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Spatial Negative Influence of Cairo Mega Movement corridors on adjacent Local Areas Land Uses and Movement: Ain Shams Corridor Case Study

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ABSTRACT

The research is focused on discussing the importance of transportation in metropolitan areas and analyzing the positive and negative spatial impacts of the major movement corridors in Greater Cairo on the surrounding local areas. It aims to highlight the regional benefits of these corridors while also addressing the spatial challenges faced by the local areas. The study emphasizes the significance of movement circulation for pedestrians and vehicles in the urban functionality of local movement, serving as a connection between land uses and daily activities. While the mega movement corridors have significantly improved access between Greater Cairo's main districts, they have also introduced challenges at the local level. The research examines the impact of the Ain Shams corridor as an example of a new movement corridor introduced by the government in the last 5 years, in two major areas, and additionally, identifies the resulting challenges in land uses and movement circulation in these areas. The findings underscore the importance of segregating movement circulation between the regional and local levels to enhance accessibility for pedestrians and vehicles in local areas. Furthermore, the study reinforces the importance of comprehensive measures to enhance the efficiency of the corridor. Implementing solutions such as dedicated service roads, improved parking infrastructure, and optimized traffic management strategies can play a pivotal role in mitigating congestion and addressing the specific needs of local traffic. By addressing these challenges, the corridor can achieve improved functionality, accommodate the diverse traffic demands, and enhance the overall transportation experience for commuters and urban activities.

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1. Introduction

The development of transportation systems has had a profound impact on the layout and character of cities. The popularity of automobiles in the early 20th century, particularly in urban areas, contributed to rapid urban growth. Cars allowed people to travel to areas further from city centers, leading to the

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emergence of new suburbs and communities. The expansion of suburbs aimed to accommodate increasing populations and reduce crowding in older urban areas, often facilitated by the introduction of affordable public transportation options. However, this outward growth presented new challenges related to transportation, land utilization, and the environment. Problems such as traffic jams, air pollution caused by vehicle emissions, lengthy commutes, noise pollution, lack of parking space, limited room for walking and biking, and concerns about public safety became more common.

Prior to the emergence of the concept of sustainable development, urban planners made attempts to address the imbalances between motor vehicles and human activities. However, since the late 1970s, there has been a noticeable increase in policies aimed at addressing these issues in three major aspects. The first aspect involves promoting alternative modes of travel, emphasizing mobility through walking and public transport. The second aspect focuses on altering land use and urban design policies to facilitate alternative modes of travel and reduce trip distances, as shown in the case of compact city planning. Lastly, there has been a push to reform transportation prices and taxes by factoring in the full socio-environmental costs of driving into the price of fuel, road use, and parking, as demonstrated in the central London business area through increased taxes for access after 6:00 am (Wheeler, 2004).

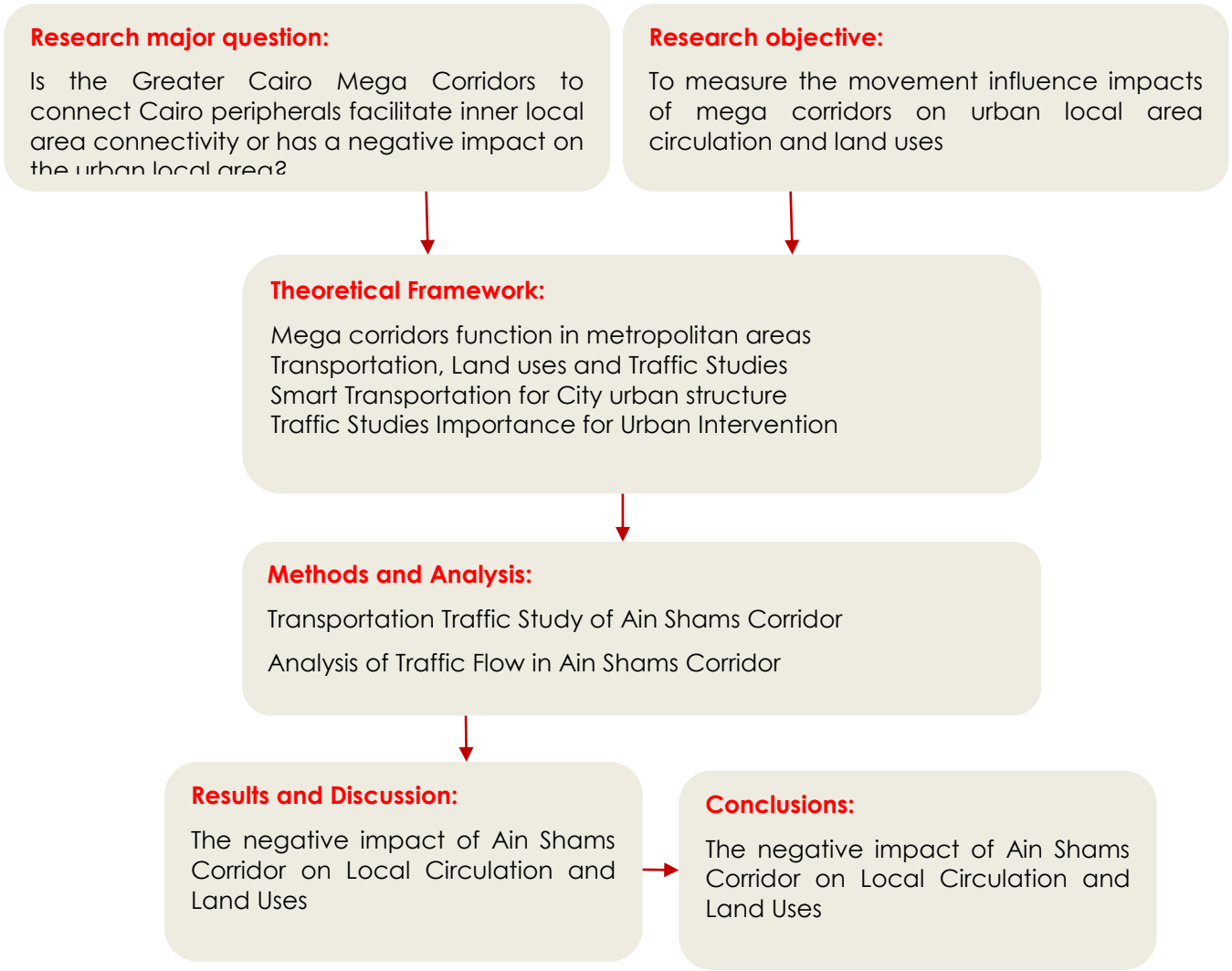


Figure 1: Research Methodology

Over the past five years, the Egyptian authorities have implemented an ambitious plan to upgrade specific roads in the Cairo metropolitan area with the aim of improving traffic flow from east to west and north to south. This initiative connects new cities such as the 6th of October, the new Cairo, and the new capital city on the outskirts of old Cairo. However, these corridors have negatively impacted the surrounding areas, resulting in traffic congestion and insufficient parking facilities, limiting local transport accessibility. Figure 1 presents the research methodology used to assess these negative impacts and determine the effectiveness of these corridors in addressing transportation delays in the Cairo metropolitan peripheries, while also exploring alternative solutions.

