city ranking

PM2.5 and PM10 levels were generally low, keeping air quality within healthy limits most of the time. Significant contributors to this pollution include:

Vehicular Emissions - The growing number of private automobiles, many of which are older and less efficient, contribute significantly to nitrogen oxides (NOx), carbon monoxide (CO), and particulate matter emissions.

Construction Activities - Ongoing urban growth contributes to the emission of dust and other particles. Construction sites generate a significant amount of dust and particulate matter, which can damage air quality. Excavating, demolishing, and moving heavy machinery all produce dust, which can cause lung problems for surrounding individuals. Construction projects frequently use diesel-powered gear and trucks, which produce pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), and particulate matter. These pollutants contribute to air pollution, which can have negative health consequences.

Industrial Emissions - Industrial operations, particularly on the outskirts of the city, contribute to the emission of sulfur dioxide (SO_2), volatile organic compounds (VOCs), and other pollutants. Though less substantial than traffic, certain industrial operations add to the city's air pollution problems.

The report of the National Environment Agency referring to the year 2023 shows that by analyzing the state of dust particles (PM10 and PM 2.5), in certain periods, in certain areas, different harmful indicators appear above the allowed parameters. Based on the monitoring results, for the year 2024 the annual rate of PM10 (40 μg/m^3) has been exceeded at the Tirana Hygiene Station and there is an excess of the annual PM10 rate of 35.4%, only in the months of January, February and December 2023 (Figure 3).

Table 1. Pollution in Tirana for 2023

Tirana Hygiene Station	SO_2 μg/m^3	O_3 μg/m^3	CO μg/m^3	NO_2 μg/m^3	PM_{10} μg/m^3	Benzene μg/m^3
January 2023	6.38	24.06	1.43	41.38		0.96
February 2023	4.85	33.23		38.92		0.75
March 2023	11.88	49.43	0.74	37.03		0.55
April 2023		50.03	1.56	32.82		0.47
May 2023	6.98	42.75	0.5	37.04		0.52
June 2023	4.7	51.68	0.73	35.59	57.78	0.67
July 2023	3.16	66.12	0.74	37.18	55.68	0.46
August 2023	2.57	58.71	0.49	40.02	42.62	1.59
September 2023	3.26	45.28	2.14	42.46	56.89	0.34
October 2023	2.35	34.42	1.01	38.43	50.1	1.23
November 2023	3.28	25.12	3.38	40.57	50.79	1.13
December 2023	3.67	17.09	1.34	48.76	65.28	1.02

This shows that there is an increase in PM10 dust particles only in the cold period of the year, as a result of the use of fossil materials or wood for heating homes. The average value of PM10 for the three months of January, February and December 2023 is 59.51 μg/m³ and we exceed the annual norm of PM10 (40 μg/m³) by 48.8% during winter (Figure 4). Focusing on the nitrogen dioxide indicator, for the year 2023, the annual rate of NO_2 was exceeded at the ASHR Tirana station in the months of January, August, September, October, November. In the other months of the year, the average monthly values of NO_2 are very close to the norm but do not exceed it.

This increase comes as a result of the circulation of vehicles, often with heavy traffic[1].

[1] *Tirana is the largest city in Albania characterized by heavy traffic where one of the air pollutants emitted from the road vehicles is carbon monoxide (CO)*

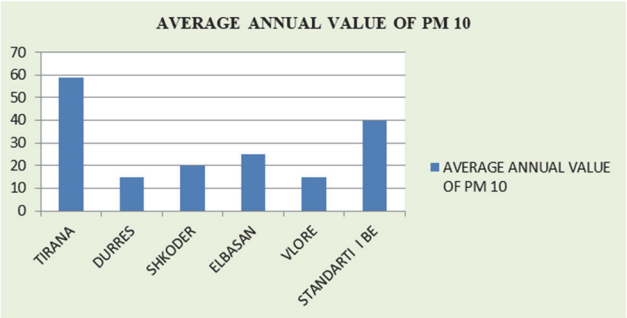

Figure 3. Average of annual value of PM 10

2.1 Pollution Levels

The city frequently suffers alarming amounts of tiny particulate matter (PM2.5 and PM10). These particles, which are frequently derived from traffic exhaust and construction dust, can pose substantial health hazards, particularly when inhaled in large quantities over time. Some places, such as central metropolitan zones, have PM2.5 levels that exceed the European Union's recommended criteria.

