Future Cities and Environment

A Study of Strategic Plans of Sustainable Urban Development for Alexandria, Egypt to Mitigate the Climate Change Phenomena

TECHNICAL ARTICLE

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ABSTRACT

Existing cities are difficult to reconfigure due to their population density and congested highways, which have a detrimental effect on the environment and human health. Sustainable urban development essentially improves people's quality of life, preserves human health, and mitigates the global consequences of the climate change phenomena. As a result, there is a demand for sustainable cities, which are metropolitan areas powered by cutting-edge technology. This study looks at the subject of sustainable urban planning and how to apply all of the latest innovative solutions to Alexandria's public transit systems. It focuses on the development of Alexandria as a platform for a high quality of life through a strategic urban plan that gives a future vision for reducing traffic congestion and pollution. This study offers a feasible solution to the city's traffic problems through the use of smart infrastructure and innovative mobility solutions. The suggested sustainable design is based on the city's green belt and new axes to establish new traffic channels that will alleviate congestion and solve the city's traffic concerns. This plan is regarded as an important approach to a strategic urban plan for Alexandria's transformation into a sustainable metropolis.

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1. INTRODUCTION

The 'built environment' is a large, immobile object that requires time and money to change (Gleeson et al., 2008). In all countries, cities serve as the focal points and drivers of societal growth. Simultaneously, they are the world's top consumers of natural resources and the largest contributors to pollution and greenhouse gas emissions. Climate change is one of the most critical environmental concerns confronting cities. A second significant problem is the environmental impact of urban fossil fuel use, particularly oil. Climate change and an oil-based economy are inextricably linked: car emissions considerably contribute to greenhouse gas emissions and thus to global warming (United Nations, 2009). "Nothing else has a greater negative impact on the earth's environment than our cities. Cities advance through striking a balance between urban activities, human well-being, and the preservation of the region's natural and biological diversity. It has been noted that paying more attention to the strategic development of urban areas and "avoiding early-stage urban design errors" could result in more sustainable cities and reduced greenhouse gas emissions (Lehmann, 2008). The growth in road traffic and demand for transportation in recent years, particularly since the early 1990s, has resulted in severe congestion, delays, accidents, and environmental problems, particularly in large cities. Congestion has developed into a true disease that afflicts both developed and developing countries. It impacts both motorists and public transportation users, and in addition to diminishing economic efficiency, it has a number of other negative consequences for society. The worrying thing is that this expression of modern times has been intensifying indefinitely, morphing into a nightmare that threatens urban life's quality (Alberto, 2003).

1.1 RESEARCH AIM

This research intends to develop a sustainable strategic urban plan for Alexandria that will alleviate the harmful effects of pollution caused by the city's traffic problems and congestion in order to mitigate the city's people' exposure to the negative impacts of climate change phenomena.

2. CLIMATE CHANGE PHENOMENA

Climate change is the increase in the Earth's average temperature caused by the release of carbon dioxide molecules and other greenhouse gases into the Earth's atmosphere. Traditionally, carbon dioxide molecules have helped to regulate temperatures on Earth; however human activities have affected the natural processes of CO2 molecules, resulting in the greenhouse effect (Mohamed et al., 2013). Climate change has been identified as having a number of potentially catastrophic implications, if measures are not implemented to regulate and reduce humankind›s impact on the environment. More immediate impacts include unpredictable and extreme weather events and crop damage associated with prolonged drought. Coastal settlements could also potentially be compromised if polar ice caps continue to melt, causing sea levels to rise. Other concerns exist relating to the collapse of ecosystems, as the temperatures affect the equilibrium between animals in the food chain, and the roles of these creatures within it. The overarching concern of climate change is that it will result in a disintegration of the Earth's capacity to provide for, and support, human life (Campanella, 2008). The Intergovernmental Panel on Climate Change urges all responsible persons to promote their country's mitigation strategies (Jentsch, 2008; Holmes, 2007). On the local level, while Egypt contributes only very little to global greenhouse gas (GHG) emission (0.6% of global emissions), GHG is one of Egypt's. (Ministry of Environment of Egypt, 2016).

In recent times, decision-makers in Egypt are of the opinion that a national strategy should be put in place to ensure the adoption of the most relevant approaches to mitigating climate change in the country, i.e., effort should be directed to the promotion of zero and low-carbon energy systems to substantially minimize energy consumption, coupled with detailed strategies for adaptation and mitigation (Mahdy et al., 2013). Although the climate has a major impact on outdoor and indoor thermal performance, most Egyptian research studies on climate change are still limited to agriculture, biodiversity, and conservation strategies for historical buildings and heritage sites, particularly in coastal cities such as Alexandria (Mahmoud et al., 2021).

3. CITIES TRAFFIC PROBLEM STATEMENT

Cities such as New York, London, and Paris have all had to contend with the daily influx of thousands of automobiles. Congestion is a major issue for everyone in the city. The primary causes of traffic congestion are increased vehicle ownership, ineffective road management, and negligent employer behaviour. One of the primary reasons for increased congestion is the increased number of automobiles on the road. The adult population is growing, and as a result, more people desire their own personal transportation. As the number of automobiles increases, the likelihood of congestion increases as well. That is why congestion is nearly unheard of in smaller towns and villages. This is exacerbated by a lack of adequate infrastructure. Local governments and national governments do little about the approaching

possibility of severe congestion until it occurs. The city does not expand in lockstep with an increased reliance on automobiles. A single roadway with two lanes on either side may not sufficient ten years from now as the population grows. Frequently, authorities fail to upgrade this to a dual carriageway (Scholar Advisor, 2019). There are numerous approaches to alleviate traffic congestion through the use of smart city technologies, including the following.