2. Transportation, Land uses and traffic study

2.1. Land uses and transportation

traffic is influenced by land use, and changes in land use can lead to different types of traffic movements. Similarly, London's Blunden notes that traffic serves as the link between the transport system and land use. Both elements are responsible for generating traffic, as changes in land use can create specific traffic patterns, while transport infrastructure developments can also generate traffic to specific areas. This, in turn, can lead to the emergence of new uses and activities in the area, such as the establishment of factories or tourist attractions (Breheny, 1992). Research in urban transport planning has emphasized the crucial role of transportation in people's daily lives, providing mobility within and outside the city. The economic structure of a community relies on transportation and mobility infrastructure, encompassing various modes of transport. Given the close relationship between urban land use and traffic, comprehensive data on traffic conditions, public transport, land use, population, economic activities, social dynamics, and urban services is essential for effective planning and development of urban areas, particularly in relation to highway schemes (Breheny and Rookwood 1993)

Traffic jams are a pressing problem in many urban areas. Recent advancements in traffic management methods have proven effective in addressing this issue by enhancing urban transportation efficiency and reducing congestion. Assessing traffic patterns in urban road networks is crucial for effective traffic control. It enables authorities to accurately determine the status of network traffic operation and provide relevant information about congested roads. Evaluating the situation of traffic congestion with appropriate measures is essential. Cities typically experience high congestion during peak commuting hours, especially on highways. Over the last three years, the congestion problem has exacerbated due to insufficient road infrastructure and poor management in urban areas. It is essential to identify the primary causes of traffic congestion, particularly how the existing infrastructure fails to meet the demands of city traffic. In Saudi Arabian cities, traffic congestion arises from factors such as low usage of public transportation, inadequate street networks, high vehicle ownership, urbanization, and population growth.

2.2. What is a traffic study?

The traffic study involves estimating the volume and movement of various types of vehicles, including those wishing to move through the study area. The study assesses car ownership, development needs, and future projects in the study area, as well as the services required from commercial, cultural, recreational, and emergency vehicles. Conducting a traffic survey to determine the current traffic volumes on the road network in the study area. Predicting the volume of trips to and from the region. Analyzing the service levels of streets within the study area before and after planning and reconstruction efforts. Evaluating the demand for waiting areas, both indoor and outdoor, within the study area. Proposing alternative traffic routes in the event of congestion and developing traffic regulation proposals within the framework of the Urban Plan or for industrial works (Chavhan, S., & Venkataram, P. 2020).

2.3. Importance of traffic study

The main objectives of traffic studies are to Assess the current traffic situation and identifying bottlenecks and traffic problems. Predicting future traffic levels based on expected physical and population developments. identifying appropriate solutions to improve traffic flow and reduce congestion, and ensuring the safety of all road users, including drivers, pedestrians, and cyclists. The traffic study receives its importance through helping to achieve smooth and efficient traffic flow, saving time and costs, enhance traffic safety and reduce road accidents, improve the quality of life of the population by reducing environmental pollution and noise resulting from traffic congestion, and support economic growth and sustainable urban development by providing effective traffic infrastructure (Almatar, M., 2023).

2.4. Traffic Study Methodology

Field data on traffic volume is collected in various regions and roads and analyzed to understand current patterns and trends. Projections of future traffic levels are also made based on different factors such as population growth and urban development. Current and projected traffic analysis mainly follows the major methodology of traffic planning study which includes these elements to form traffic study (Shirazian& Eskandari, 2021)

1. Road and intersection traffic capacity study:
   The ability of roads and intersections to absorb current and projected traffic volume was assessed, identifying choke points and potential problems.
2. Assessment of service levels and traffic congestion:
   Traffic service levels are analyzed to measure the quality of traffic flow and the driving experience. Traffic congestion levels and their impact on traffic network efficiency are also assessed.
3. Study of entrances, exits, and traffic flow:
   Traffic flow is analyzed at key entrance and exit points for projects and urban areas, and the best solutions are identified to design them to ensure smooth traffic.
4. The importance of studying entrances and exits in projects:
   Studying and designing entrances and exits play a vital role in ensuring smooth and safe traffic flow in urban and suburban projects. Their importance lies in:
5. Ensure smooth traffic and avoid congestion at key points:
   Well-designed entrances and exits help to efficiently distribute traffic and avoid stacking cars at key entry and exit points, reducing congestion, delays, and improving users' experience.
6. Determine the best locations for entrances and exits based on traffic flow:
   Traffic studies help understand traffic patterns and identify locations best suited to create entrances and exits. These sites are selected to correspond to the main traffic flow, facilitating seamless access and exit.
7. Design of entrances and exits according to engineering standards and legal requirements:
   Entrances and exits are designed according to specific geometric standards, such as passage width, navigation vision, rotation angles, etc. The applicable legal requirements and traffic regulations are also observed to ensure safety and compliance with regulations (Almatar, 2023).

2.5. Transportation and metropolitan spatial land use structure international best practice

Metropolitan areas are implementing policies to manage urban growth, such as the compact urban growth strategies seen in Portland, Oregon, and the Greater Vancouver region. Greater Vancouver's approach prioritizes creating a compact metropolitan region by concentrating a significant portion of population growth within the "growth concentration area" in the central part of the region, as depicted in Figure 2.5 showing the Greater Vancouver growth boundaries. The urban growth policy aims to channel future growth around regional centers while also providing mass transit to connect these centers,

promoting accessibility and reducing private automobile dependence (Ewing & Bartholomew 2018) . In a similar vein, Portland, Oregon, has managed urban growth through the adoption of an Urban Growth Boundaries policy (UGB), which helps the local government regulate growth using tools such as urban service limits (Wheeler, 2004). While individual communities contribute to a city's overall structure, the planning of the broader urban region is crucial. Larbi (2022) argues that adopting a polycentric urban structure, where multiple centers are connected by public transit corridors, can accommodate growth while preserving walkable neighborhoods and reducing reliance on cars. Figure 2 illustrates how this approach allows a city to expand while providing efficient public transportation options that decrease car dependency. (Larbi, M., *et al.* 2022).

