ORIGINAL STUDY

Predicting the Role of Connectivity in the Development of Border Regions in Egypt

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Abstract

The research analyzed the current situation of the development of 12 existing roads in the development plan 2052 and linked to the Governors of (Matrouh, North Sinai, South Sinai, New Valley, and Red Sea), and by reviewing previous studies, it showed the link between road development and the demographic and social factors of the population. The methodology for studying various cases and the methodology for predicting development models are the most appropriate for the field of research. This research examines the goals and challenges of road development with global experience that can be applied to development plans.

The research is based on the correlation test and the DurbineWatson regression test using SPSS to analyze the relationship between road development and demographic and social factors in the current situation and predict the future of road development linking border areas.

The research concluded the impact of population demographic factors on supporting connectivity in border regions, and showed the role of Port Said/Sharm El Sheikh Road in forming development centers, the role of Wadi El Natroun/ Alamein Road in supporting agricultural development along the road, and the role of the Upper Egypt/Red Sea Road in supporting urban and industrial development. Along the road, this study also predicted the factors affecting the improvement in the efficiency of road development, linking the border areas targeted by the study.

Keywords: Connectivity rate, Demographic factors, Economic development, Road development, Urban development

1. Introduction

Roads are considered to be the main vector of urban growth, and the mutual relationship between movement, urbanization and economy are the basis of urban development, as it affects the structure of land use and the spatial distribution of activities and population. So Egypt's 2052 development plan aimed at increasing connectivity as an instrument to expand the development of new urban areas, attract residents and activities outside the valley and the Delta, and achieve a balanced urban and spatial balance across the state's entire surface through several mechanisms, including: Preparing strategic land use plans on both sides of the national road network with a width of 2 km in accordance with Presidential Decree No. 233 of 2016 to support the development of 21 roads (General Authority For Urban Planning, 2017).

The research focused on the analysis of development on 12 existing roads connected to border governorates (Matrouh, North Sinai, South Sinai, New Valley, Red Sea), as they are the most important areas that support development and achieve a balance between residents and places. Therefore, the research aims to investigate the current situation of land use around the roads surveyed (area of urban mass, the area of economic activity) with a measurement of their correlation with factors that affect population movement and support connectivity (demographic characteristics of the population by sex, age, and income, the number of employments and its distribution according to the educational level and the main sectors of employment, the type of housing and its ownership), to identify priority roads in support of development and to predict which factors most affect the development of new area to attract population.

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2. Research problems

Research problems focus on linear urban development to develop border regions, based on the relationship between movement, urbanization, and the economy, while not optimally exploiting the vast areas along roads, the presence of roads alone is not sufficient to attract activities and residents and support the urban development of border regions.

3. Research objectives

Analyze the correlation between land use on targeted roads for the development of border areas, and factors affecting the movement of the population and supporting connectivity; understand priority roads and the most important factors affecting the development of border areas, using the SPSS statistical analysis program.

4. Research methodology

Research was based on the following methodological procedures as it shows in Fig. 1.

(1) Descriptive approach: Review previous studies to identify factors influencing road development and connection, and various methodologies to measure the size of development resulting from road construction.
(2) Comparative analytical method: Analyze the relationship between land uses on roads targeted by the study and the developmental factors affecting road development, including roads compared with these factors.
(3) An introspective approach: To predict the most important factors influencing road development, and the most influential roads in attracting the population to border regions.

