Souad H. Bousnina
Faculty member, College of Arts, Geography Dept. University of Benghazi

Abdurabbah S. Saleh
Director General of Libyan Center for Urban Planning, Libyan Authority for Scientific Research

Fares F. Fares
Faculty member, College of Science, earth Sciences Dept. University of Benghazi

Marwan A. Ramadan
Dean of the School of Humanities, Geography Dept. Libyan Academy Benghazi branch

* *Corresponding author: E-mail* :
Abdurabbah_s@academy.edu.ly

Urban Planning and Air Quality: Assessing the Impact of Green Space Absence in Benghazi City

A B S T R A C T

The rapid urban expansion in many developing cities has often occurred at the expense of environmental considerations, particularly the integration of green infrastructure. In the case of Benghazi city, in Libya, the absence of adequate green spaces within the urban fabric has raised growing concerns about deteriorating air quality and the associated health risks. This study investigates the relationship between the lack of green spaces and urban air pollution in Benghazi city, highlighting the implications for urban planning policies and public health.

Using a mixed-methods approach that combines spatial analysis of air quality data, and urban land use assessment, the study identifies critical areas where green infrastructure is missing and correlates this with elevated levels of pollutants such as $PM10$ and NO_2. The findings suggest that the limited presence of urban vegetation contributes significantly to poor air circulation, increased heat retention, and a higher concentration of airborne pollutants.

The research emphasizes the need for urban planners and policymakers to prioritize green infrastructure in future development strategies, not only to enhance environmental sustainability but also to mitigate health disparities and improve the overall urban quality of life.

التخطيط الحضري وجودة الهواء : تقييم تأثير غياب المساحات الخضراء في مدينة بنغازي

سعاد حمد الزروق بوسننينة/ كلية الآداب, قسم الجغرافية, جامعة بنغازي, ليبيا.

عبدربه سعيد حسين صالح/ مدير عام المركز الليبي للتخطيط الحضري, الهيئة الليبية للبحث العلمي.

فارس فتحي فارس/ كلية العلوم, قسم علوم الارض, جامعة بنغازي, ليبيا.

مروان عبدالكريم رمضان/ عميد مدرسة العلوم الانسانية, الاكاديمية الليبية للدراسات العليا, فرع بنغازي

الخلاصة:

غالبًا ما حدث التوسع الحضري السريع في العديد من المدن النامية على حساب الاعتبارات البيئية, وخاصةً دمج البنية التحتية الخضراء, و في حالة مدينة بنغازي الليبية, أثار غياب المساحات الخضراء الكافية ضمن النسيج الحضري مخاوف متزايدة بشأن تدهور جودة الهواء والمخاطر الصحية المرتبطة به, حيث بحثت هذه الدراسة في العلاقة بين نقص المساحات الخضراء وتلوث الهواء الحضري في بنغازي, مع تسليط الضوء على آثار ذلك على سياسات التخطيط الحضري والصحة العامة, باستخدام نهج متعدد الأساليب يجمع بين التحليل المكاني لبيانات جودة الهواء وتقييم استخدام الأراضي الحضرية, وحددت الدراسة المناطق الحرجة التي تفتقر إلى البنية التحتية الخضراء, وتربط ذلك بارتفاع مستويات الملوثات مثل PM10 و NO_2, وقد اشارت النتائج إلى أن الوجود المحدود للنباتات الحضرية يساهم بشكل كبير في ضعف دوران الهواء, وزيادة احتباس الحرارة, وارتفاع تركيز الملوثات المحمولة جوًا. ويؤكد البحث على ضرورة قيام مخططي المدن وصناع السياسات بإعطاء الأولوية للبنية التحتية الخضراء في استراتيجيات التنمية المستقبلية, ليس فقط لتعزيز الاستدامة البيئية ولكن أيضًا للتخفيف من الفوارق الصحية وتحسين نوعية الحياة الحضرية بشكل عام.

الكلمات المفتاحية: التعدين، الاستثمار، التوزيع المكاني، التنمية المستدامة، البيئة الحضرية

1.Introduction

Cities around the world are experiencing rapid urban growth and infrastructure expansion, which heightens environmental and public health challenges. With increasing urbanization, managing air pollution has become a pressing necessity. The accelerated growth of cities, coupled with rising traffic and industrial activities, poses significant threats to air quality. Emissions from exhausts and harmful particulates increase pollution levels, which in turn negatively affect human health and the environment.

The growing levels of air pollution and their detrimental impacts have become a critical issue for maintaining air quality and public well-being. In this context, green spaces emerge as a central element in improving air quality and contributing to the development of a healthy and sustainable urban environment. Green spaces

offer a comprehensive environmental safeguard by purifying the air and also play a vital role in enhancing social and mental well-being. Air quality in cities is thus a fundamental component of community health and urban sustainability.