According to recent data, Tirana's AQI (Air Quality Index) has fluctuated, with some days seeing "moderate" pollution levels (Figure 5). This suggests that, while the air quality is not harmful, it is still enough to cause health problems for sensitive individuals, such as those with respiratory disorders. Efforts to monitor and improve air quality are underway, but the city confronts significant obstacles in lowering pollution levels to safe levels for its population.

Table 2. Tirana air quality index (AQ)

Day	Pollution level	Wind
Thursday,Aug 15 2024	Moderate 66 AQ US	11,2mp/h
Friday,Aug 16 2024	Good 46 AQ US	11,2mp/h
Saturday,Aug 17 2024	Moderate 51 AQ US	11,2mp/h
Sunday,Aug 18 2024	Moderate 57 AQ US	11,2mp/h

Enforcing stricter emission standards[2] for construction vehicles and machinery can reduce the impact of vehicle emissions. Regular air quality monitoring and reporting can help identify and address pollution sources promptly.

NO_2 levels are also elevated, especially in high-traffic regions. The concentration frequently exceeds both the EU and Albanian safety limits, adding to the city's overall pollution burden. Elevated amounts of VoCs have been identified in several hotspots throughout the city, mostly due to automotive emissions.

3. Potential Strategies for Air Quality Improvement

3.1 Strengthening Emission Regulations

Implementing stricter emissions standards for vehicles, particularly focusing on phasing out older, high-emission diesel vehicles, can significantly reduce pollutants like NO_2 and particulate matter. Tax breaks and subsidies may also play an important role in encouraging the use of electric and hybrid vehicles.

Enforcing stronger rules on industrial emissions and encouraging the use of cleaner technologies in industries surrounding Tirana would help minimize pollution from this sector.

[2] *Emission standards are the legal requirements governing air pollutants released into the atmosphere*

3.2 Promoting Sustainable Public Transportation

Investing in the creation of a comprehensive public transportation network, such as buses, trams, and cycling facilities, can minimize reliance on private vehicles. A modern and efficient public transportation system would reduce traffic congestion and overall automobile emissions. Invest in high-capacity transit options like Bus Rapid Transit (BRT) and light rail systems to service densely populated areas and lessen dependency on private vehicles. Modernizing the public transport fleet with electric or hybrid cars can cut emissions and enhance air quality.

Implementing policies that make public transport more appealing, such as fare reductions, dedicated bus lanes, and improved services, could encourage more citizens to choose public transportation over personal vehicles.

3.3 Enhancing Urban Green Spaces

Increasing the amount of green space, such as parks, green roofs, and urban forests, can help to absorb pollutants and improve overall air quality. Trees and plants operate as natural air filters, greatly lowering the concentration of airborne particles.

Establishing green buffer zones around high-traffic areas and industrial zones can help to mitigate the spread of pollutants into residential areas. Integrate green spaces, such as parks, green roofs, and urban forests, into mobility planning to improve air quality, reduce urban heat islands, and enhance the overall urban environment.

Tirana's growing urbanization has put strain on its existing green spaces, raising concerns about their preservation. However, the municipal administration intends to expand and conserve green spaces as part of its urban development policy. Future goals include creating green corridors that connect different parts of the city, improving ecological networks, and promoting sustainable urban mobility.

3.4 Improving Infrastructure and Urban Planning

Developing urban planning strategies that reduce the need for long commutes and encourage walking and cycling can help reduce vehicle emissions. Mixed-use complexes, which combine residential, business, and recreational areas, can reduce dependency on cars.

Creating large bike and pedestrian networks that are safe, accessible, and well-maintained. To encourage walking and cycling, use traffic calming measures such as decreased speed limits, larger sidewalks, and protected bike lanes.

Widen and improve sidewalks to make walking safer and more comfortable, especially in high-traffic areas. Improve pedestrian safety with better crosswalks, pedestrian signals, and traffic calming measures around schools and residential areas.