3.1 ADAPTIVE TRAFFIC SIGNALS

Traffic lights are becoming more intelligent because of V2I technology. For example, the city of Columbus, Ohio, is utilizing data collected from government fleet vehicles as part of other smart city pilot programs to optimize traffic light timing. By gaining a better understanding of traffic flow and the length of time vehicles idle at stop lights, the city can better adjust traffic signal timing to match daily traffic changes (Reduce Traffic Congestion, 2018).

3.2 V2I SMART CORRIDORS

Adaptive traffic lights are a component of certain intelligent corridors. Smart corridors can alleviate traffic congestion on congested roadways as well as hazardous places, such as a major highway in Wyoming that is frequently used for freight transportation in addition to passenger cars.

3.3 TRACKING PEDESTRIAN TRAFFIC

In order to reduce road congestion, the first step is to better understand pedestrian traffic. Another example of V2I technology being used in Las Vegas is in tracking how many vehicles pass through intersections at different times. The city is also tracking how many pedestrians are crossing streets and jaywalking, and thus using this data to determine which intersections require rerouting when high numbers of pedestrians are using them. In addition, the city will also be notified whenever a pedestrian is approaching an intersection when the light is about to change, which gives them the option to delay the signal, if necessary, thereby improving the overall safety of the city.

3.4 CAR SHARING AND MULTI-MODAL SOLUTIONS

There is currently no consensus on whether vehicle sharing and ride hailing applications genuinely help ease congestion (the most recent report indicates that they divert transit ridership). In either case, they provide more alternatives. City planners and individuals working in the public transportation industry view it as a connectivity issue (Reduce Traffic Congestion, 2018).

4. CASE STUDY: ALEXANDRIA CITY, EGYPT

Alexandria is Egypt's second largest city, with a population of 5.2 million (CAPMAS, 2018) and a 32-kilometer-long coastline on the Mediterranean Sea in the country's north central region as shown in Figure 1. Alexandria is Egypt's main seaport, accounting for over 80% of Egypt's imports and exports, and serves as a major tourist destination. It is home to the Alexandrina Bibliotheca.

Area (Km^2)	2,679
Population (Million)	5.2 (10/2018)
Density (person/Km^2)	1,709
Green Spaces (m^2/Person)	0.9 (Ibrahim, 2010)

Table 1 Alexandria City (source: CAPMAS, 2018).

Figure 1 Alexandria City (Ministry of Housing, 2018).

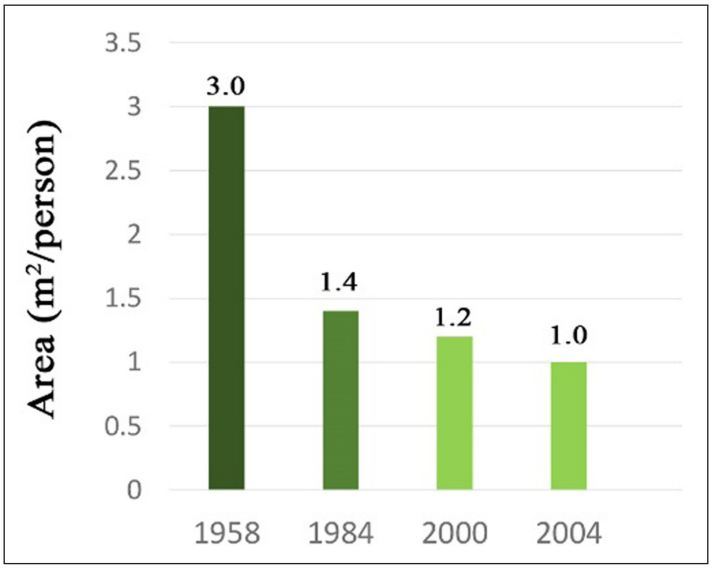

Figure 2 Alexandria Green area/capita (Ibrahim, 2010).

4.1 ALEXANDRIA CITY

Alexandria is a Mediterranean city with a history dating back more than 2,000 years. It is Egypt's second-largest city, behind Cairo. It was previously home to the famed Pharos Lighthouse, one of the ancient world's seven wonders. Alexander the Great founded it in 331 BC.

4.1.1 Geographical location

Alexandria is located on the western rim of the Nile Delta, between latitudes 31° 08' N and 31° 26' N and longitudes 29° 27' E and 30° 04' E. Alexandria's northern limit runs along the Mediterranean Sea for approximately 93.5 kilometres, beginning in the east at Abo-Kir bye and ending at kilometre 61.5. Alexandria- Matrouh highway. It shares its eastern and southern borders with the Buhyira Governorate. The Matrouh Governorate forms the western boundary. Additionally, it is restricted to the northern Mediterranean Coast and Lake Mariout in the south (GOUP, 2000).

4.1.2 Alexandria area

Alexandria covers an area of 2679 km^2; farmland covers around 163 km^2 or 5.66 percent of the overall area of the city, as illustrated in Table 1 & Figure 3 (Alexandria Governorate, 2018).

Apart from the central business district, Alexandria city is divided into six districts, each with its own distinct set of activities, such as urban, rural, and tourism. It is organized into 15 divisions based on the administration of police divisions. The Alexandria Governorate divided the Al-Agamy District from the Amraia District in March 2013 (Alexandria Governorate, 2018). This resulted in the addition of one district to Alexandria, which now has seven as shown in Figures 4, 5, 6, 7.