This brings to light the interdependent relationship between implementing green spaces and maintaining air quality as a key to balancing urban development with environmental preservation. On the one hand, green spaces help reduce the concentration of air pollutants and purify the air through photosynthesis. On the other hand, green environments and parks provide opportunities for improving urban lifestyles, promoting green transportation, and reducing harmful emissions.

From the perspective of urban and rural geography, which focuses on the interaction between humans and their surrounding environment, this study addresses one of the most pressing environmental issues in urban settings— namely, the impact of the absence of green spaces on air quality in the city of Benghazi. The study analyzes the city's current status, urban planning frameworks, and the prevailing air quality conditions.

2.Research Problem

Benghazi is undergoing rapid urban development and population growth, resulting in significant expansion of urban infrastructure. However, there is a notable deficiency in the implementation of green spaces. This growing phenomenon negatively affects air quality and the overall urban environment. Therefore, the core issue addressed in this study revolves around the escalating environmental and public health challenges in Benghazi due to the lack of green space development. Specifically, the study focuses on:

1. **Increased air pollution**: The lack of green spaces limits the city's ability to absorb and filter harmful emissions and airborne particles, leading to elevated pollution levels.
2. **Urban heat escalation**: The scarcity of vegetation contributes to rising urban temperatures with wide-ranging consequences.
3. **Future challenges**: Continued urban expansion and environmental pressures exacerbate the future challenges of maintaining sustainable air quality.

3.Research Questions:

1. What is the concept of air quality within the framework of sustainable urban environments?
2. Does the absence of green spaces contribute to increased air pollution and urban heat?
3. Is there a correlation between the lack of green spaces and poor air quality?
4. What is the current status of green space implementation in Benghazi?

4.Research Objectives:

This study aims to:

1. Assess the impact of the lack of green spaces on air pollution levels in Benghazi.
2. Examine the relationship between the absence of green infrastructure and the rise in air pollutants.
3. Determine the urban heat effect caused by the deficiency of green spaces and its implications on air distribution and quality.

5.Significance of the Study:

This research is particularly relevant given Benghazi's current reconstruction efforts and extensive urban development initiatives. It also addresses a notable gap in academic literature on sustainability in urban environments. Furthermore, the study is committed to deepening the understanding of the reciprocal relationship between green space implementation and air quality improvement.

The study includes a comprehensive analysis of how green spaces can contribute to reducing air pollution and enhancing environmental and social health. It also seeks to encourage the strategic use of green spaces as an effective tool to improve air quality, with an emphasis on engaging local communities and government entities in the pursuit of a healthier, more sustainable urban environment.

Ultimately, this research provides a deeper understanding of how the lack of green spaces affects air quality and contributes to environmental and health-related challenges in Benghazi. The findings could inform the development of effective environmental policies and sustainable urban planning strategies.

6.Study Methodology:

Given the exploratory nature of this research, which investigates the impact of the lack of green spaces on air quality in the city of Benghazi, a case study methodology is deemed most appropriate. This approach allows for an in-depth examination of the case, the collection of comprehensive data, and consideration of the broader context, historical background, and current dynamics. The case study method enables an accurate assessment of how the lack of green spaces affects air quality.

In parallel, the study will employ a descriptive analytical approach, analyzing both quantitative and qualitative data related to Benghazi's urban planning schemes and current environmental status. This dual approach ensures a thorough understanding of the issue and helps formulate recommendations across various levels—policy, technical, and legislative—aimed at enhancing green infrastructure and improving urban air quality.

7.Theoretical Framework

Urban planning is considered one of the principal tools for reducing various types of pollution (noise, dust, fumes, smoke, etc.) in urban environments. Improving and developing planning strategies can significantly enhance air quality and reduce pollution levels. This requires the active engagement of local authorities and policymakers in adopting and implementing sustainability principles through comprehensive and detailed urban planning. These plans should be grounded in effective planning considerations to help create urban environments that are economically, socially, and environmentally sustainable.

One essential strategy is to increase green areas (lawns and tree planting) and water bodies within the urban fabric, parks, and both public and private green spaces across the urban landscape. This contributes to improving air quality and mitigating urban heat, as trees act as natural air filters by reducing dust, odors, and toxic gases.

Sustainable urban design is also a critical approach for mitigating environmental pollution and the effects of climate change in cities. It emphasizes designing cities, buildings, and public spaces in ways that promote environmental sustainability and minimize the adverse effects of pollution. This includes coordination between urban and regional planning, designating industrial growth zones away from

residential areas, improving industrial facility management, and regulating emissions, street cleaning, and urban planning controls.