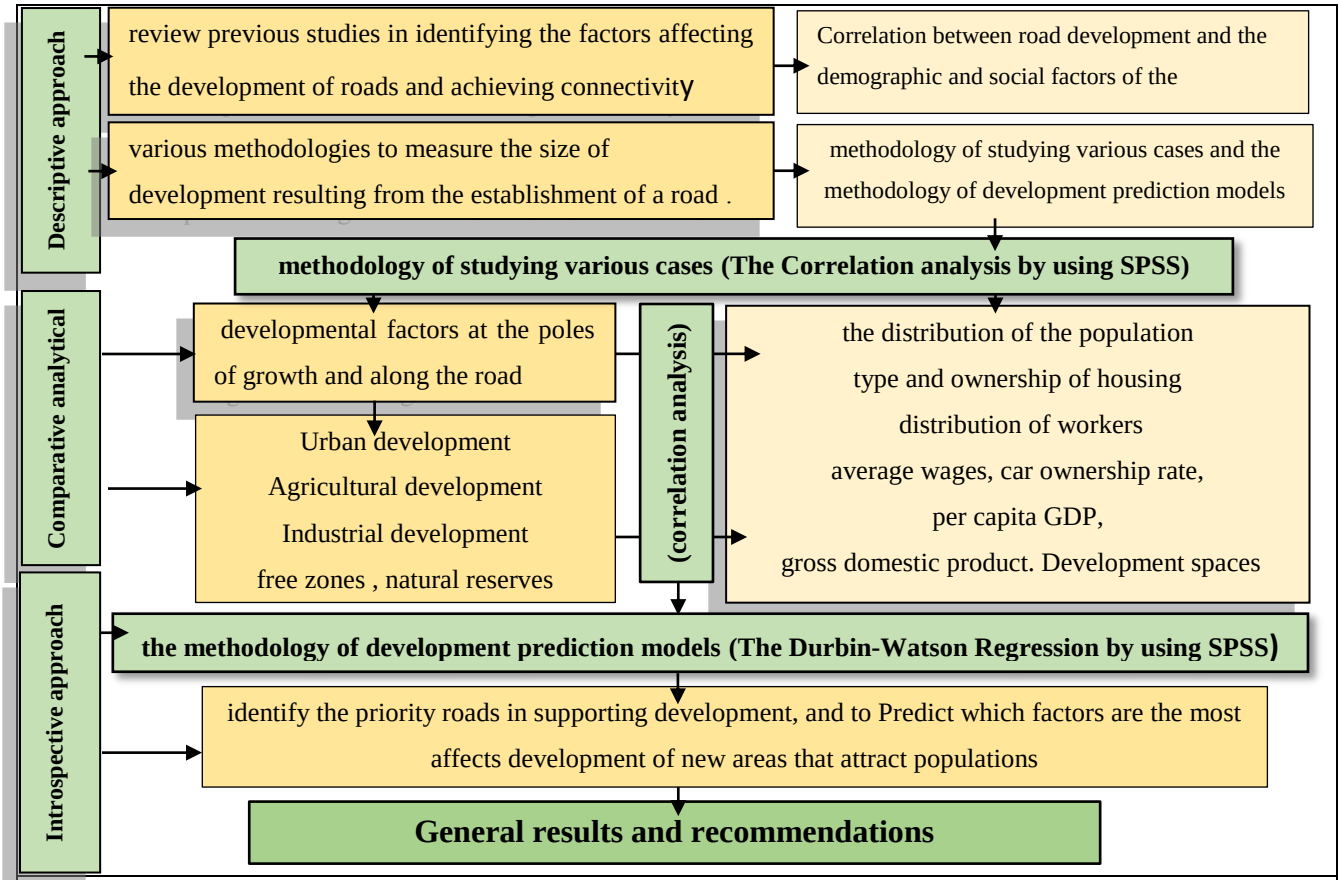


figure 1: **Research Methodology source: by researcher**

5. Previous studies relating to the subject of research

The importance of road transport is to support connectivity that affects development and job creation, and road development depends on the distance factor and the strength of the parties in attracting development factors.

5.1. Studies on developed countries

Georgi 2001, applied to the United States (Georggi and Pendyala, 2001), and Newbold et al. in 2005, applied to Canada (Newbold et al., 2005), studied the effect of trip generation, by studying the correlation between demographic factors related to age and average family income.

The results showed that the increase in the age of the population and the decrease in family average income was linked to the decrease in trip generation, as the elderly depend on private car transportation.
Best and Lanzendorf (2005) (Best and Lanzendorf, 2005) also discussed the effect of sex on daily car use in Germany, and the results showed that there were no differences between gender and total trips, as women make fewer trips to work by car and more trips for non-work-related activities such as shopping and childcare.

In 2005, Moriarty and Honery studied, by applying it to Australian cities (Raimond, 2005), the relationship between the proximity to growth poles and urban centers, and the generation of trips, which was found to be related to gender (women move less to growth poles than men), according to the connection to work.

In 2010, Hunt and Broadstock confirmed, applying in Great Britain (Broadstock et al., 2010), the impact of connectivity on urban development by measuring the correlation of traffic rates with the development of urbanization on roads based on the characteristics of the place (central and marginal areas) and the rate of car ownership.