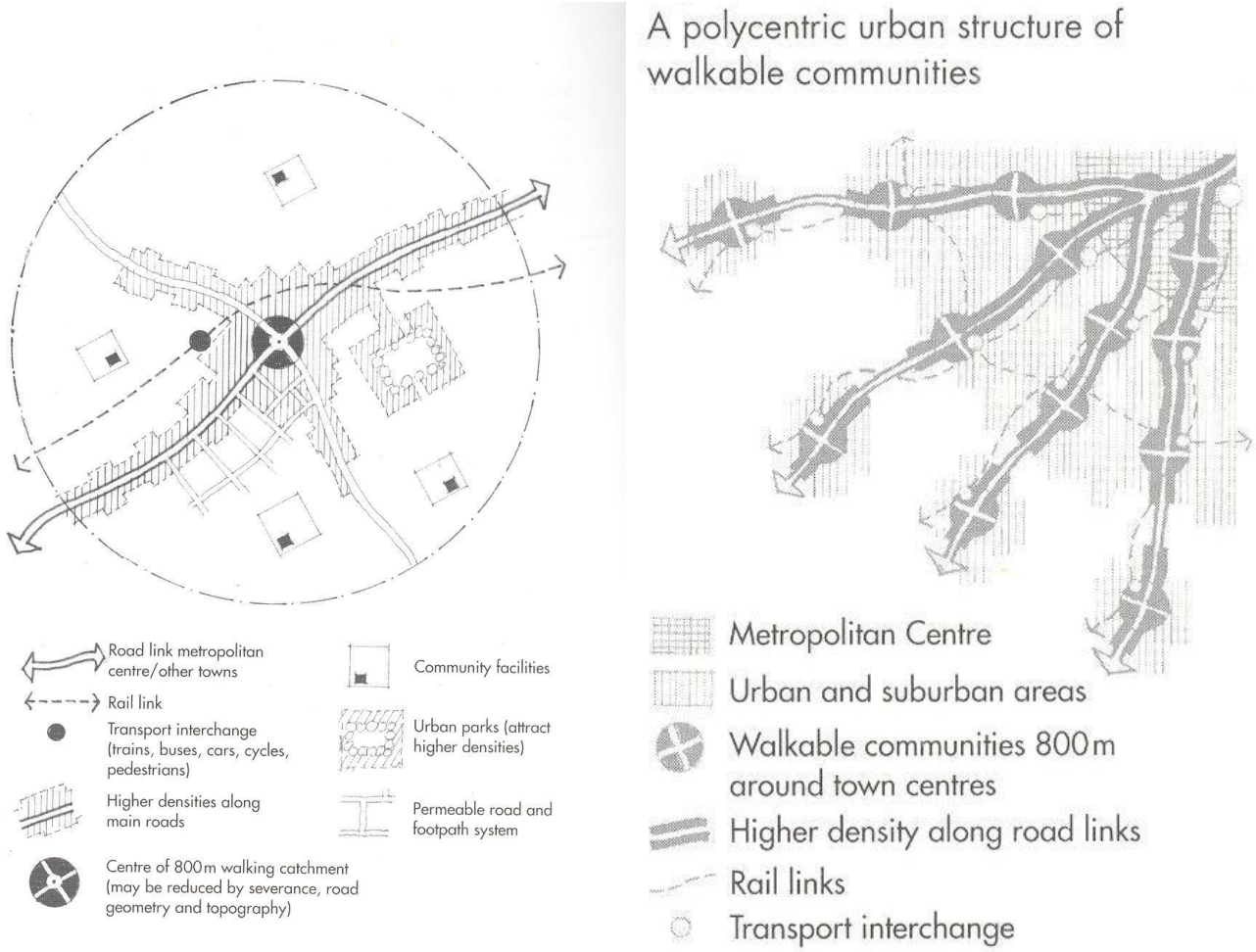


Figure 2. Poly-centric Urban Growth of Greater Cairo Model (Calthorpe, 2000)

The urban structure of a community starts with the urban region. According to Volgmann & Münter, (2022), the idea of a polycentric urban structure supports the expansion of cities while preserving pedestrian-friendly sub-communities through the development of urban transit corridors. As shown in Figure 2, the concept of a polycentric urban structure permits the city to expand while simultaneously establishing transit corridors to lessen reliance on automobiles. The polycentric urban structure is endorsed by Calthorpe in the concept of Transit-Oriented Development. Calthorpe emphasizes the importance of pedestrians as "the catalyst that gives meaning to the essential qualities of communities"

(2004, p. 76). He argues that the spatial layout should be influenced by transit accessibility and environmental considerations and proposes the establishment of urban growth boundaries that support polycentric growth (2004, p. 80). The effectiveness of transportation in facilitating polycentric urban growth hinges on the provision of a suitable mass transit system that reduces reliance on automobiles.

The example of Curitiba's public transit system shows how effective a well-designed bus network can be. The city prioritized bus transportation by creating dedicated bus lanes and using these routes to guide urban development. This approach resulted in a fast and affordable system that is now being expanded to connect with the surrounding metropolitan area. Figure 3, indicates the concept of using the major Corridor a a mass Transit system. The system's efficiency has encouraged residents to choose public transit over personal cars, even though Curitiba has a high rate of car ownership and a growing population. Remarkably, car traffic has decreased significantly. Today, Curitiba boasts the highest public transit ridership in Brazil, with approximately 2.14 million daily passengers (Larbi, M., *et al.* 2022). Furthermore, the city enjoys some of the country's lowest pollution levels and per capita gas consumption. Curitiba's system also prioritizes affordability and accessibility. A low "social fare" makes transportation accessible to low-income residents living on the city's outskirts. The system uses a flat fare for all trips, meaning shorter rides help subsidize longer ones. This allows a single fare to cover trips up to 70 kilometers (Ewing, 1997).

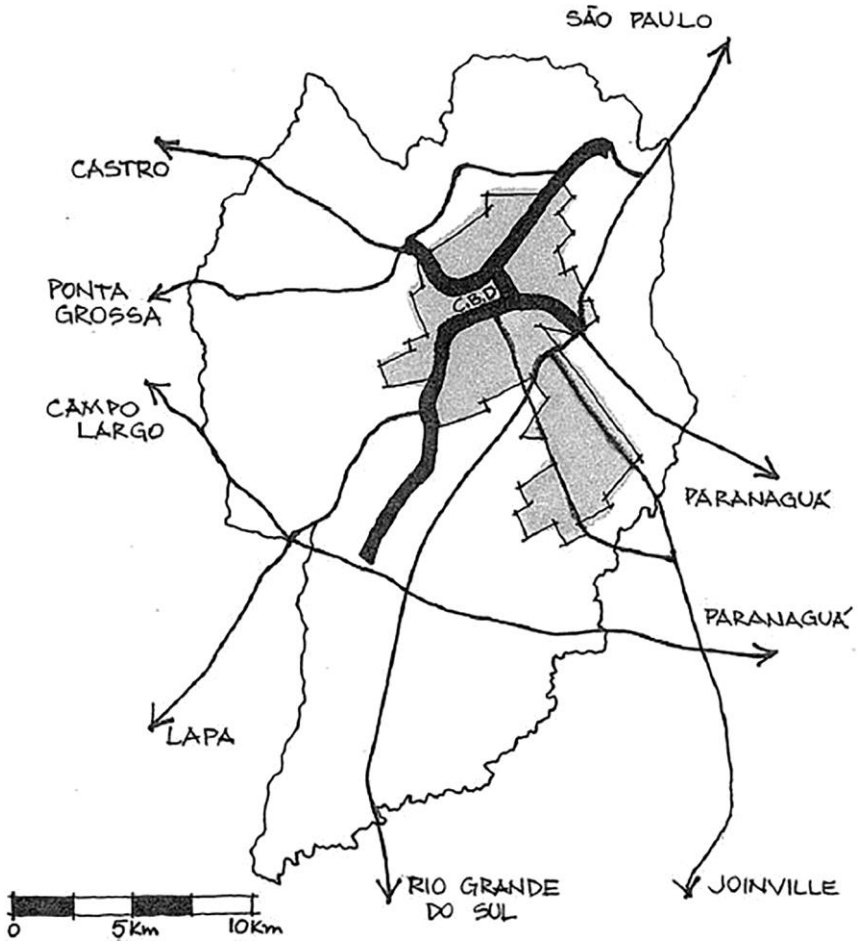


Figure 3: Curitiba, Brazil Mass Transition System and Urban Corridors (Larbi, M. *Et al.* 2022)

3. Greater Cairo Metropolitan Region GCMR transportation issues

3.1. Greater Cairo Metropolitan Region urban characteristics in the last decade

The Greater Cairo Metropolitan Region (GCMR) is home to over 21 million people (CAPMAS, 2017) and ranks among the top twenty largest mega-cities globally. It spans 928 km2 in central Egypt and is situated alongside the Nile River. Within this region lies the Greater Cairo Metropolitan Area (GCMA), encompassing the major cities of Cairo, Giza, and Qaluibia. After undergoing privatization, economic reform, and market liberalization in the 1990s, the region experienced rapid economic growth with real economic expansion averaging around 6.2% annually during the 1994–1997 "boom" period (Rodenbeck, 2000). the last decade between 2013-2023 urbanization took a radical turn with the new regieme that witnessed a vast road netwrok and a series of new towns such as the New Capital city, New Alamain, additionally, a big number of intiatives and urban projects that require a clear urban policy which put a load of pressure in infrasructure and transportation strategy.