This part of the study defines key concepts such as air quality, sustainable urban environments, and sustainability and its dimensions, in an attempt to answer the following questions:

1. What is the concept of air quality in sustainable urban environments?
2. Does the absence of green spaces contribute to increased pollution and urban heat?
3. Is there a correlation between the lack of green spaces and air quality?

7.1.Sustainability Concept:

Various organizations and international bodies concerned with development and environmental issues have proposed definitions of sustainability. The most widely accepted is that of the Brundtland Commission, which defines sustainable development as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

7.2.Sustainability Dimensions:

- **Economic Dimension**: Refers to the achievement of sustainable growth in national income, both quantitatively and qualitatively, with a primary focus on qualitative growth. This must be achieved without compromising environmental integrity and should ensure employment opportunities while preventing wealth concentration among a small elite.
- **Social Dimension**: Focuses on developing human capital through improvements in health and education, inherently linked to other dimensions of sustainability.
- **Environmental Dimension**: Aims to ensure economic well-being for both present and future generations while preserving the environment, maintaining natural capital within economic activities, and enabling continuous improvements in living standards.[1]

Figure 1: Dimensions of Sustainability
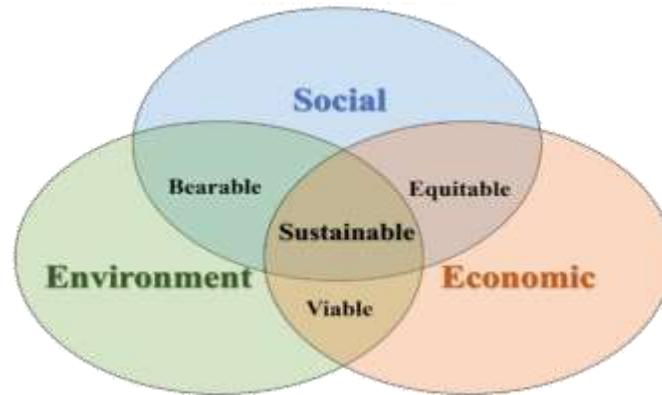
Source:*https://en.wikipedia.org/wiki/Sustainable development*)

7.3Sustainability in Urban Planning:
7.3.1. Community Participation

Community participation refers to the involvement of all or some of the population in political, economic, and social life, including setting national goals. In planning, it means that citizens actively participate in the committees and authorities responsible for preparing, implementing, and monitoring development plans at various levels. True participation fosters bottom-up development, empowering marginalized and underprivileged groups in shaping and reviewing development strategies.[2]

7.3.2. Lifetime Neighborhoods

These are accessible built environments that offer high-quality, enjoyable housing conditions, allowing residents to remain in their homes as long as possible regardless of age or physical ability. Key components include:

- Innovation and planning
- Housing and the built environment
- Services and infrastructure
- Social inclusion

7.3.2.1.Objectives:

- Accessibility.
- Availability of infrastructure, housing, and social services.
- Safe, attractive environments (regarding traffic and crime).

- Strong local identity and social cohesion.[3]

7.4. Compact Urban Fabric:

This refers to the design of integrated, livable, and viable urban neighborhoods that attract residents and businesses while reducing urban sprawl. It includes:

- Mixed-use development
- Affordable housing
- Public parks and pedestrian-friendly layouts
- Reuse of developed land

This model conserves open spaces, enhances clean air and water supply, and fosters sustainable communities. [4]

7.5. Sustainable Urban Design:

Sustainable urban design aims to create balanced and environmentally friendly urban environments. It allows architects and planners to design urban spaces that benefit both people and nature. It encompasses:

- Integration of human and natural environments
- Biodiversity preservation in urban areas
- Managing building and transport densities
- Land-use planning related to green spaces, buildings, workspaces, and infrastructure.[5]

7.6. Indicators of Sustainability in Urban Planning:

From the above, sustainability indicators in urban planning can be summarized by their focus areas according to the three sustainability dimensions:

Table 1: Key Focus Areas of Sustainable Urban Planning Based on Sustainability Dimensions

Sustainability Dimension	Urban Planning Aspects	Focus Areas
Economic	Urban Planning	- Integrating commercial with residential uses
		- Pedestrian-friendly environments
		- Roadside parking and service lanes
Social	Urban Planning	- Community participation in planning
		- Aesthetic elements in streets
Environmental	Urban Planning	- Green spaces and open areas to reduce temperature