4.1.3 Congested Urban Transport System

Urbanization has resulted in an imbalanced distribution of employment and residential regions, resulting in increased commute times, congestion, and pollution. Simultaneously, central districts have grown vertically, resulting in increased congestion and increased demand for services that the city cannot provide as shown in Figure 8. Currently, the level of servicing on roadways is low.

The current transportation system is insufficient to accommodate long-distance commuting needs. Due to the city's liner shape, commuting traffic and congestion are concentrated in a few east-west routes, and the city is unfriendly to pedestrians. Even short travels might be inconvenient, particularly in the metropolitan core. The public mass transit system lacks enough coverage and capacity, and the fleet's quality has deteriorated significantly. As a result, private vehicles and privately operated microbuses account for a portion of passenger travel on shared routes, resulting in increased congestion. Taxis serve as a substitute for public transportation for local excursions, despite the fact that they are not a financially viable option for passengers (Alexandria Governorate, 2018). In 2010, the entire volume of public transportation was anticipated to reach 220 million passengers per year 603,000 passengers a day. In 2010, private-operated microbuses transported around 1.5 million people every day 547.5 million passengers a year (Alex. AS&P, 2013).

This table is calculated by dividing the total number of trips made inside Alexandria's borders by the total population. Internal trips were 6.2 million in 2014 and are expected to reach 8.7 million in 2032. This includes travel to and from the external zones.

Additionally, there is no transit body that controls public transportation in Alexandria. In this setting, transport operators operate their own services independently of one another (bus, train, minibus, etc.). Vendors on the street who take up public space frequently come into dispute with the transit system. There are little green spaces available to residents who lack recreational

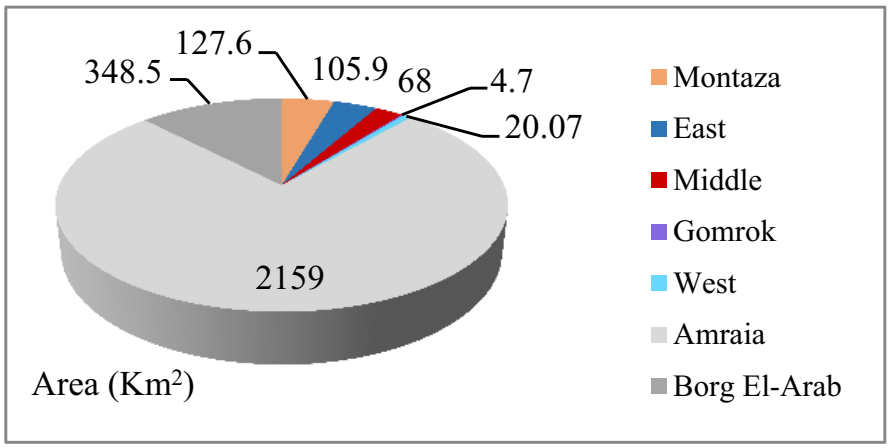

Figure 3 Alexandria City Area (Source: Alexandria Governorate, 2018).

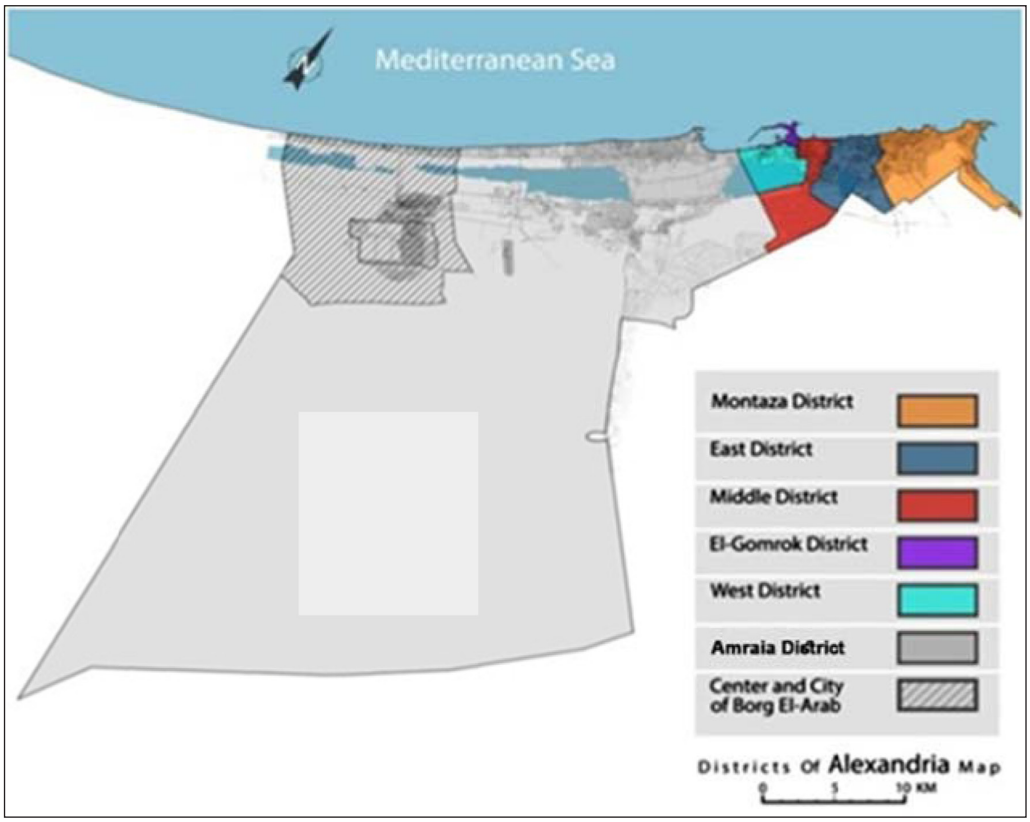

Figure 4 Alexandria Districts (Ministry of Housing, 2018).