The results showed that the rate of car ownership was linked to the generation of trips, where's it was not linked to increase public transportation by generating trips.

5.2. Special studies for developing countries

Priyanto and Friandi (2010) studied, by applying it to Indonesia (Priyanto and Friandi, 2010), the relationship between mobility rates and (car ownership rate, family size, housing type, number ofworkers, average wages), In 2011, Sarsam and Al-Hasani (Ali and Ismael, 2022) also studied statistical models to predict the trip generation and transportation in Baghdad, analyzing the relationship between infrastructure factors and social and economic characteristics.

In 2012, Sofia and others analyzed, by applying it to Iraq (Sofia and AL-Zubaidi, 2012), a trip generation model based on the city's economic and social characteristics, and land use.

The study showed a correlation between mobility and the rate of travel generation with family size, gender, number of workers, and number of students in the family.

Jaideep Mukherjee, Bhadradri Raghuram Kadali1n 2022 (Mukherjee and Kadali, 2022) and Fan Yang In 2023 (Yang et al., 2020), also highlighted the difficulties in developing models for the rate of trip generation in developing countries by linking the land use around the road, due to the weak data collection techniques and modelling approaches, which represented the most important main challenges associated with the modelling of trip generation, and among them was the Global Positioning System (GPS) used to study land use development.

From the above, it became clear that the rate of trip generated was affected by a group of social and demographic variables related to gender, age, and income. Despite differences between the economic and social levels of the countries, it was found that the movement was positively related to the average family size and negatively to the average family income. It has become clear that the need for movement, is the basis for movement, whatever the Costs and means of transport. Among this research aimed to study and analyze the relationship between road development and demographic factors related to the distribution of the population by gender, age, level of education, marital status, type and ownership of houses, average family size, population size, population distribution by qualification, employment sector, average wage, car ownership, per capita GDP, and gross domestic product. Development spaces.

6. Methods for measuring road development

Researchers used some methodologies to measure

road development, analyzing the correlation between the center and the periphery and the degree to which development poles have been formed along the way (Florida Department Of Transportation, 2010; Srinivasan and Kockelman, 2002; Wisconsin Department Of Transportation, 1998). Measurements to measure road development are targeted to land use studies around the road and demographic factors that generate causes ofmovement (work, study,marriage/ divorce, entertainment) and affect the attraction of the population and generate trips according to the need for movement from the center to the periphery, including the assessment of the need for a road according to the following methodologies (MINISTRY OF TRANSPORT and JAPAN INTERNATIONAL COOPERATION AGENCY, 2009):

(1) Case studies before and after road construction: This is based on monitoring the evolution of land use around roads, and comparing variables before and after road construction.
(2) Miscellaneous Case Studies: It is based on the study of land uses in several methods and comparison of results, including monitoring factors affecting development.
(3) Research of mathematical economic models: This depends on the creation of mathematical models for different regions for the same periods, the study of the same region during different periods and the comparison of the results.
(4) Research on input and output models: This depends on the development of an economic activity in the research area and the study of its impact on land use and the attracting population to make the decision to build the road.
(5) Research of similar pair models: It depends on choosing two cities that are compatible with the same demographic, geographical and economic conditions, establishing a road in one of them and comparing the results.
(6) Study of development prediction models: This depends on the prediction of road development, through the establishment of mathematical models that assume the continuity of the surrounding conditions, and others assume the achievement of the desired objectives, whether the road is built, and compare the results to make the decision to build the road.

From the above, research is based on the methodology of various case studies to analyze the correlation of factors affecting communication and support for development on existing roads and the methodology of development prediction models to predict the future development of roads in border regions, assuming a continuation of the status quo.

7. International experiences in road development

Road development has been based on international experience to support communication and gradual development between different regions and improve opportunities to attract investments and provide employment opportunities, while linking to the demographic and social characteristics of the population.

Workers can be attracted to a region because of short travel times, high wages, or easy access to goods and services. The experience of the countries of Malaysia, India, and Indonesia has been chosen, which are similar to Egypt in terms of population growth and poverty rates, although there are regional differences between the different regions. Countries' experiences in developing roads to support communication and achieve development.

7.1. Delhi-Mumbai industrial corridor

The corridor aims to expand urban development 150-200 km around the industrial road, as it shown in (Fig. 2), to connect rapidly growing areas with poorer ones through the establishment of an investment zone to provide employment opportunities, support industrial production, and increase the region's exports four times.