Source: *Prepared by the researcher*

7.7. Air Quality Index (AQI):

The Air Quality Index (AQI) is a daily tool for reporting air cleanliness and potential health effects. According to the U.S. Environmental Protection Agency (EPA), AQI is categorized into six levels of health concern, each identified by a color code. Monitoring devices like the Air Visual Outdoor Monitor can cover areas up to 132 km² [6]. The index primarily measures:

- Particulate matter (PM2.5 and PM10)
- Ozone (O_3)
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Carbon monoxide (CO)

Table 2: AQI Levels of Health Concern

AQI Value of Index	Levels of Health Concern	PM$_{2.5}$ Conc. (µg/m³)	PM$_{10}$ Conc. (µg/m³)	Daily AQI Color	Air Pollution Level
50 - 0	Good	0 - 12	0 - 45	Green	Level 1
100 - 51	Moderate	12.1 - 35.4	55 - 154	Yellow	Level 2
150 - 101	Unhealthy for sensitive groups	35.5 - 55.4	155 - 254	Orange	Level 3
200 - 151	Unhealthy	55.5 - 150.4	255 - 354	Red	Level 4
300 - 200	Very unhealthy	150.5 - 250.4	355 - 424	Purple	Level 5
500 - 301	Hazardous	250.5 – Higher	425 - Higher	Maroon	Level 6

Source: *http://www.cleanairmichiana.com)*

7.8. Quality of Life:

Quality of life refers to the interaction of social, economic, and environmental factors influencing individual well-being and satisfaction. It includes perceptions of physical health, psychological state, independence, social relationships, and environmental context [7].

Figure 2: Hierarchical Structure of Basic Quality of Life Needs

Source: *https://drphelanipresume.blogspot.com*
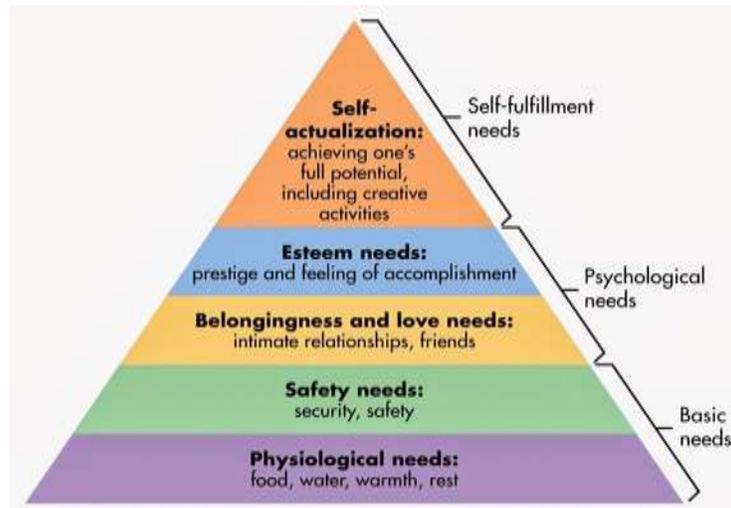
7.9. Green Spaces: A Valuable Resource for Urban Health:

Non-communicable diseases (NCDs) and climate change are among the greatest health challenges of the 21st century [8]... NCDs like cancer, cardiovascular disease, chronic respiratory diseases, diabetes, and neurological disorders cause 68% of global deaths [9]. Climate change is expected to cause hundreds of thousands of additional deaths annually by 2030 [10].

Factors like air pollution and physical inactivity significantly contribute to NCD risks. Approximately 88% of urban residents are exposed to air pollution levels that exceed WHO guidelines [11]. In 2012, ambient air pollution was responsible for 3.7 million deaths globally. Urbanization also decreases physical activity and increases reliance on vehicles [12].

The 2030 Agenda for Sustainable Development acknowledges the intersection of health and climate concerns. Strategic interventions that target multiple SDG goals simultaneously are essential [13].

7.10. Green Spaces, Parks, and Waterways: Solutions for Urban Health:

Urban parks and green spaces offer effective solutions to the health and safety impacts of rapid, unsustainable urbanization. They also align with global priorities such as climate change, sustainability, public health, and biodiversity conservation.

Scientific literature shows that natural environments positively impact human health by:

- Reducing stress
- Enhancing mental health
- Supporting social interaction and physical activity

Research links green spaces to:

- Better pregnancy outcomes
- Lower cardiovascular disease rates
- Reduced obesity and diabetes
- Improved mental well-being [14].

Vulnerable groups often live in neighborhoods with limited access to green areas. Expanding and enhancing urban green spaces can help reduce health disparities

and exposure to air pollution. Trees can reduce carbon emissions and energy demands by providing strategic shading. [15].