The Greater Cairo Metropolitan Region (GCMR) has become increasingly integral to the Egyptian economy, contributing over 45% to the GDP and almost 40% to manufacturing output (CAPMAS, 2017). This growth can be traced back to the late 1980s when the Egyptian government adopted an economic reform strategy in line with the recommendations of the International Monetary Fund and the World Bank (Bush, 2001). The years 1985–1989 witnessed a 52% expansion of Greater Cairo, leading to the emergence of a new industrial hub. However, the lack of effective land management policies has resulted in the scattered placement of factories throughout the GCMR, intertwined with other land uses, making it challenging and costly to provide services. Additionally, the development of housing compounds, recreational facilities, and service infrastructure has further strained the GCMR. For instance, housing developments in the 6th of October satellite town increased by 76% during the 1994–2000 period. The structure of the manufacturing sector exacerbates the lack of planning and services due to the absence of necessary planning regulations, which are crucial for mitigating the adverse impact of factories (Sutton and Fahmi, 2001). The rapid industrial growth, along with other forms of development in the GCMR, additionally, the introduction of a New Capital City in the North in 2017, has intensified long-standing problems such as inadequate infrastructure, extensive environmental degradation, and growing social inequality Ghalib, et al, 2021).

Egypt, despite not being a newly independent country, faces similar challenges that necessitate demonstrating its unity and sovereignty to both national and international audiences. In 2011, a revolution led to the overthrow of President Mubarak and his regime after a 30-year rule. Another wave of protests occurred in 2013, resulting in the removal of President Morsy from his elected position due to his close ties to the Muslim Brotherhood and his attempts to manipulate the constitution in their favor. Following several transitional phases, President El-Sisi came to power, marking a critical need for the restoration of Egypt's economic, political, and social stability. The new capital is set to accommodate five million residents and create 1.75 million permanent job opportunities. The residential areas are designed to include housing options suited for various income levels, prioritizing quality of life. In addition to housing governmental buildings and foreign embassies, the city will feature hotels, shopping centers, an airport, a theme park, and essential services for residents and visitors. With Cairo's agglomeration currently housing nearly 20 million people, the new capital aims to accommodate a population equivalent to 25% of the existing agglomeration.

3.2. The regional ring road as an attraction for urbanization

The completion of the regional ring road in its northern, eastern, and southern sections has significantly impacted land use and population changes around Cairo. The road has spurred development around the 6th October new town, leading to potential further expansion. This has also led to the growth of informal private development, along with social exclusion, impacting new settlements and cities in a manner not anticipated by the master plan or the General Organization for Physical Planning (GOPP). Moreover, to the east of the city, the New Capital City has emerged, with continuous extensions in the

eastern areas However, much of the housing development associated with the regional ring road is private and caters to higher-income groups, rather than being part of the public infrastructure. As a result, growth has proceeded despite the master plan, rather than due to it.

3.3. Cairo urban transportation corridors growth

The official development goals for Cairo, as outlined in the 1970 Master Plan, were designed to accommodate 2 million inhabitants and included plans for the city's urban structure and public facilities. However, due to the substantial increase in Cairo's population, the challenges posed by agglomeration dis-economies and disadvantages have become more pronounced for both the national and city governments (Jenssen et al., 1981). The focus of master planning in Cairo has been on physical development, particularly the road network, water supply, and sewage disposal (MHR, 1970 and 1976), reflecting local political and technocratic attitudes toward urban planning and city management. It remains uncertain whether the plan has successfully achieved its objectives. The urban area covered by the GCMR has expanded by over three times its 1974 size, now encompassing approximately 602 km2. In 2015, plans were unveiled to relocate the capital of Egypt. The new capital, often referred to as the "New Administrative Capital," is slated to be situated no more than 45 km from the current Cairo location. The specific selection of the site was not publicly justified, in contrast to previous proposals to move the Egyptian capital. The chosen location, which is roughly equivalent in size to Cairo's current agglomeration, is situated in Egypt's eastern desert. Some researchers associate this choice with the ongoing development initiatives in the Suez Canal region, viewing it as a means to bolster regional connectivity (SISNAC,2024). Official statements cite the primary reasons for relocating the capital as the challenges faced by the existing city, including the intensifying congestion and insufficient infrastructure to support the growing population in one of the world's most densely populated cities. The designated area for the new capital spans 170 thousand feddans, approximately 700 km2. Importantly, the selected site is devoid of existing settlements (SISNAC,2024).

The transportation corridors experience severe congestion due to intensive use, highlighting the contrast with the relatively underutilized land between them. Additionally, decentralized development has been rapidly expanding. For instance, between 1976 and 1984, 45% of land converted to urban use was located 11-20 km from the urban center. This trend continued from 1984 to 1988, with 45% of converted land located over 30 km from the urban center. These extensive development patterns will lead to higher infrastructure costs and increased energy consumption in the future. As a consequence, in 2016, according to the New Urban Communities Authority NUCA, a series of urban corridors were introduced to solve these congestion problems to facilitate regional transportation from east-west and north-south GCMR peripherals. Consequently, the absence of effective land management institutions and policies before and during recent economic changes led to a predictable outcome: the congestive expansion of urban activities across the region (NUCA, 2019).

3.4. Political influences on urban planning in Egypt

It is worth noting that the Egyptian government can be categorized within the framework of the well-known "new Authoritarian" model. This model has been utilized in Latin America and numerous Arab countries. According to Collier (1979), it does not entail the authoritarianism of an individual or a family dictatorship (as seen with Colonel Nasser in 1952), where the military merely plays a supporting role. Rather, it involves a more complex bureaucratic, authoritarian system where the military, law enforcement, and civil bureaucracy assume prominent roles, not to sustain a dictator in power, but to execute projects that serve political objectives. In Egypt, this takes the form of strong law enforcement to quell the labor force and pave the way for rapid economic growth. In both scenarios, the model is bureaucratic in the sense that it operates through a reinforced executive and a robust central administration. Additionally, it depoliticizes the expression of social interests and extends bureaucratic

control over daily life. Various factors must be considered to address the issue of political influence on urban planning decision-making, including political instability, elitism, and political expediency.

The urban planning policy has been significantly affected by political instability. One notable characteristic of urban development politics is the prevalence of rhetoric without corresponding policy plans, leading to limited policy implementation. This is primarily due to the transient nature of political leadership, resulting in the breakdown of new policy development at an early stage. New leaders often distance themselves from the intentions and plans of their predecessors, striving to establish their own mark on decision-making. They typically appoint their own advisors to key government positions, leading to delays and the loss of valuable knowledge and experience.

Furthermore, top-level instability results in inactivity within the lower tiers of the civil service. The hierarchical nature of the Egyptian administrative system fosters a top-down decision-making approach that discourages administrators from delegating responsibilities. Consequently, they frequently handle day-to-day matters unrelated to the priorities of private citizens or groups. Additionally, lower-ranking civil servants are hesitant to take independent action, as doing so may result in reprimand, transfer, or even dismissal. Consequently, they typically act only with direct approval from superiors.

The second significant political factor influencing urban planning is the impact of the elitist nature of the government. The disparity between the elite and the general populace is evident in the urban space organization proposals. Decision-makers prioritize city beautification and orderly layouts over fundamental urban planning needs. In Egypt, it is common for decisions to be influenced more by political factors than sound technical reasons.

4. Current state of Urban transportation in the GCMR

In the Greater Cairo Metropolitan Region (GCMR), urban transportation has garnered attention from decision makers despite the absence of a sustainable urban policy. This attention primarily focuses on issues related to pollution and traffic management. Urbanization in Egypt experienced significant growth at the beginning of the 20th century, with only around 15% of the population residing in urban areas. By the late 2020s, this figure had tripled to approximately 44%, and it is projected to surpass 50% by the early 2030s (CAPMAS, 2017).

The existing Egyptian cities were not initially designed to accommodate the rising population, resulting in considerable strain on infrastructure and utilities, including transportation, communication, water, sewage, and electricity. Unplanned urban expansion around major cities also gives rise to social problems and adverse environmental consequences.