Fig. 2. Delhi-Mumbai Industrial Corridor source (Center, 2015).

7.1.1. Corridor development challenges

(1) Difficulty obtaining low-value land for investment in existing and rapidly growing cities.
(2) Transfer of polluting plants outside the state of Dilhi according to the state's plans.
(3) Lower potential for creating employment opportunities in the industrial sector due to work regulations that do not clearly define the reasons for dismissal, wage reduction, and the determination of working hours.
(4) The poor performance of the Indian special economic zones in facilitating manufacturing opportunities for investors, despite the rise in domestic demand for goods.

7.1.2. Corridor development results

(1) The effective role of the Ministry of Trade and Industry in attracting investment to develop the industrial corridor in coordination with local and international investment institutions.
(2) Focus on the development of new industrial centers, while urbanization emerged as a secondary goal of industrialization.
(3) Developing new areas far from existing, rapidly growing cities.
(4) Reducing regional disparities through the utilization of the diversity of industrial development in Gujarat in the growing industrial growth of Rajasthan.
(5) Enhancing employment opportunities for medium and small enterprises in Rajasthan.
(6) Flexibility in employment and management of work laws and regulations in the State of 'Rajasthan' by the government, with the addition of provisions in the work regulations in the State of 'Gujarat' to be environmentally friendly.
(7) Developing the 'Dolera' investment area as a new smart industrial city connected to the transport networks (roads, railway lines, ports) and close to the oil Centers.
(8) Developing economic zone legislation to facilitate industry in terms of reducing taxes and supporting infrastructure projects (Center, 2015).

7.2. Six corridors in Indonesia

Developing six corridors with the aim of exploring the natural resources of each corridor and obtaining human resources, as shown in (Fig. 3), to increase connectivity, develop growth centers, and reduce regional disparities by creating logistical nodes, including ports and railway lines. The eastern corridors of North Sumatra, West Java, and the northern coast of Java will be launched in an experimental phase as a plan for the main raw materials of palm oil, rubber, and coal, to develop sustainable policies for food security, water, and energy and to reduce poverty.

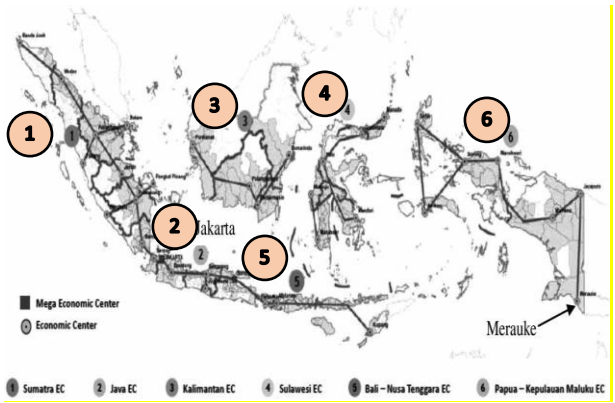


Fig. 3. Six Corridors in Indonesia. Source (Ito et al., 2014).

7.2.1. Corridor development challenges

(1) How to accelerate development to join the major countries by thinking about a comprehensive strategy to support economic development and improve the well-being of the population.
(2) The development of six economic corridors in Indonesia, all of which are based agriculture (palm oil, cocoa, rubber, and timber); mining (coal, steel, nickel, copper, and bauxite); energy resources (oil, gas, coal, and geothermal) to support Indonesia's major industries.
(3) From a natural economy to an economy based on knowledge and innovation.
(4) Support tripartite cooperation between the government, the business sector, and the academic community.
(5) Addressing the social impacts of the confiscation of local agricultural land for the benefit of large investment companies and how to compensate their owners to expand large-scale agricultural projects to avoid food and energy crises (biofuels).
(6) Preserving agricultural lands, natural reserves, and forests from invasion and environmental damage resulting from road development.

7.2.2. Corridor development results

(1) A knowledge density imbalance exists between corridors depending on the availability of qualified human resources.

(2) Developing major activities in all corridors.

(3) Rehabilitation of 26 institutions to create economic conditions to expand investment in all corridors and increase economic growth rates.

(4) Proposing three models of cooperation to create economic corridors as knowledge centers (research institutions) and integrated development, vocational education programs (Innovation Clusters). The basic requirement for these models is the creation of human capital.