According to WHO, lack of physical activity contributes to 3.2 million deaths annually, while air pollution is responsible for over 7 million premature deaths globally [16]? Green infrastructure helps mitigate both risks simultaneously [17].

In conclusion, if green spaces in urban areas are implemented according to land-use planning standards, they will significantly reduce air pollution and urban heat [18]. A direct inverse relationship exists: the more green space, the lower the pollution and temperature levels [19]. Neglecting this aspect exacerbates pollution and climate issues, highlighting the urgent need for planning authorities to fully implement green zones and water corridors to cool the environment and improve air quality [20].

8. Practical Framework
8.1. The Urban Scene of Benghazi:

Libya began preparing the Second Generation Planning Project (2nd GPP) in 1980. Before that, urban planning in the country focused mainly on the first element of urban planning—comprehensive planning. For the first time, national, regional, and sub-regional long-term detailed plans were prepared under this second generation project. These included comprehensive and general plans for cities and major population centers, implemented from 1980 to 2000, with Dioxides Associates (Greece) responsible for drafting the plans according to sound planning standards.

The Libyan Authority for Scientific Research, through the Libyan Center for Climate Change and the Libyan Center for Urban Planning, has collaborated to install platforms for air quality monitoring. These stations measure pollution levels of various types and observe several climatic elements such as humidity, wind speed, atmospheric pressure, and temperature. They also monitor cyclones continuously throughout the day, month, and year. These stations are connected to NASA and aim to build an open-access database for all researchers and stakeholders. Five stations were installed in the cities of Al-Bayda, Jalu, Benghazi, Zliten, and Tripoli (Figure 3).

Figure 3: the locations of air quality measurement platforms

Source*: https://drphelanipresume.blogspot.com*
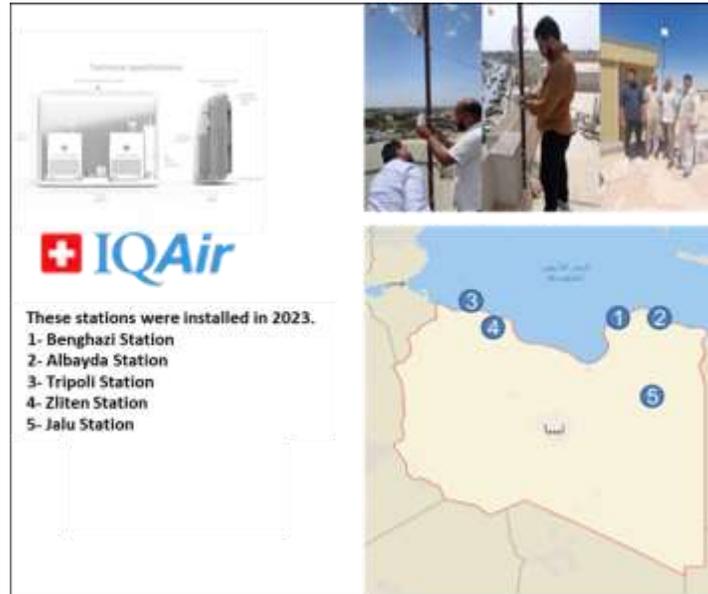
8.2. Location of Benghazi:

Benghazi lies in the northeastern part of Libya at coordinates (32.11667°N, 20.06667°E). It overlooks the Mediterranean Sea and has a warm climate and semi-arid weather, with hot, dry summers and mild, rainy winters. It is the second-largest city in Libya.

8.3. Land Use According to the 2nd Generation Plan:

The comprehensive plan for the Benghazi urban cluster (2nd generation) covered an area of 24,021 hectares. A large part of this area was allocated for green belts, agricultural lands, and special zones. The green rural belt was a key feature of the plan, designed to:

- Protect the city from southern desert winds (Qibli), especially in spring and fall,
- Separate residential areas from heavy industrial zones in the south,
- Preserve the sensitive natural environment in Al-Kweifiya by controlling eastward urban expansion.

The actual land available for urban uses was about 16,000 hectares. The residential areas were planned to accommodate 80,000 people, at a residential density of 100

persons/hectare. Since this exceeded the projected population of Benghazi (750,000) for the year 2000, the plan could accommodate the city's needs well beyond the target year[21].   See   Table   (3)   and   Figure   (4).