4.1. Sustainable development and transportation planning: an assessment of progress in the GCMR

Since the 1970s, numerous projects have been approved to expand and improve urban quality. Efforts to enhance infrastructure and expand existing urban areas began in the early 1980s. The most significant progress in transportation and road networks occurred between 2013 and 2023, witnessing several mega projects. Despite this vast progress, a holistic framework is needed to connect these mega projects with the extensive urban growth in GCMR, such as the underground network and the second ring road. Movement corridors intersecting GCMR are essential to facilitate regional movement across the old Capital.

The government's transportation policy aims to connect the different parts of the GCMR. For example, the two ring roads have revitalized the new towns project and provided accessibility for the population to commute to and from the city. Therefore, the transportation project does not theoretically increase the rate of overall urban growth. Additionally, the government does not allow building permits to be issued within a certain range of the two-ring roads. However, the application of the law and its

enforcement at the local government level remains problematic, as pressures from local representatives in the political council to deliver favors for the local population create urban chaos at the local level.

4.2. Impacts of transportation projects on the GCMR urban context

The construction of transportation projects aimed at connecting the inner city with new towns has led to traffic congestion issues at the junctions where these roads intersect with Cairo's local transport network. The transportation department is currently focusing on reorganizing the city's transportation network to address these challenges. Key issues with the existing urban transportation system include the absence of a long-term policy and the lack of coordination between transport projects and urban development in the city.

The long-term impact of policies is sometimes misunderstood by certain government bodies, leading them to view policy-making as simply proposing a new set of projects. Additionally, many policymakers are primarily focused on the day-to-day aspects of transportation services and operations. The importance of establishing reliable information for policy formulation and monitoring is not fully recognized by city officials. For those officials who do recognize its significance, challenges arise in obtaining either nonexistent data or acquiring it with great difficulty. Furthermore, the significance of an adequate information system is often overlooked by top politicians, who tend to prioritize short-term projects that produce immediate results, thereby diverting attention from the formulation of long-term policies.

4.3. Organisational, institutional and financial constraints in transportation planning in the GCMR

In many developing countries, including Egypt, the existing institutional structure often hinders the expected output and achievements. This is often due to the mismatch between qualified personnel and their appointed positions. Additionally, there are issues in the financing system of projects, with major implementation work being prioritized over complementary tasks, often leaving the local government with insufficient resources and technical support. To address these challenges, the government needs to consider restructuring the local government mechanism and decentralizing decision-making over the next decade. This will require a clear agenda and sustained efforts to strengthen decision-making at the local level.

4.4. Traffic Study of Ain Shams Corridor Method

The Ain Shams corridor is of utmost significance for Cairo, serving as a critical thoroughfare that seamlessly connects the western fringes of the city, including 6th of October City, the West Cairo Ring Road, and Giza City, with the eastern fringes, encompassing the New Capital City, Nasr City, and Cairo International Airport. This important corridor not only serves as a link between these areas but also plays a vital role in facilitating transportation and connectivity for the residents and businesses located along its route.

Furthermore, the historical urban fabric of Old Cairo is intricately intertwined with the path of the Ain Shams corridor, as it extends from the northern part of the city, showcasing the corridor's deep-rooted connection to the rich heritage and traditional elements of the region. The visual representation in Figure 4 provides an intricate and detailed depiction of the exact path of the Ain Shams Corridor, highlighting the specific districts and neighborhoods it traverses through, including Mostorod, Matria, Ain Shams, Masr Elgedida, and Almaza Airport.

By effectively interconnecting these diverse areas, the Ain Shams corridor plays a crucial role in promoting economic growth, tourism, and urban development. Its influence extends beyond mere physical connectivity, fostering cultural exchange and bolstering the social and economic ties between different

parts of the city. Additionally, the corridor serves as a lifeline for the efficient movement of goods and services, contributing to the overall vibrancy and functionality of Cairo's urban landscape.

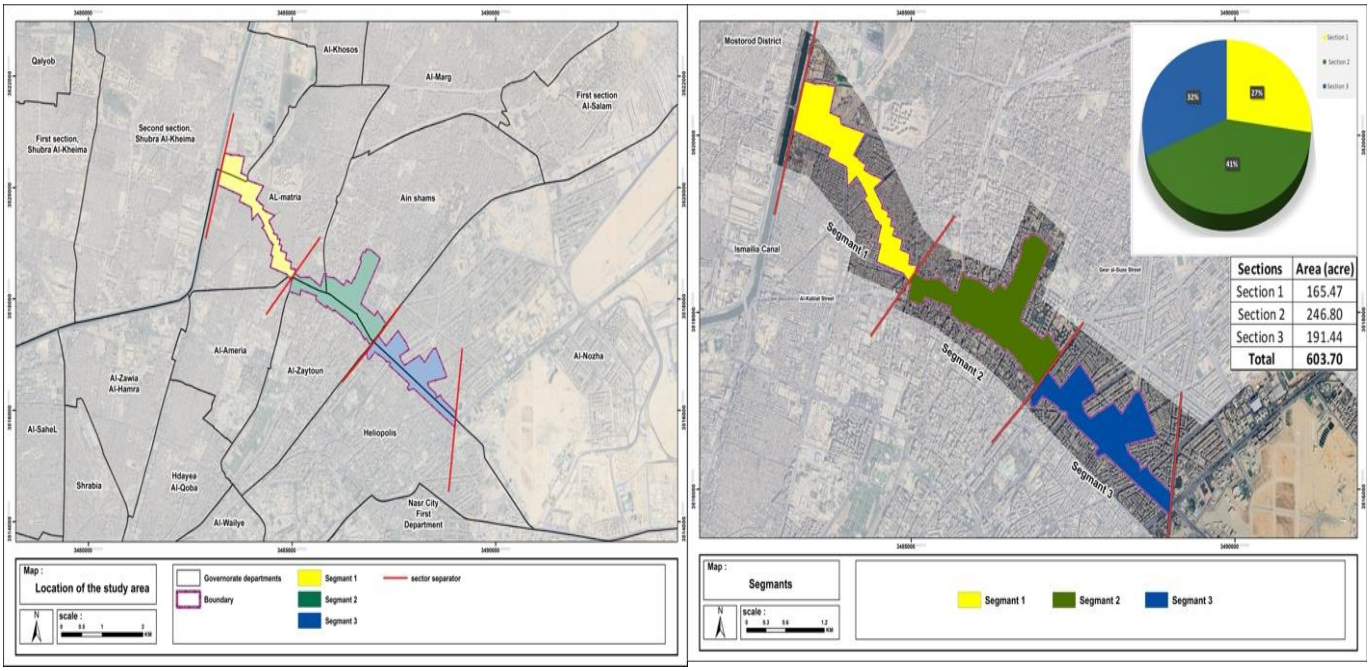


Figure 4: Ain Shams corridor location and Major Trafic Segements (Researcher, 2024)

4.5. Urban Characteristics of Ain Shams Corridor

The Ain Shams corridor, situated in the northern part of GCMR, is a bustling mixed-use area with a high density of various developments spread along the route from the Ring Road to Alamaza Airport as indicated in Figure 5. It's noteworthy that only 13% of the land is designated for residential use, while the remaining area encompasses a diverse range of land uses including commercial retail centers, administrative services, daily use markets, food and beverage establishments, as well as small shops and workshops. This corridor experiences heavy local traffic due to its popularity, and it is well-connected with bus stops and microbus stops to accommodate the densely populated areas. The population density within this region varies from 500 people per acre to as high as 3000 people per acre. Figure 3 provides a detailed spatial distribution of land uses and their corresponding percentages, depicting a significant clustering of both land use types and population densities.