Expand electric scooter-sharing programs as a practical and environmentally beneficial alternative to driving, especially for short distances.

Create designated parking and charging stations for scooters and other micro-mobility devices to reduce clutter and ensure availability.

Implementing tighter controls on dust and emissions from construction sites, including the use of dust suppression devices and the timing of building operations, can help to decrease the construction industry's contribution to air pollution.

3.5 Public Awareness and Education

Expanding real-time air quality monitoring throughout Tirana and making this data publicly available can raise awareness and empower residents to take precautionary steps, particularly on days with low air quality.

Launching public education campaigns about the health effects of air pollution and how to reduce personal contributions to air pollution, such as driving less and conserving energy, can encourage community engagement in air quality improvement efforts.

3.6 Adopting Renewable Energy Sources

Encourage the use of renewable energy sources, such as solar and wind power, to minimize reliance on fossil fuels, which are a major source of air pollution. Government incentives for individuals and companies to install renewable energy systems could accelerate the changeover.

Increasing the number of EV charging stations throughout the city, particularly in residential areas, commercial zones, and near public transport hubs. Provide financial incentives, such as subsidies or tax breaks, for purchasing electric vehicles, and offer benefits like free parking or access to restricted zones.

3.7 Encouraging Sustainable Construction Practices

Encourage the use of eco-friendly and sustainable building materials to lessen the environmental effect of new construction projects. Green certifications and incentives for developers that use sustainable practices can further encourage this movement.

Organize instructional workshops for architects, builders, and homeowners to increase knowledge of the advantages of sustainable building materials. Topics could include the environmental effect of traditional materials, the benefits of alternatives such as bamboo, reclaimed wood, and recycled steel, and examples of successful green building projects.

Launch public awareness efforts that emphasize the long-term cost savings, health benefits, and environmental benefits of eco-friendly products. Use many media platforms to reach a larger audience.

Encourage builders to pursue certifications such as LEED (Leadership in Energy and Environmental Design), which recognizes the use of sustainable materials[3]. Certified buildings typically have a better market value and can attract environmentally aware purchasers or tenants.

Foster partnerships between government agencies, construction companies, and material suppliers to promote the availability and use of eco-friendly materials. Collaborative initiatives can include bulk purchasing agreements to reduce costs or research and development projects to innovate new sustainable materials.

3.8 Collaboration and Policy Integration

Effective implementation of these policies requires partnership between government, the private sector, and civil society. Integrated policies that address air quality in the larger context of urban development, public health, and climate change can build more resilient and sustainable urban settings.

Encourage coordination among government departments, such as urban planning, transportation, the environment, and health, to ensure that policies are consistent and mutually reinforcing. For example, integrating transportation and environmental regulations can result in the creation of greener public transportation networks that cut emissions and enhance air quality.

Create rules that encourage private enterprises to invest in environmentally friendly projects including renewable energy, green building, and waste reduction. This could include tax breaks, grants, or preferential loan conditions for enterprises that satisfy specific environmental standards.

Participate in worldwide networks and agreements that promote sustainable development, such as the UN Sustainable Development Goals (SDGs). These networks can provide useful resources, knowledge sharing, and assistance with national sustainability efforts.

Collaborate with neighboring countries on cross-border concerns including air and water pollution to guarantee a consistent approach to environmental preservation.

4. Economic and Social Implications

Implementing these strategies requires careful consideration of the economic and social implications. While stronger laws and infrastructure improvements may be costly, the long-term benefits of enhanced public health and environmental sustainability outweigh them. Moreover, creating green jobs and enhancing quality of life can foster social equity and community well-being.

Upgrading public transportation, expanding green spaces, and enhancing urban planning require substantial initial investments. These costs may put a strain on the city's budget in the short term, particularly if they are paid for by public funds. These expenditures are anticipated to result in long-term cost savings by lowering healthcare costs, increasing worker productivity, and improving general quality of life.