Table 3: Land Use Distribution for the General Plan of Benghazi Urban Cluster (Second Generation Project) – Year 2000

Land Use Category	Area (hectares)	Percentage (%)
Residential Areas	6,000	25.0%
Industrial Areas	2,500	10.4%
Green Belt & Agricultural Use	8,000	33.3%
Public Facilities	1,200	5.0%
Roads and Transportation	1,500	6.3%
Special Use Areas	2,000	8.3%
Recreational/Open Spaces	821	3.4%
Total	**24,021**	**100%**

Source: *Office of Architecture for Engineering Consultations, Comprehensive Plan Report – Benghazi, Fifth Report, Benghazi, 2009*

Figure (4): Land Use of the General Plan (Second Generation Project) Year 2000
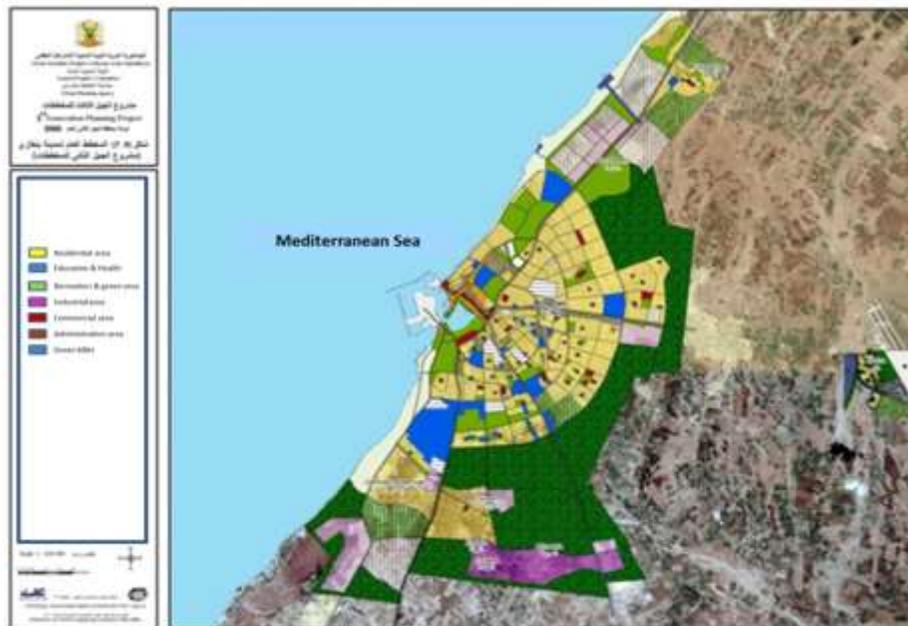
Source: *Office of Architecture for Engineering Consultations, 2009*

8.4.Deviation from Planned Green Areas:

By 2006, a study by the Office of Architecture during the preparation of the third-generation plans (2000–2025) for the Benghazi planning region revealed that the designated green and recreational spaces had not been implemented—spaces that were intended to help the city adapt to climate variability and act as natural air filters ,By 2024, and when compared with the land use plans of the 2nd generation, aerial images of Benghazi show a clear lack or complete absence of green areas in the urban fabric, particularly in high-density residential zones (Figures 6).

Figure 6: Lack of greenery in high-density urban areas

Source: *https://earth.google.com and field study /24-3-2024*

Instead, the built environment has expanded beyond planned limits, with:

- Encroachment on the green belt
- Unregulated urban sprawl

- Widespread use of concrete and barren surfaces

These conditions contribute to rising temperatures, humidity, and air pollution, whether due to natural or human-caused sources. Most residential buildings also fail to adapt to current or future climate realities, making them unsuitable for a livable urban environment.

8.5.Air Quality and CO₂ Levels:

The Air Quality Index (AQI) is used to report daily air conditions. It measures how clean or polluted the air is and whether it poses any health risks, based on readings from devices such as the Air Visual Outdoor Monitor, which covers about 132 km² of Benghazi[22].

The AQI health levels are color-coded:
1. Green – Good air quality
2. Yellow – Moderate concern for sensitive individuals
3. Orange – Unhealthy for sensitive groups
4. Red – Unhealthy
5. Purple – Very unhealthy
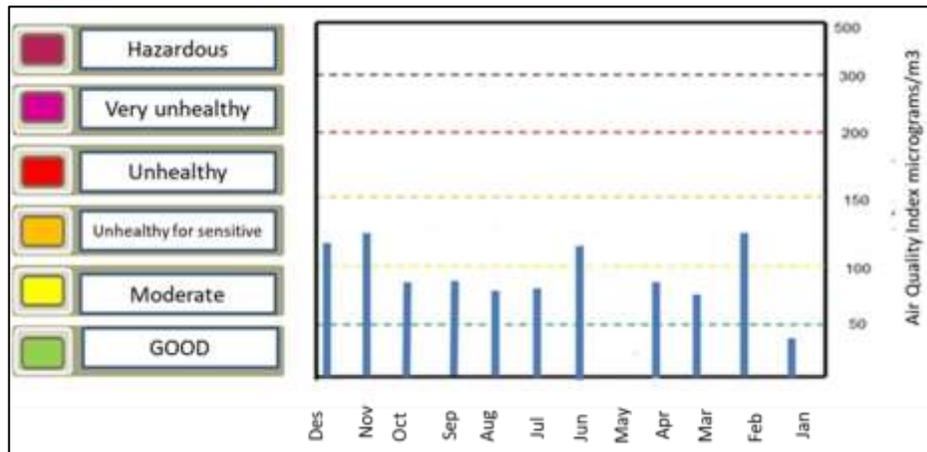6. Maroon – Hazardous

The pollutants are categorized as:
1. Natural sources
2. Mixed sources
3. Human activities.