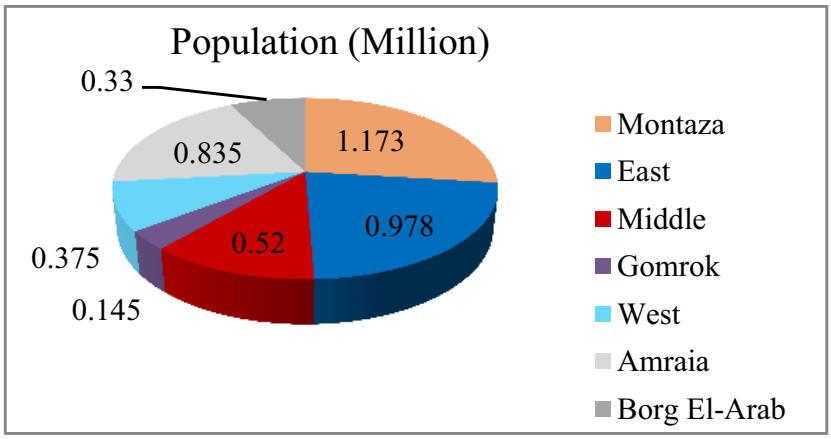

Figure 5 Alexandria Population (CAPMAS, 2018).

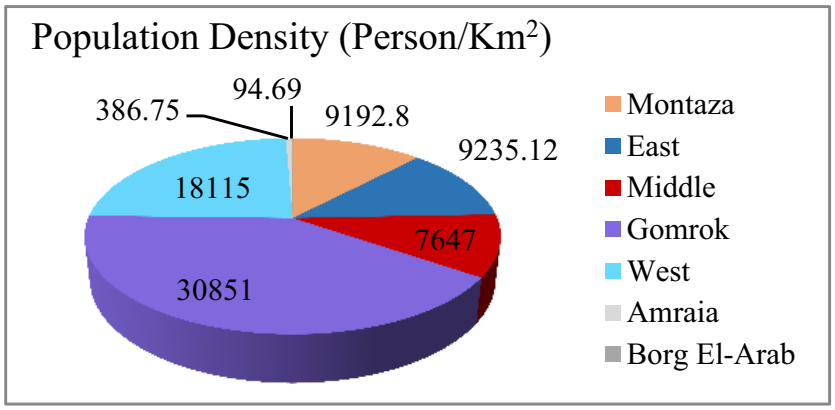

Figure 6 Population Density (CAPMAS, 2018).

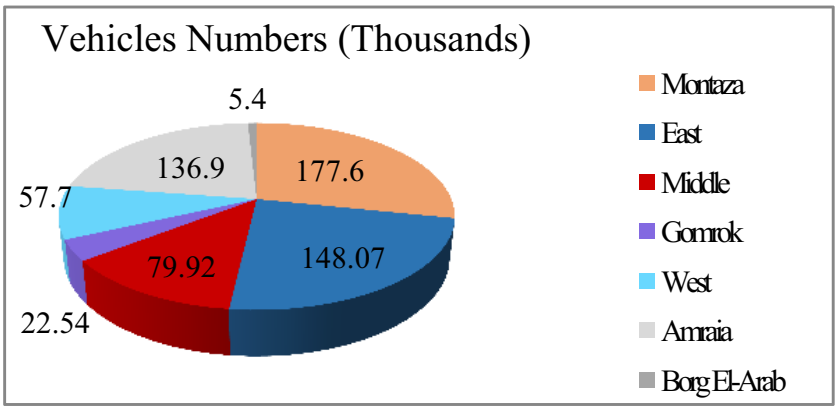

Figure 7 Vehicles Numbers (CAPMAS, 2018).

Figure 8 Alexandria City's Traffic Problem and Pollution (Mohamed et al., 2013).

facilities, and the Cornish are not particularly pedestrian-friendly (Alex. AS&P, 2013).

4.1.4 ALEXANDRIA ENVIRONMENTAL ISSUES

The city is located on a T-shaped peninsula that is sandwiched between the sea, lagoons, and old lakes. Due to the fact that a large portion of the city is below sea level, flooding and drainage are important issues. According to SUP Alex 2032, the city›s population is predicted to grow from 4.1 million to 6.9 million by 2032 (a 65 percent increase), putting strain on the site as shown in Table 2. Physical limits combined with environmental dangers necessitate that future urban development occur in places that are not low-lying (Alex. AS&P, 2013).