(5) Open agricultural horizons with corridors and transform local agriculture through large-scale corporate investments in crops food and biofuels for foreign markets.

(6) Implementation of the Belt and Road Initiative, in order to reduce the negative environmental impacts resulting from the expansion of infrastructure in forests, agricultural lands, and natural reserves (Ito et al., 2014; IOP ConferenceSeries, 2017).

7.3. Five Corridors in Malaysia

To develop five Corridors that achieve connectivity and development for 70 % of the country's area, as shown in (Fig. 4), to achieve balanced growth between different regions. The northern corridor includes the states of Perlis, Kedah, Penang, and Perak on the northern peninsula.

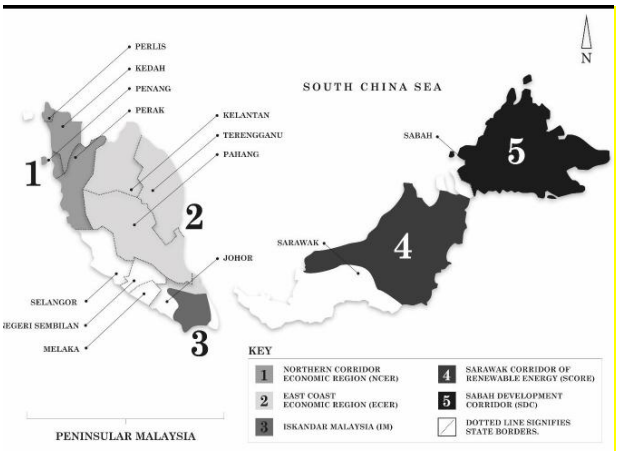


Fig. 4. Five Corridors in Malaysia.
Source (Athukorala and Narayanan,2017).

7.3.1. Corridor development challenges

(1) Support development by relying on the manufacturing base in Penang (producing 90 % of electronic and electrical components, 46 % of gross domestic product, a third of high wage workers, and logistical infrastructure with a port and airport) and the agricultural base in the regions of Kedah, Perak, and Perlis.

(2) Obstacles to integration between the Bebang region
and the remote areas, according to the federal government system, in terms of the jurisdiction over the identification of land allocated to investment and infrastructure development.

(3) Coordination between different regions to put the private interest above the public interest with enforceable guarantees to support competitive future projects.

(4) Balance of spending opportunities on large Bebang projects and the development of the rest of the regions to support development.

(5) Strengthening the link between the port and the airport with new growth Centers in remote areas to benefit from urban and industrial development while creating labor intensive activities away from Bebang.

7.3.2. Corridor development results

(1) The success of the border port as a logistics Center for the knowledge industries, through corridor development, Port, Airport, Logistics, and industrial infrastructure.

(2) The headquarters of multinational companies for the final assembly of consumer electronics and electrical goods have been established in Penang, and due to high rent and space constraints, there is the possibility of expanding the manufacturing base to the 'Kulim' complex in 'Kedah' to provide employment opportunities for low-income people. A second industrial area has also been developed in the 'Batu Kawan' region, with an area of 1500 ha.

(3) Thinking about expanding Bebang Airport in the Kulim region.

(4) The 329 km double railway line was constructed from Ipoh, Perak, to Padang 'Besar, Perlis.'

(5) Focus on the development of the Kedah and Perlis regions clearly in the investment plan, through the Kedah RubberCity project and the Kedah Science and Technology Park, to promote natural rubber-based industries and develop the 'Chopping Valley', to develop infrastructure, solar power generation, and green manufacturing in 'Perlis'.

(6) Provide attractive incentives to investors in the form of a tax exemption for companies for a period of five years (with the possibility of extension for another 5 years), and a tax exemption for imports of machines, as well as support for worker training. But the data does not show structural Fig. 4. Five Corridors in Malaysia. Source (Athukorala and Narayanan, 2017).
changes in Malaysia's economies, which have not yet benefited from long-term projects to bridge the development gap between the 'Piping' border and the surrounding areas (Athukorala and Narayanan, 2017).

By reviewing some global experiences, a set of institutional factors have been identified to support development through road development in order to achieve the goals envisioned behind road construction in reducing poverty indicators, providing employment opportunities, and reducing regional disparities, as follows:

(1) The institutional role in the management and coordination of development between different parties, in obtaining land for investment in major projects, in coordination with local institutions and investors, and in remuneration of local land owners in the event of any damage.