Air quality data for Benghazi show:

- Good air in January
- Unhealthy air in February, May, October, and November
- Moderate in other months. (Figure 10)

Figure 10: Air Quality and CO₂ Levels

Source*: https://www.iqair.com/libya*

Benghazi is more affected by natural pollutants, especially desert dust from southern winds. This emphasizes the lack of vegetation, particularly along the southern boundary, which could have mitigated this issue (Figure 11).

Figure 1١: categorized The pollutants


Source*: https://www.iqair.com/libya*
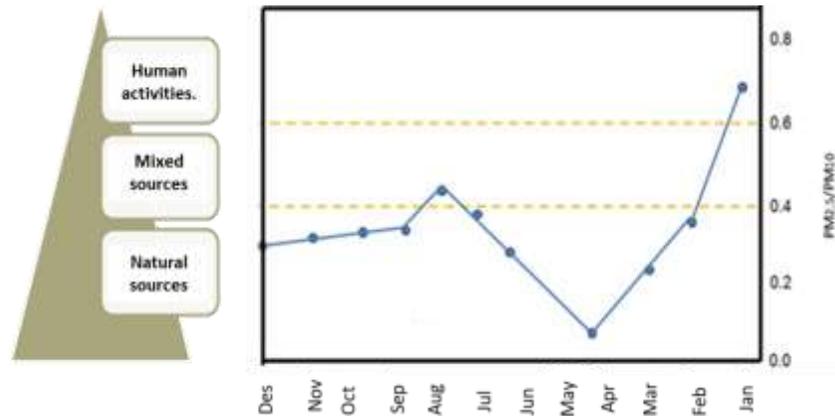
8.6.CO_2 and Climate Change:

Carbon dioxide (CO_2) is one of the most influential greenhouse gases, as it traps heat in the atmosphere. From May 2019 to 2023, CO_2 levels in the atmosphere have increased by about 3 ppm, which is a critical warning. This trend is expected to:

- Raise global temperatures
- Increase wildfires
- Cause sea-level rise
- Lead to water scarcity

Unfortunately, most Libyan buildings and housing plans are not climate-resilient, posing future risks (Figure 12).

Figure 11: CO_2 and Climate Change

Source*: https://www.iqair.com/libya*
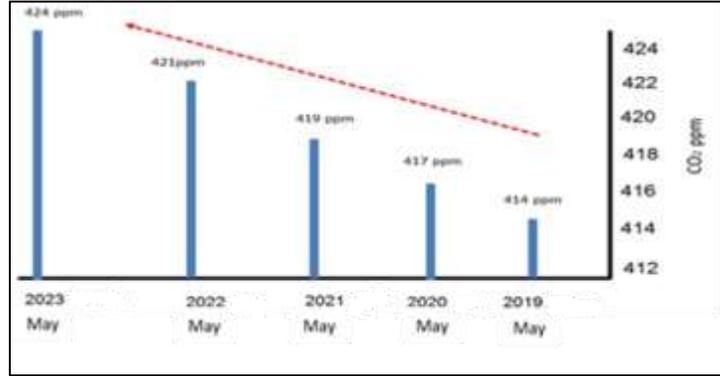
8.7.Findings:

The key results that emerged from this study include:

1. Dominance of concrete and bare surfaces across Benghazi's urban fabric, especially in summer, contributes to higher temperatures, humidity, and dust.
2. Lack of climate-sensitive urban design.
3. Benghazi is more polluted by natural sources due to lack of green cover and water bodies.
4. Non-compliance with the designated green spaces in urban land-use plans.
5. A notable rise in CO_2 concentration (2–3 ppm from 2019–2023), which is highly alarming for global and local ecosystems.

8.8.Recommendations:

To address these challenges, the following actions are recommended:

1. Improve air quality by restoring and expanding green areas to counteract air pollution.
2. Promote sustainable urban planning by integrating green infrastructure into planning policies.
3. Reduce health impacts by acknowledging how poor green space planning affects public health.
4. Increase environmental awareness about the role of greenery in healthy urban living.