Additionally, following the Egyptian January revolution in 2011, growth of unplanned buildings and illegal

ITEM	2014 – BASE YEAR		2032 – MASTER PLAN		EVOLUTION
No. Inhabitants (M)	4.6		6.9		50%
Total mobility/inhabitants[1]	1.3		1.3		–
Daily car trips/inhabitants	0.6		0.5		–
Cars and taxis[2]	3,000,000	39%	3,300,000	30%	10%
Collective taxis[2]	4,100,000	53%	5,500,000	50%	34%
Public transport[2]	600,000	8%	2,100,000	19%	250%
motorized mobility/day[2]	7,700,000	100%	10,900,000	100%	42%

Table 2 Daily Mobility Pattern and Model Breakdown at 2032 Horizon, Along Urban Transport Scenario (Source: Pierre-Arnaud, 2014).

Figure 9 Existing Main Roads & Squares in Alexandria City (Allam, 2015).

neighborhoods has surged in Alexandria›s informal districts, which house one-third of the city›s total population. These infractions are deemed extremely hazardous to both persons and the city›s infrastructure as shown in Figure 9. While Alexandria's air quality is generally satisfactory in comparison to air quality standards, this does not mean that there are no regions affected by air pollution (El-Sawy, 2010). Residents of Alexandria now suffer from air pollution caused by congested streets and unauthorized building. Alex-mid, an environmental measurement center located in Alexandria Bibliotheca, measured the city's air quality and pollution sources in 2012 (Alex-Mid, 2012), and other researchers determined the city›s environmental attributes, which are represented in Figure 10 as a percentage of good, moderate, and bad environmental attributes (Farag et al., 2015).

Green Areas Shortage in Alexandria

As stated in Table 3, Alexandria contains roughly 684 acres of green space and gardens (Ministry of Environment of Egypt, 2016). This green space (684 acres) is deemed insignificant in comparison to the city's entire area and population, which is approximately 0.9 m^2 per person as shown in Figure 2. However, the World Health Organization recommends a ratio of 9 m^2 per resident in metropolitan areas (Holmes et al., 2007). Additionally, to this scarcity of green space in Alexandria, the surge of building infractions following the Egyptian Revolution in 2011 resulted in a reduction in overall green space (Ministry of Housing, 2018). As a result, numerous strategic plans have been developed for the development of Alexandria's urban spaces, such as the Strategic Urban Plan for Alexandria 2032.

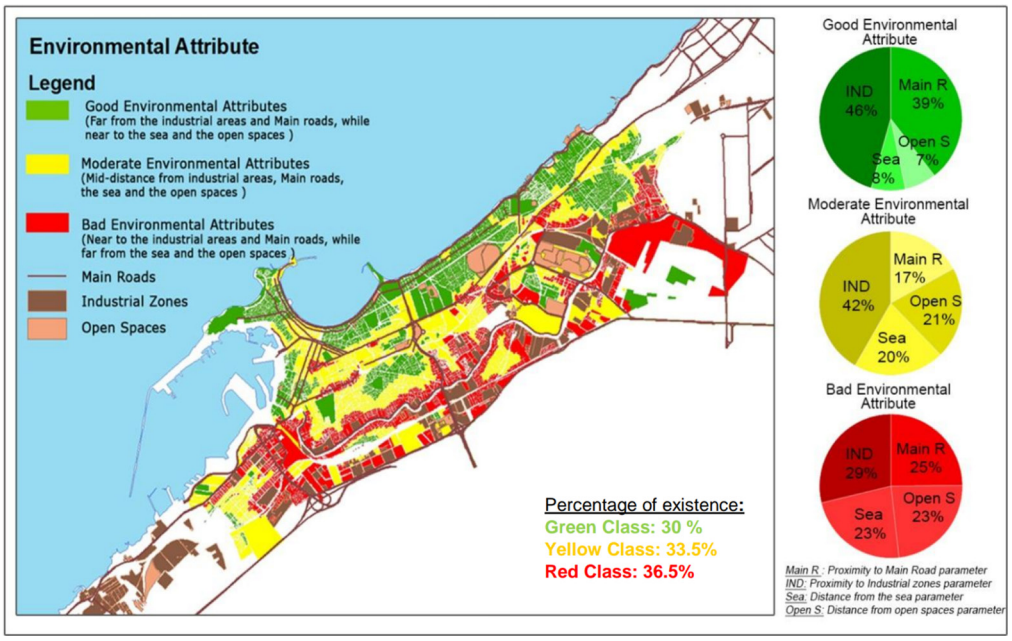

Figure 10 Major Sources of Air Pollution in Alexandria (Source: Farag et al., 2015).

N.	PUBLIC GARDENS AND GREEN AREAS	AREA (ACRES)
1	El-Montaza Gardens	370
2	International Gardens	130
3	Antoniadis Gardens	84
4	El-Shallalat Gardens	79
5	The Zoo Gardens	21
Total Area		684 Acres

Table 3 Public green areas in Alexandria city (GOUP, 2000).

4.2 ALEXANDRIA URBAN SCENARIOS FOR ALEXANDRIA 2032

AS&P was commissioned by Egypt's Ministry of Housing in 2010 to develop a General Strategic Urban Plan for Alexandria, the country's second largest metropolis. The master plan's objective is to create succinct technological planning solutions for the critical concerns.

Three master plans for pioneering projects will illustrate these ideas and will be accompanied by economic feasibility studies. AS & P will lead and coordinate a diverse international consultant team comprised of economic specialists, infrastructure, and environmental engineers, until the end of 2012. The AS & P group will discuss all courses pertaining to regional, urban, and transportation planning. There are two geographical alternatives for Alexandria's future urban growth as follows:

- Spatial Scenario No. 1: This scenario entails the expansion of multiple lines from Elmontaza district to the new city of Borg Elarab, as well as complementary core growth, as seen in Figure 11a.
- Spatial Scenario No. 2: This scenario focuses on the concentric core growth and regional nodes, which include the East and West districts, as well as the new city of Borg Elarab, as seen in Figure 11b.