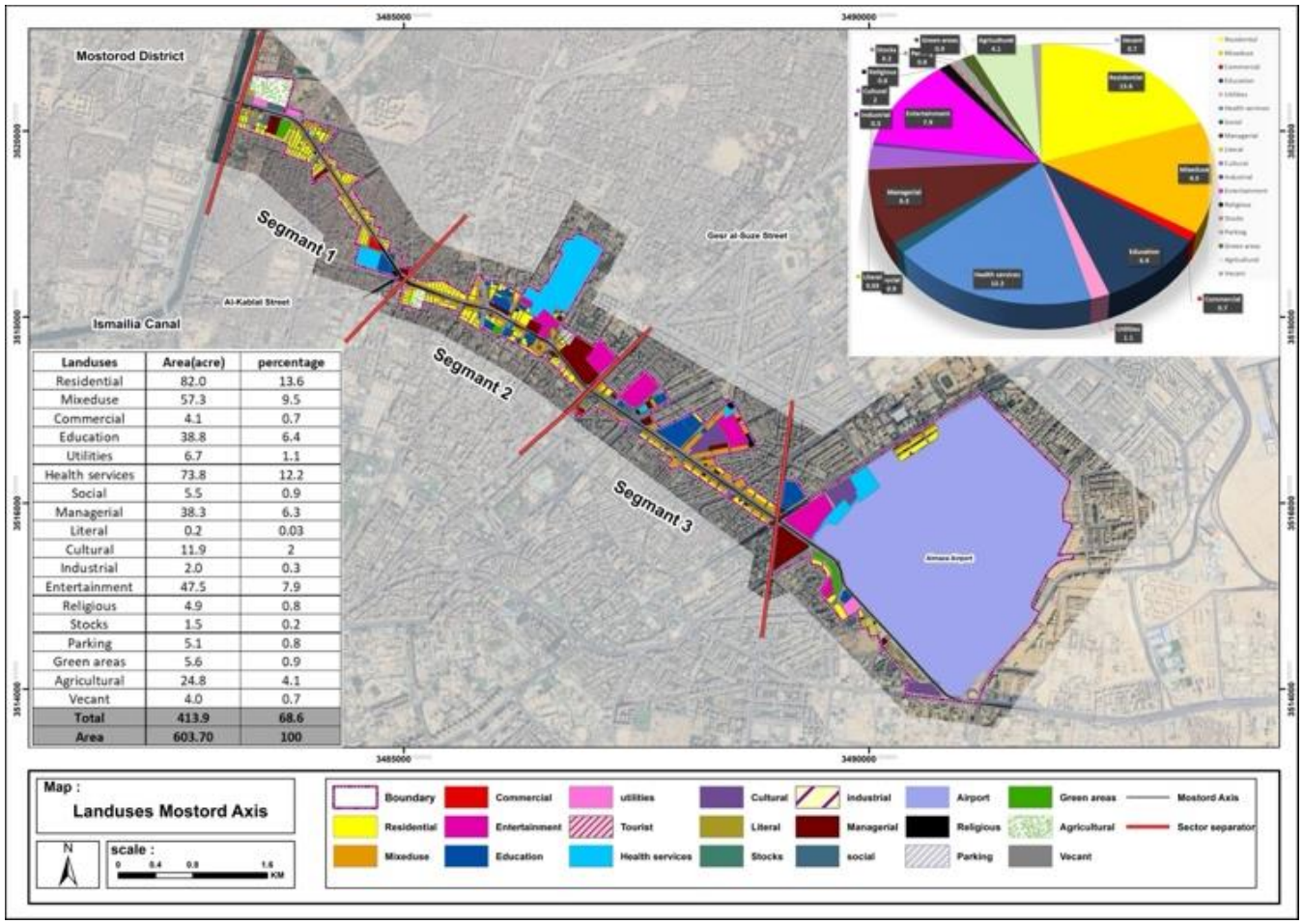
The development in the Ain Shams corridor has been driven by the burgeoning demand for commercial and residential spaces in the area. The carefully planned mix of land uses has contributed to the vibrancy of the corridor, making it a hub of activity and economic exchange. The presence of various businesses and services has not only provided convenience to the residents but has also attracted visitors and workers from other parts of the Greater Cairo Metropolitan Region.

The transportation infrastructure plays a crucial role in facilitating the movement of people within the corridor. The well-connected network of roads, along with the availability of public transit options, ensures that the area remains accessible despite the heavy local traffic. Additionally, the presence of bus stops and microbus stops serves as vital nodes for commuting, catering to the transportation needs of the densely populated region.

Moreover, the spatial distribution of land uses and population densities, as depicted in Figure 5, showcases the intricate interplay between urban planning and demographic patterns. The clustering of

different land use types reflects the deliberate arrangement of commercial, residential, and service-oriented spaces to cater to the diverse needs of the population. Similarly, the varying population densities across different areas within the corridor underscore the dynamic nature of urban settlement and the nuanced distribution of inhabitants across the landscape.

Overall, the Ain Shams corridor stands as a prime example of effective urban planning and development, showcasing a harmonious integration of diverse land uses, robust transportation infrastructure, and responsive spatial organization to meet the needs of a burgeoning population within the Greater Cairo Metropolitan Region.



Landuses	Area(acre)	percentage
Residential	82.0	13.6
Mixeduse	57.3	9.5
Commercial	4.1	0.7
Education	38.8	6.4
Utilities	6.7	1.1
Health services	73.8	12.2
Social	5.5	0.9
Managerial	38.3	6.3
Literal	0.2	0.03
Cultural	11.9	2
Industrial	2.0	0.3
Entertainment	47.5	7.9
Religious	4.9	0.8
Stocks	1.5	0.2
Parking	5.1	0.8
Green areas	5.6	0.9
Agricultural	24.8	4.1
Vecant	4.0	0.7
Total	413.9	68.6
Area	603.70	100

Figure 5. Ain Shams Corridor land uses distribution (Researcher, 2024)

4.6. Traffic Study Methodology

In order to test the research hypothesis, a comprehensive quantitative analysis will be conducted to examine the traffic flow through the Ain Shams corridor. This analysis will specifically focus on distinguishing between local car units and passing-through car units traveling from west to east. The methodology for this analysis is as follows:

Firstly, we will employ Geographic Information System (GIS) technology to thoroughly assess and estimate the land uses on both sides of the corridor. This will allow for a detailed understanding of the spatial distribution of different land uses in the area.

Subsequently, the corridor will be divided into three distinct segments based on the homogeneity of socio-economic aspects and the nature of land uses on both sides. This division will be illustrated in a designated figure for clarity.

Furthermore, specific count points will be identified at the beginning and end of each segment, particularly at the bridge locations over cross junctions. These count points will enable us to effectively separate local circulation from passing-through traffic and obtain accurate traffic flow data for analysis and comparison figure 6 and 7.