5. Support decision-making by offering data-driven guidance on the environmental cost of neglecting green areas.
6. Enhance quality of life by focusing on clean air and climate-friendly neighborhoods.
7. Protect and rehabilitate the green belt, ensuring it fulfills its intended function.
8. Enforce environmental regulations through:
   o Pollution control standards
   o Emission monitoring systems
   o Use of eco-friendly materials and modern technologies for clean urban development

References:

1. Mahdi, A. W., Sattam, N. S., & Hamad, R. K. (2020). *The role of renewable energies in achieving sustainable development: An analytical study*. Kirkuk University Journal for Administrative and Economic Sciences, Special Issue, 99–100. (In Arabic)

2. Al-Qeeq, F. S. (2014). *The role of community participation in achieving sustainable development: Strategic development plans as a case study*. Palestine Journal for Research and Studies, Islamic University, Gaza, p. 4. (In Arabic)

3. Andrews, B. G. (2007). *Towards Lifetime Neighborhoods: Designing sustainable communities for all*. Department for Communities and Local Government, UK, p. 8.

4. Shrivastava, R., & Sharma, A. (2011). Smart growth: A modern urban principle. *Architecture Research*, 1(1).

5. Al-Jamasi, A. D., & Al-Qeeq, F. S. (2010). *Strategies for achieving sustainable urban planning in the Gaza Strip using GIS*. Islamic University, Faculty of Engineering, Gaza. p. 6. (In Arabic)

6. U.S. Environmental Protection Agency. (2014). *Office of Air Quality Planning and Standards Outreach and Information Division*, Research Triangle Park, NC, p. 12.

7. Yousef, A. M. M. (2009). Measuring and managing the development of new urban communities through quality of life indicators. International Conference on Urban Land Development: Issues and Priorities, p. 9. (In Arabic)

8. UAE National Center of Meteorology. (2024, October 3). *Air quality monitor*. Retrieved from https://airquality.ncm.ae

9. NCD Alliance & Global Climate and Health Alliance. (2016). *NCDs and climate change: Shared opportunities for action*. Retrieved December 3, 2024, from https://ncdalliance.org

10. World Health Organization. (2014). *Global health estimates: Summary tables—DALY by cause, age, and sex 2000–2012*. Geneva. Retrieved December 3, 2024, from http://www.who.int

11. World Health Organization. (2016). *Climate change and health: Fact sheet No. 266*. Retrieved December 3, 2024, from http://www.who.int (In Arabic)

12. World Health Organization. (2006). *Air quality guidelines: Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*. Copenhagen. Retrieved December 5, 2024, from http://www.euro.who.int

13. World Health Organization. (2016). *Road traffic injuries: Fact sheet No. 358*. Retrieved March 13, 2024, from http://www.who.int (In Arabic)

14. NCD Alliance & Global Climate and Health Alliance. (2016). *NCDs and climate change: Shared opportunities for action* (p. 4). Retrieved March 13, 2024, from https://ncdalliance.org

15. Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, 35, 207–228. https://www.annualreviews.org

16. Maas, J., Verheij, R. A., Groenewegen, P. P., de Vries, S., & Spreeuwenberg, P. (2012). Nearby nature and human health. *Environmental Research*, 115, 51–58. https://www.researchgate.net

17. Institute of Health Equity. (2014). *Natural solutions for tackling health inequalities*. London: University College London. Retrieved March 17, 2024, from http://www.instituteofhealthequity.org

18. World Health Organization. (2015). *Reducing global health risks through mitigation of short-lived climate pollutants: Scoping report for policymakers*. Geneva. Retrieved March 17, 2024, from http://www.who.int

19. Kenny, G. P., Yardley, J. E., Brown, C., Sigal, R. J., & Jay, O. (2010). Heat stress in older individuals and patients with common chronic diseases. *Canadian Medical Association Journal*, 182(10), 1053–1060. https://www.ncbi.nlm.nih.gov

20. Akbari, H. (2002). Shade trees reduce building energy use and CO_2 emissions from power plants. *Environmental Pollution*, 116(Suppl. 1), S119–S126. Retrieved from http://webmail.seedengr.com

21. Office of Architecture for Engineering Consultancy. (2009). *Benghazi Regional Urban Plan, Third Generation Master Plan Project (2000–2030)*. (In Arabic)

22. Fares, F. F., Abogrean, E. M., El Oshebi, F. M., & Taleb, A. B. (2023). Determination of carbon dioxide (CO_2) concentration in Libya and comparison with global atmospheric emissions during the spring season. *Environment and Climate Changes Conference*. (In press)