(2) Improve the exploitation of natural resources by focusing on economic development projects first and then attracting the population and urbanization.

(3) Developing regulations and laws to improve investment opportunities in new areas.

(4) Study the environmental impacts resulting from the expansion of infrastructure and the no intrusion into agricultural land and natural reserves.

(5) Attention to gateway cities to support the knowledge economy and to create logistics areas based on ports and airports.

(6) Balancing spending opportunities in different regions by reviewing the link between economic activities in the centers, and periphery.

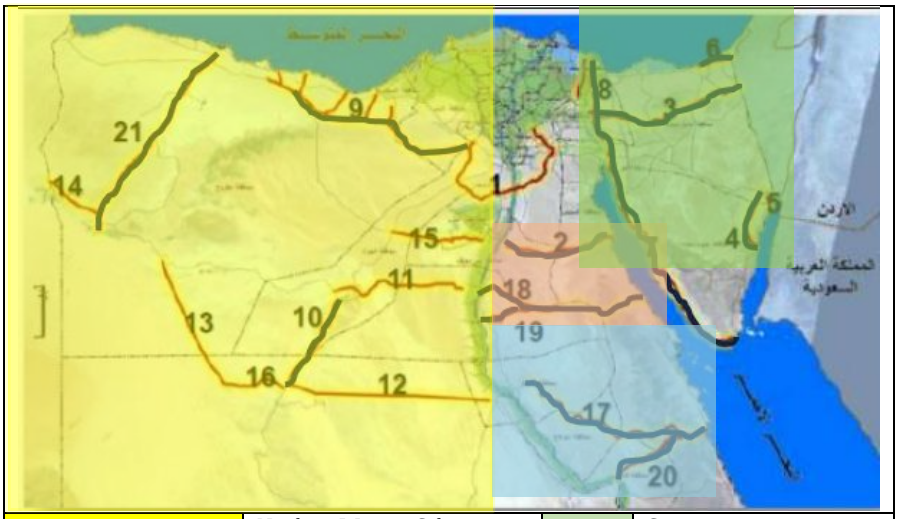
(7) Implementing an intelligent transportation system and planning to move polluted industrial areas outside densely populated areas and providing employment opportunities in new areas outside the centers.

(8) Human resources by enabling research institutions, vocational education programs, and innovation groups to create human capital capable of maintaining the pace of the knowledge economy.

8. Roads targeted by the study

The research specialized in studying the roads targeted for the development of border regions in the areas of Sinai, Galala and oases in the northern Western Desert and the southern Red Sea coast (12 existing roads out of a total of 21 Ismailia/ Hassana roads, Nuweiba/Taba, Arish/Rafah, Port Said/Sharm El-Sheikh Sinai, Beni Suef/ Zafarana roads, Sheikh Fadl/Ras Ghareb, Minya/ Ras Ghareb in the Galala area, Bahariya Oasis/ Farafra roads, Siwa/Matrouh, Wadi Al-Natroun/El Alamein in the northern Western Desert, Qena/ Safaga roads, Upper Egypt/Red Sea in the southern Red Sea range, in accordance with Presidential Decree No. 233 of 2016 preparing strategic plans on both sides of those roads with a depth of 2 km) (General Authority For Urban Planning,2017), to transfer the population from densely populated areas to the new development areas .