These geographical scenarios depict Alexandria's future growth and offer viable alternatives for urban development, but in my opinion, the city's urban sprawl, particularly to the east, has been resolved. Thus, this research proposes resolving traffic issues and establishing a green belt along the Alexandria governorate's borders in order to avert random expansion and slum regions (Alex. AS&P, 2013).

5. PROPOSED RENOVATION OF ALEXANDRIA CITY

This article proposes a development strategy for Alexandria by outlining a recommended plan that addresses the city's most pressing environmental issues, including transportation systems, air pollution, and energy efficiency. According to World Health Organization guidelines, it adds additional green space and pedestrian corridors to maintain social distance between people as a safeguard against the climate change negative impacts.

5.1 TRANSPORT AND TRAFFIC SERVICES

The first phase in the strategic plan for sustainable development is to address Alexandria's traffic congestion by the following proposal:

5.1.1 The Green Belt and its Road

This proposal calls for the establishment of a green belt along the Alexandria governorate's border with El-

Baheera and Matruh governorates. (As seen in Figure 12, this green belt allows population expansion to continue in the west and western-southern directions but prohibits it from continuing in the east and south. Additionally, the thesis proposes the construction of a new road next to the green belt, dubbed the Green Belt Road. The purpose of this route is to connect high-traffic areas within Alexandria to the rest of the city, particularly El-Gaish Road and other internal highways, to facilitate short travels within the city and tourism activities. The Green Belt Road will be constructed by repurposing existing roads.

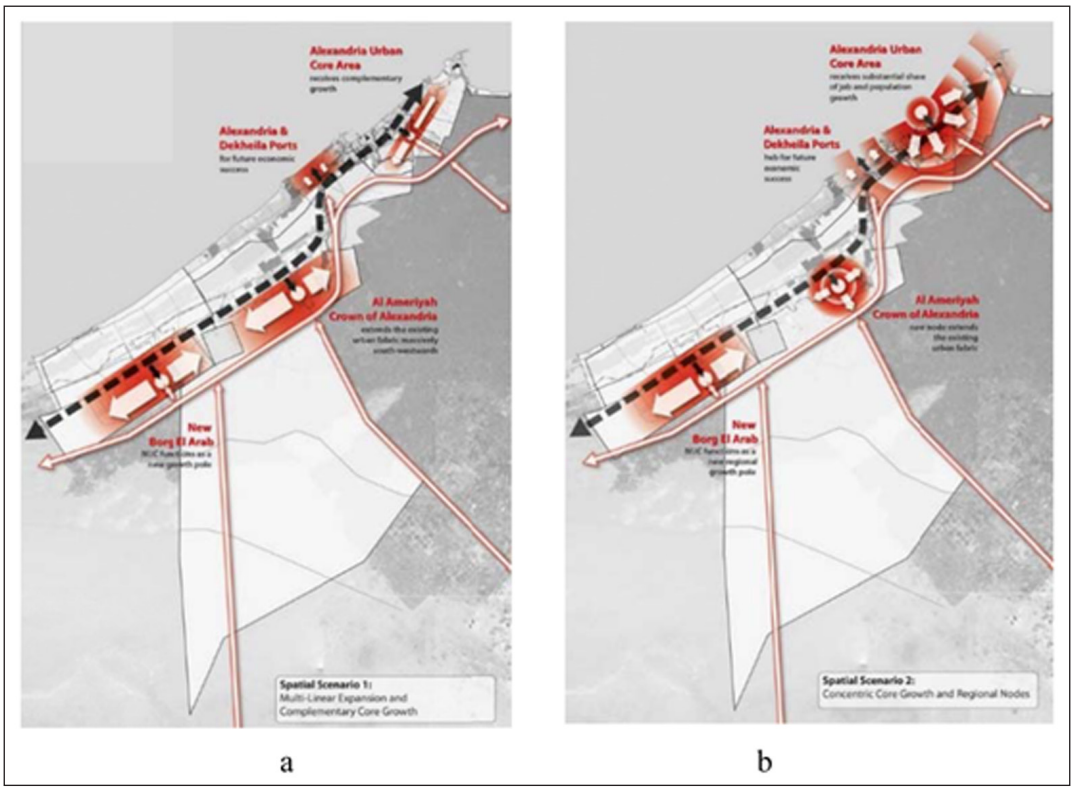

Figure 11 Alexandria Urban Growth Scenarios 2032 **a** & **b** (Alexandria Master Plan 2032, 2013).