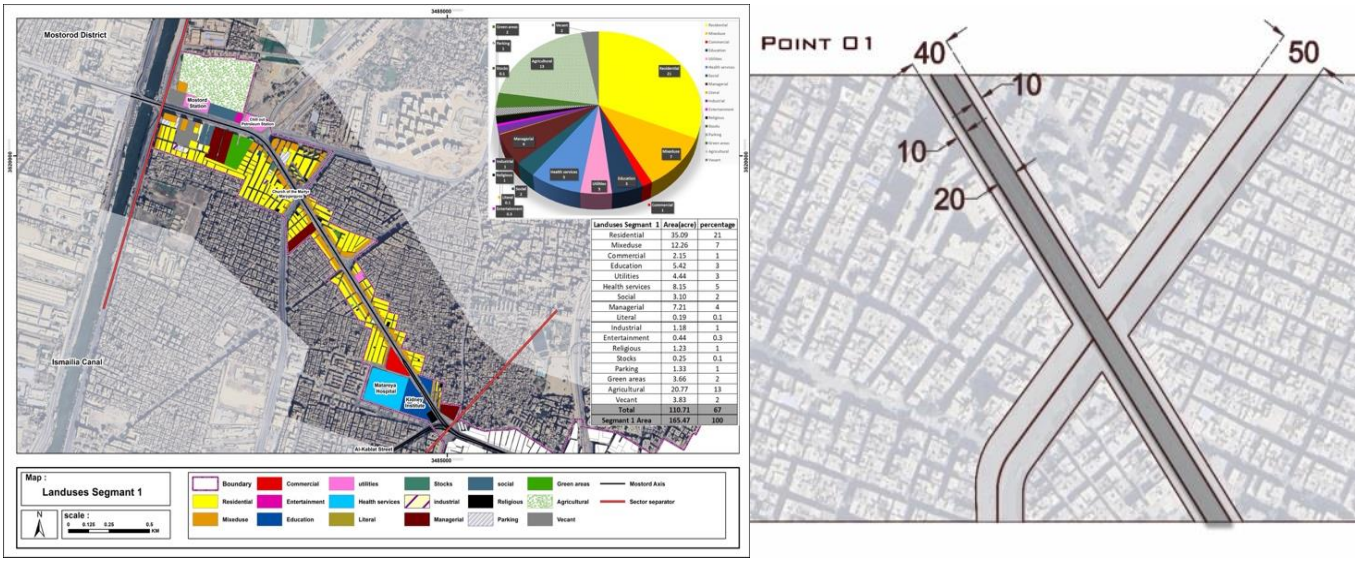


Figure 6. Ain Shams Corridor segment 1 (Mostord- Mataria) land uses and Traffic Study point (Researcher, 2024).

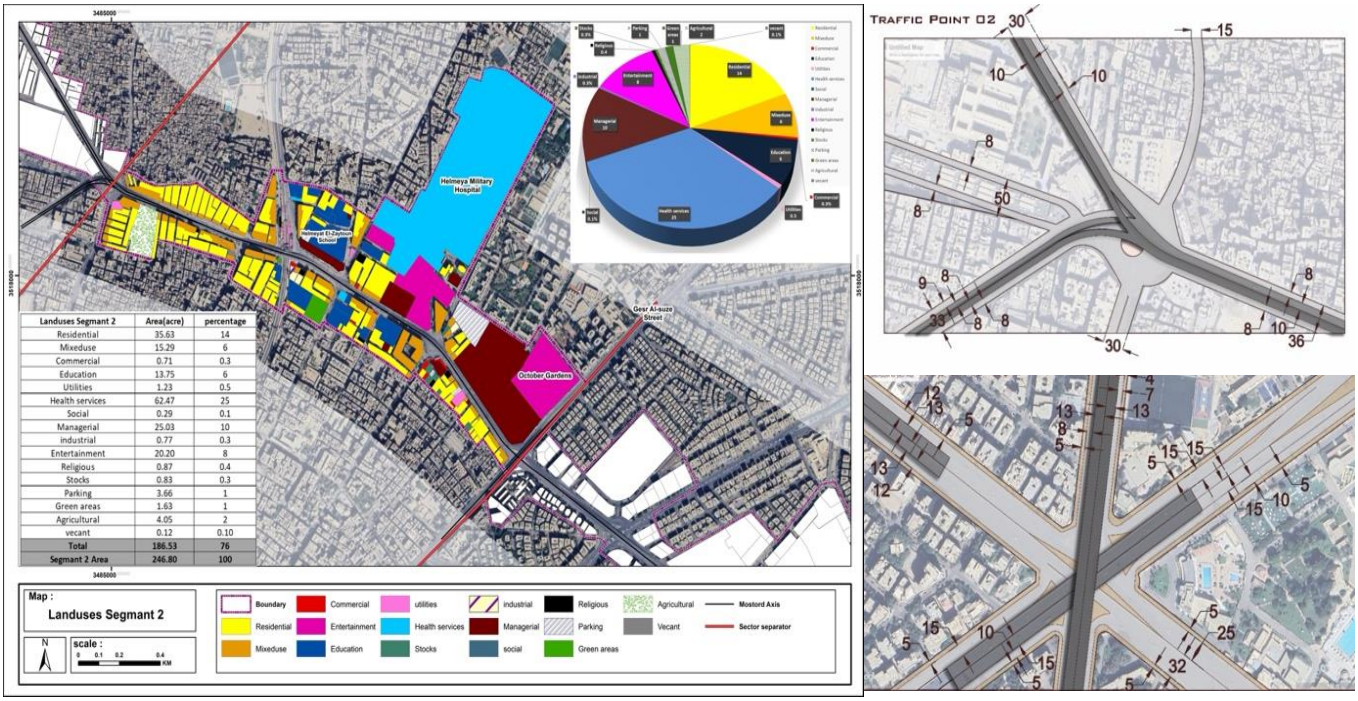
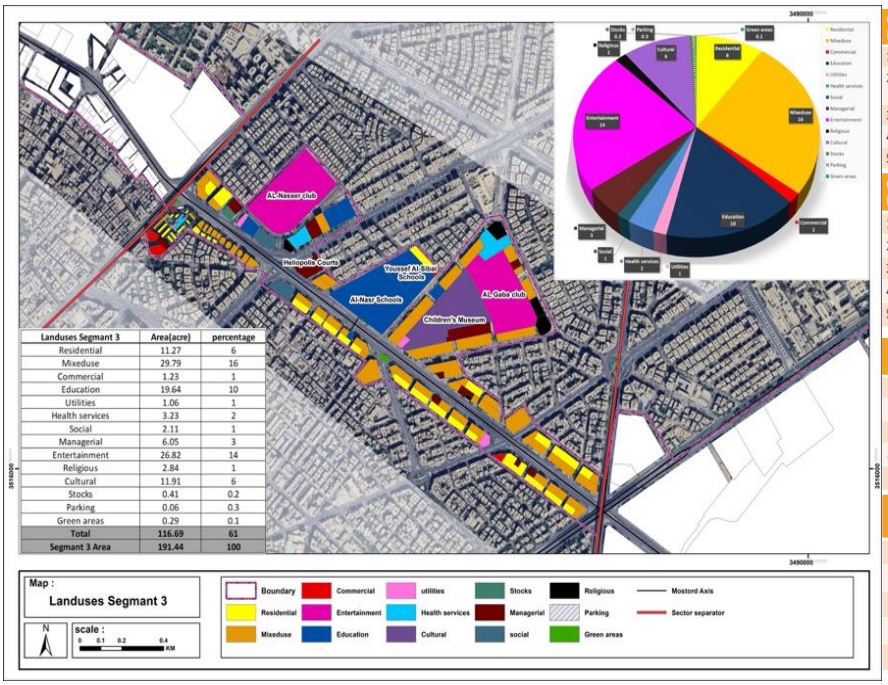


Figure 7. Ain Shams Corridor segment 2 (Ain shams- Gesr Elsuez crossing) land uses and Traffic Study point (Researcher, 2024).

The construction work has led to a 35% reduction in road width, primarily due to the installation of new bridges to facilitate through traffic. This has resulted in a negative impact on the traffic lanes designated for local movement. The study indicates that only 35-40% of the total traffic in both directions utilizes the corridor for through traffic from west to east GCMR. The remaining 60% experiences congestion in a single lane in each direction, highlighting significant traffic management challenges. The heavy mixed-use development on both sides of the corridor significantly contributes to heavy local traffic. The daily operation of restaurants, supermarkets, and other commercial activities has intensified the local traffic flow. Additionally, the lack of service roads and inadequate parking spaces in both directions further exacerbate the inefficiency of the corridor, warranting the need for comprehensive measures to address these shortcomings.