[3] *Are materials that are produced, used, and disposed of in a way that minimizes their negative impact on the environment and human health. They are typically made from renewable or recycled resources and are designed to be long-lasting and biodegradable.*

Cleaner air can lead to improved public health, which can translate into fewer sick days and higher productivity. Tirana may experience an increase in tourists due to improved air quality. Cleaner air contributes to a better quality of life for all residents, leading to increased life expectancy, reduced healthcare costs, and a healthier workforce. This, in turn, can strengthen social cohesion and improve overall well-being.

Expanding public transit can increase access to important services and job opportunities, especially for low-income individuals who do not possess their own vehicles. Providing affordable and accessible public transportation is essential for promoting social fairness.

Engaging local communities in the planning and execution of air quality improvement efforts can assist ensure that these measures meet the needs of all people, particularly those in impoverished neighborhoods who are most vulnerable to pollution.

5. Collaborative Efforts for Long-Term Success

To achieve long-term improvements in air quality, a coordinated approach is required. To design and implement effective policies, government agencies must collaborate closely with the private sector, non-governmental organizations, and citizens. International cooperation and the implementation of best practices from other cities facing comparable difficulties can be quite beneficial.

Effective coordination between national and local governments is critical to the successful implementation of air quality programs. National policies should be in line with local activities to ensure consistency in regulations and enforcement at all levels of government. The Ministry of Environment, in collaboration with the Municipality of Tirana, should take the lead in formulating standards, tracking progress, and guaranteeing compliance with air quality rules.

Air quality improvements should be incorporated into larger urban planning, transportation, health, and energy strategies. For example, urban development projects should contain accommodations for green spaces, whilst transportation regulations should favor low-emission automobiles and public transit development. One of the most important projects in the General Local Plan, called the Metropolitan Forest, envisages the planting of 2 million trees that will girdle urban Tirana in a ring of parks, forests and agricultural land, thus providing the city with its green lungs, expanding the possibilities for recreation and more importantly, limiting sprawl.

The business sector, particularly sectors that contribute to pollution, must implement cleaner technology and practices. Businesses can be encouraged to lessen their environmental impact by offering incentives for innovation, such as tax rebates for those who invest in green technologies. Public-private partnerships can also encourage the development of sustainable infrastructure, such as electric vehicle charging stations and renewable energy installations.

Local communities should actively participate in air quality initiatives. Public engagement in decision-making processes ensures that policies address residents' needs and concerns, particularly those in vulnerable or heavily polluted areas. Grassroots organizations and NGOs can support community participation through awareness campaigns, workshops, and public consultation.

6. Conclusions

Improving air quality in Tirana is a complicated task that necessitates a comprehensive and coordinated effort involving the government, the commercial sector, civil society, and international partners. The strategies discussed, which range from stronger emission restrictions and sustainable urban planning to public awareness campaigns and international collaboration, provide a road map for addressing the city's air pollution problem.

The preparation of the traffic flow monitoring strategy and their evaluation against the pollution data obtained from the direct measurements of the air indicators in Tirana enables an effective mechanism for the identification of problematic hot spots of pollution and their targeting with corrective measures.

While there are some major economic and societal consequences, such as initial infrastructure expenses and the need for behavioral change, the long-term advantages greatly outweigh the difficulties. Cleaner air will improve public health, increase quality of life, and promote long-term economic growth. Tirana can become a healthier, more livable city by collaborating and incorporating these ideas into broader urban development and environmental policy.

Tirana can benefit from international cooperation by implementing best practices from other cities that have successfully handled air pollution. This includes technical support, capacity-building programs, and the exchange of information about effective air quality management strategies. The success of these projects will be dependent on ongoing monitoring, adaptive management, and active participation from all stakeholders. Tirana can improve its air

quality while simultaneously serving as a model for other towns experiencing similar issues if it fosters a culture of sustainability and collaboration.

European Ambient Air Quality Directives will push local authorities to increase sustainable mobility, reduce emissions of pollutants from traffic and heating, and a real expansion of urban green space in each city, with the planting of trees. This would reduce pollutants such as PM and nitrogen oxides (NOx), and of course increase CO_2 sequestration. The implementation of the Ambient Air Quality Directives is thus an opportunity to improve our cities and save many lives.

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