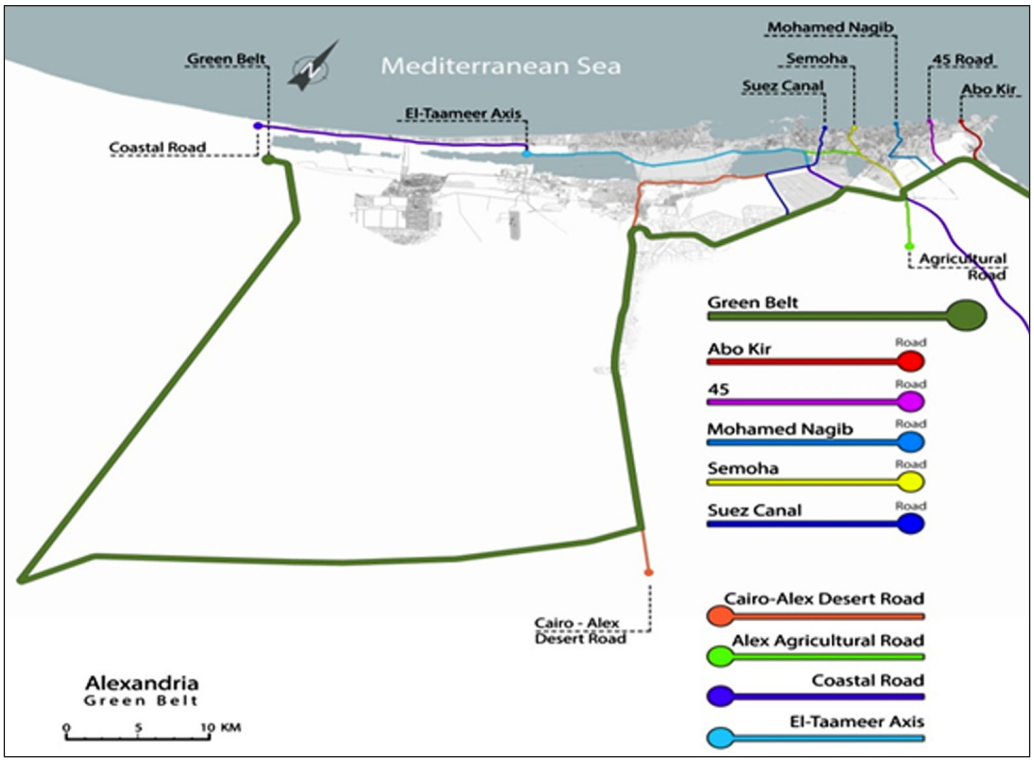

Figure 12 Suggested Green Belt and its Road and Axes (made by the researcher).

Green Belt Road Map

The proposed route continues eastward within the Alexandria-El-Baheera Boundaries, until it reaches the end of the El-Montaza District Boundary.

This road is divided into the following major axes:

- Canal Suze Axis • Smoha Axis • Mohamed Nageeb Axis • 45 Road Axis • Abo-Kir Axis

These axes begin at the Green Belt Road and end at the El-Gaish Road, passing existing roadways (Coastal, Agriculture, and Ring Roads) and internal roads (El-Mahmoudia, Railway, Abo-Kir, and El-Tram Road) (as shown in Figure 12).

5.1.2 Underground Train and Monorail

The installation of a train hanging in Alexandria was linked to the idea of the subway on the grounds that land beneath the train could also be exploited to expand streets, as well as the establishment of any investment projects and monorail stations.

The monorail is proposed to replace the city tram (as depicted in Figure 13) that connects East and West Alexandria, so creating a broad internal road that may be used in one direction and connected to the Abo-Kir Road in the other. This underground railway connects El-Montaza to Borg El-Arab, while the monorail is used for internal mobility between Alexandria districts, with sufficient monorail stations located at the main existing tram station.

Track 1: Ras El-Teen Station – El-Dakhila Station – El-Agamy Station – Sidi Kreer St.

Track 2: El-Manshia Station – Mina El-Basl St. – Karmoz St. – Amraia St.

Track 3: El-Raml Station – El-Shohaa St. – Moharm Bey St. – Somoha St. – Elnoza St. – El- Shatby Station – El-Ryada Station – Sidi Gaber Station – Bolkly Station – San Stefano Station – Victoria Station – Nageeb Station – 45 Station- El-Mamoura Station – Abo Kir Station

5.1.3 Proposed Sea Taxi

This concept proposes the establishment of a Sea Taxi that will transport passengers between East and West cities and vice versa, as seen in Figure 14. This mode of transit will function as a tourist and recreational attraction in the city, serving both the private and public sectors.

5.1.4 Proposed El-Gaish Road (Cornish)

This research focused on the benefits of Alexandria, such as the El-Gaish Road, which advised segmenting it into lanes according to the numerous activities depicted in Figure 15.

- Seating spaces with greenery
- Bicycle path
- Private car lane (with a 40 km/h speed restriction)
- Public transportation lane (with a 40 km/h speed limit)

5.2 COMPARISON BETWEEN PROPOSED AND ALEXANDRIA 2032 STRATEGY PLAN

In terms of transportation systems, environmental treatment, urban planning, infrastructure, and time consumed, the proposed strategy plan is compared to the Alexandria 2032 plan as shown in Table 4.

Figure 13 Proposed Monorail (Egypt Independent, 2019).

Figure 14 Proposed Sea taxi (by the researcher).