Landuses Segmant 3	Area(acre)	percentage
Residential	11.27	6
Mixeduse	29.79	16
Commercial	1.23	1
Education	19.64	10
Utilities	1.06	1
Health services	3.23	2
Social	2.11	1
Managerial	6.05	3
Entertainment	26.82	14
Religious	2.84	1
Cultural	11.91	6
Stocks	0.41	0.2
Parking	0.06	0.3
Green areas	0.29	0.1
Total	116.69	61
Segmant 3 Area	191.44	100

Count Points	Land Mark	Corridor Counts	Local Counts	Total
1	Mostorod	1400	2700	4100
2	Matria Square	1800	3200	5000
3	Helmia Crossing	2200	3800	6000
4	Gesr Suez Crossing	2600	4100	6700
5	Almaza Airport	1900	2900	4800

Count Points	Land Mark	Corridor Counts	Local Counts	Total
1	Mostorod	1400	2100	3500
2	Matria Square	1650	2400	4050
3	Helmia Crossing	2050	2900	4950
4	Gesr Suez Crossing	2300	3100	5400
5	Almaza Airport	2100	2700	4800

Count Points	Land Mark	Local Counts	Total
1	Mostorod	60	40
2	Matria Square	59	41
3	Helmia Crossing	59	41
4	Gesr Suez Crossing	57	43
5	Almaza Airport	56	44

Count Points	Land Mark	Total % of Local Counts	Total % of corrider Counts
1	Mostorod	66	34
2	Matria Square	64	36
3	Helmia Crossing	63	37
4	Gesr Suez Crossing	61	39
5	Almaza Airport	60	40

Figure 7. Ain Shams Corridor segment 3 (Gesr Elsuez- Alamaza) land uses and Traffic Study point and traffic Study results (Researcher, 2024).

5. Discussions

The main aim of analyzing traffic networks is to understand the connection between travel behavior patterns of users and the constantly changing network in a logical manner. Despite extensive research on predicting congestion and optimizing routes, there is still a lack of understanding regarding how congestion clusters are determined. Properly assessing congestion clusters in urban road networks and establishing the correlation between them holds both practical and theoretical significance in improving traffic operation efficiency. Monitoring the entire urban traffic network is expensive, and not all parts are consistently congested. Therefore, this approach offers flexibility to cater to the needs of cities. This method involves identifying areas where congestion pockets occur and then conducting analyses that allow for an assessment of the traffic condition across the entire urban network.

traffic is influenced by land use, and changes in land use can lead to different types of traffic movements. Similarly, London's Blunden notes that traffic serves as the link between the transport system and land use. Both elements are responsible for generating traffic, as changes in land use can create specific traffic patterns, while transport infrastructure developments can also generate traffic to specific

areas. This, in turn, can lead to the emergence of new uses and activities in the area, such as the establishment of factories or tourist attractions. Research in urban transport planning has emphasized the crucial role of transportation in people's daily lives, providing mobility within and outside the city. The economic structure of a community relies on transportation and mobility infrastructure, encompassing various modes of transport. Given the close relationship between urban land use and traffic, comprehensive data on traffic conditions, public transport, land use, population, economic activities, social dynamics, and urban services is essential for effective planning and development of urban areas, particularly in relation to highway schemes.

The field of transportation planning in the GCMR has made significant progress compared to earlier phases at the beginning of the 21st century. Evidence shows the implementation of road works, bridges, and regional corridors, focusing on promoting mass transit transportation. The introduction of a regional secondary ring road around the GCMR, as well as the movement corridor connecting the new cities around Cairo, including the Ain Shams corridor linking south GCMR new settlements and the ring road with the northern part of GCMR and extending to the New Cairo settlement and New Capital City, represents noteworthy developments. Nevertheless, there remains a noticeable absence of a definitive long-term policy in transportation planning. Planning decisions such as creating urban traffic corridors without considering the socio-economic and physical consequences on the adjacent areas to that corridor are considered reckless planning, as they are not based on thorough traffic studies but are mainly driven by political decisions.

The study found that only 35-40% of the total traffic in both directions utilizes the corridor for through traffic from west to east GCMR. This indicates that a significant portion of the remaining 60% experiences congestion in a single lane in each direction, highlighting the presence of significant traffic management challenges. The heavy mixed-use development on both sides of the corridor notably contributes to heavy local traffic. The daily operation of restaurants, supermarkets, and other commercial activities has intensified the local traffic flow, adding to the congestion issues.

In addition to the local traffic congestion, the lack of service roads and inadequate parking spaces in both directions further exacerbate the inefficiency of the corridor. These shortcomings warrant the need for comprehensive measures to address the traffic management challenges and improve the overall efficiency of the corridor. The current state of the corridor necessitates thoughtful planning and strategic interventions to alleviate congestion and enhance the traffic flow.

6. Conclusions

The economic structure of a community relies on transportation and mobility infrastructure, encompassing various modes of transport. Given the close relationship between urban land use and traffic, comprehensive data on traffic conditions, public transport, land use, population, economic activities, social dynamics, and urban services is essential for effective planning and development of urban areas, particularly about highway schemes.

The consideration of transport issues at the planning stages is paramount, particularly the necessity to integrate transport planning with land-use planning to achieve sustainable urban development in the GCMR. Integrated planning is especially critical for new towns and urban expansions. For example, the construction of a new ring road to connect the city with new towns must carefully consider the consequential impacts on land-use change in these areas. Rather than solely prioritizing connectivity, it may be more prudent to devise policies aimed at enhancing job opportunities in new towns, thereby reducing daily commuting on the ring road.

Sustainable development heavily relies on transport resulting from land use and urban growth. It is imperative to establish a cohesive link between land use, transport, and the environment, ensuring that short and medium-term transport plans align with long-term environmental and economic objectives.

Regrettably, there exists a disparity between the endorsement of studies and the actualization of their findings. For instance, in the GCMR, a mere 15% of over 60 transport-related studies conducted between 1975 and 2000 were implemented. This discrepancy presents a significant challenge for Egypt.

the involvement of high-level decision-makers and local councils is crucial in establishing an effective long-term urban transportation policy, which is currently lacking in the GCMR corridors. Therefore, it is imperative to establish an institutional framework for policy formulation, monitoring, and maintenance of the requisite information system to facilitate urban transport development conducive to sustainable urban growth. The study of the Ain Shams Corridor reveals several important lessons; while it may facilitate the passage of traffic traveling from south to north GCMR, the negative impact on local area traffic problems has become a major concern for local travelers, who make up at least 65% of daily travel. This contradicts the main goal of traffic management, which is meant to facilitate daily travel as much as possible.

The study indicates that only 35-40% of the total traffic in both directions utilizes the corridor for through traffic from west to east GCMR. The remaining 60% experiences congestion in a single lane in each direction, highlighting significant traffic management challenges. The heavy mixed-use development on both sides of the corridor significantly contributes to heavy local traffic. The daily operation of restaurants, supermarkets, and other commercial activities has intensified the local traffic flow. Additionally, the lack of service roads and inadequate parking spaces in both directions further exacerbate the inefficiency of the corridor, warranting the need for comprehensive measures to address these shortcomings.

The findings underscore the critical importance of addressing the congestion and traffic management challenges in the corridor. The significant imbalance in through traffic and local traffic distribution necessitates a focused approach to alleviate congestion and improve traffic flow. It is imperative to consider the diverse factors contributing to the heavy local traffic, including the ongoing commercial activities and mixed-use development along the corridor.

Furthermore, the study reinforces the importance of comprehensive measures to enhance the efficiency of the corridor. Implementing solutions such as dedicated service roads, improved parking infrastructure, and optimized traffic management strategies can play a pivotal role in mitigating congestion and addressing the specific needs of local traffic. By addressing these challenges, the corridor can achieve improved functionality, accommodate the diverse traffic demands, and enhance the overall transportation experience for commuters and businesses alike.

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Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements
Studies involving animal subjects: No animal studies are presented in this manuscript.
Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests

The author declares no conflict of interest.

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