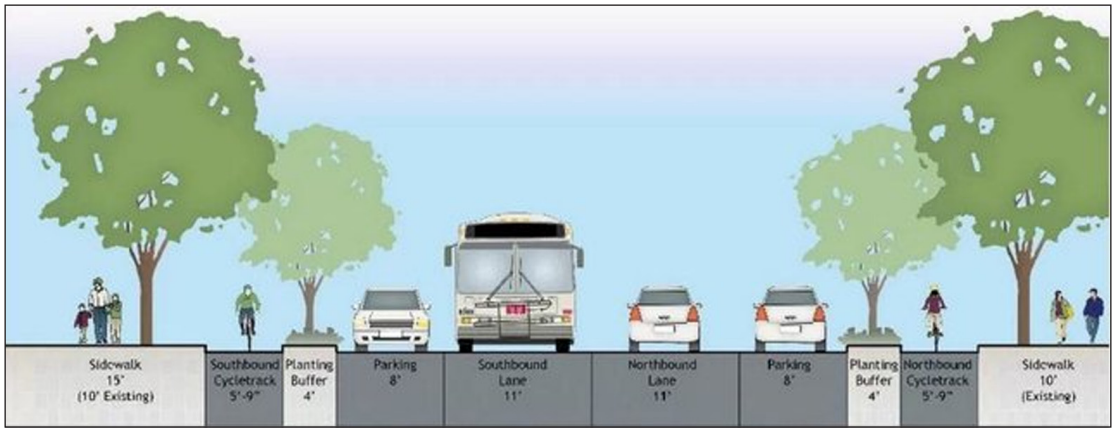

Figure 15 Suggested the El-Gaish Road's Activities (Ganiron et al., 2017).

This comparison highlights the significant components of each plan and assesses their impact on the environment and city residents as they propose solutions to Alexandria's traffic and congestion concerns.

5. MAIN RESULTS

The primary outcome of this comparison between the proposed development strategic plan and the spatial 2032 scenarios of "Alexandria: regenerating the city A contribution based on AFD experiences" shows that the proposed strategic plan isn't only more effective in resolving congestion and traffic difficulties on the Alexandria city's highways but also preventing urban sprawl and environment and people's health as well through the use of renewable energy resources and sustainable transportation systems. In addition to addressing current global events, such as climate change effects and other global concerns. So, the following findings highlight the significant results of this comparison:

- The green belt that runs along the governorate of Alexandria's borders will prevent the city from sprawling, and the ring road will alleviate congestion on the city's inner streets.
- The new traffic axes and city nodes will establish new channels for vehicles to travel from the city's south to north in a short period of time.

ITEM	PROPOSED PLAN	ALEXANDRIA 2032 PLAN
Transport	Green Belt Ring Road	New Nodes
	New Traffic Axes	Extension to West
	Monorail on Existing Tram Track	Public Transport
	Sea Taxi & Bicycles	El-Mahmoudia Road
Environment	Creating Green Belt on the governorate boundaries	Mitigating of the fossil fuel usage
	Depending on renewable energy	Natural Gas Vehicles
	Electrical Vehicles & Monorail	Enhancing city air quality
Urban Planning	Increasing of Green Spaces	Creating New City sub-centers.
	Increasing of Pedestrian Spaces	New Urban Nodes in El-Montaza District.
Infrastructures	Replacing into Smart and Digital Infrastructure	Renovating the existing infrastructure
Time Consumed	The proposed strategy plan will be executed on stages which reach 2050	The deadline of this plan is 2032.

Table 4 Comparison between Proposed versus Alexandria 2032 Strategy Plans (Made by the Researcher).

- Reliance on public transit systems rather than private automobiles reduces the number of vehicles on city streets, which improves environmental air quality.
- The expansion of pedestrian zones will generate additional free-car zones and help inhabitants maintain social distance in the event of a Covid-19 epidemic.
- Increasing the amount of green space in the green belt and other public spaces benefits the environment by lowering greenhouse gas emissions in metropolitan areas.
- By utilizing smart infrastructures, architects and planners will be able to incorporate new technology into their urban designs when restoring Alexandria.
- The strategic urban plans under consideration are deemed futuristic in nature, having been developed for either 2032 or 2050.

CONCLUSIONS

Alexandria's urban sprawl has several negative repercussions for citizens and the environment, including increased water and air pollution, increased traffic fatalities and congestion, agricultural capacity loss, and increasing reliance on automobiles.

As a result of the rapid development of the world's population, resource consumption has skyrocketed, releasing massive amounts of carbon and other greenhouse gases into the atmosphere, causing global warming and climate change phenomena that are detrimental to the environment and human health.

The primary sources of these emissions include industrial processes, fossil fuel combustion, transportation, waste collection, deforestation, which contributes to the world's lack of green space, and other human activities.

The promising solution to these environmental problems is to conserve earth resources and human health by utilising renewable energy sources "such as solar and wind energy," conserving forests and green areas, recycling waste materials, conserving potable water, and implementing smart infrastructure in our cities.

Alexandria residents are subjected to air pollution as a result of congested streets and illegal building. There are numerous unlawful constructions and structures around Egypt, most notably in Alexandria following the 25th of January 2011 revolution. It, like the rest of Egypt's cities, struggles with a lack of energy resources.

The 2032 geographical scenarios of "Alexandria's renaissance A comment based on personal experience with the AFD "have a vision for Alexandria's future expansion and provide viable urban development ideas, but in my opinion, the city's urban sprawl, particularly to the east, has been resolved. Thus, this research proposes resolving traffic issues and establishing a green belt along the Alexandria governorate's borders in order to prevent haphazard expansion and slum regions. The proposed development strategic plan is intended to address Alexandria's primary environmental concerns. It includes the following:

The green belt and its main roads are proposed features to address traffic and pollution issues on Alexandria's internal roads, particularly El-Gaish Road.

Underground trains, monorails, electric cars, bicycles, and pedestrian zones are also proposed features to address transportation issues and improve Alexandria's environmental quality.

This strategic plan contains numerous recommendations for resolving Alexandria City's primary environmental challenges, including as water, waste management, and pollution, in order to safeguard the environment and improve inhabitants' health.

COMPETING INTERESTS

The author has no competing interests to declare.

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