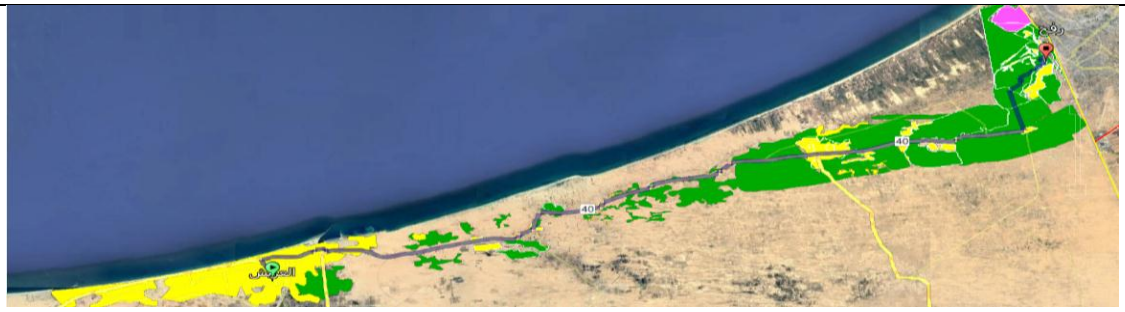
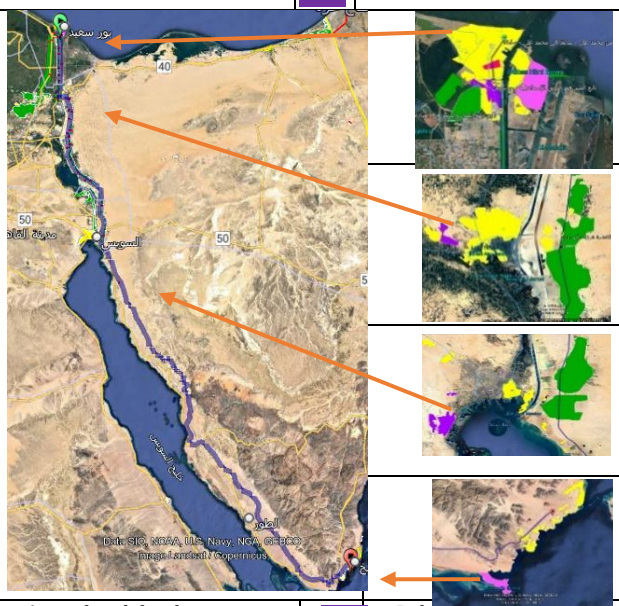
(Fig. 5), shows the targeted development ranges in the border areas, and Table 1 shows the land use of the current situation on the roads targeted by the study.



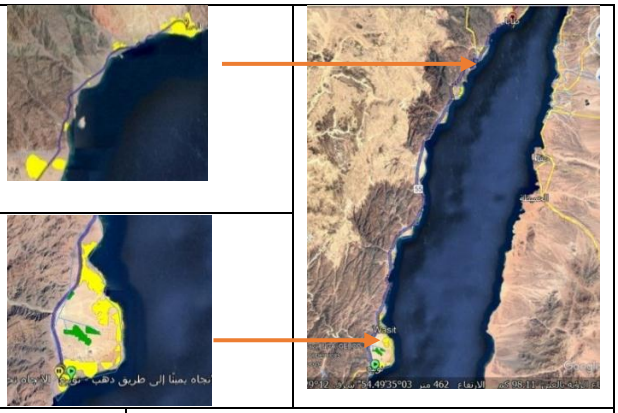
	Northern Western Sahara		Sinai
	Southern Red Sea		Galala

Figure 5 : The scopes of urban development targeted by the study Source:[1]:

Table 1. Land use in the current state of the roads targeted by the study

<table>
<tr><th colspan="8">Land use in the current state of the roads targeted by the study</th></tr>
<tr><td colspan="8">1- Sinai zone</td></tr>
<tr><td colspan="8">Al-Arish /Rafah Road: An existing road that extends for a length of 61 km, it was targeted for the development of recreational and environmental tourism and logistics, integration with the international coastal road road; and attracting international tourism through Al-Arish Airport and Port, the poles of growth on the road (Al-Arish/Rafah) .Urban development area is 8139 acres at the outskirts; 1952 acres along the road, the agricultural development area is 980 acres at the edges and 21197 acres along the road, Rafah Nature Reserve has an area of 710 acres.</td></tr>
<tr><td colspan="8">  </td></tr>
<tr><td></td><td colspan="2">Urban development area</td><td></td><td colspan="2">Agricultural development area</td><td></td><td>natural reserves area</td></tr>
<tr><td colspan="8">Ismailia /Hassana Road: An existing road extending for 183 km was targeted to establish an industrial zone for building materials (cement and gypsum), with coordination for export through the Suez Canal, and growth poles on the road (Ismailia/Hassana).
The urban development area is 10966 acres at the outskirts; and 2200 acres along the road; the industrial development area is 868 acres at the edges and 95 acres along the road, and the agricultural development area is 309 acres at the edges and 3300 acres along the road.</td></tr>
<tr><td colspan="8">  </td></tr>
<tr><td></td><td colspan="2">Urban development area</td><td></td><td colspan="2">Agricultural development area</td><td></td><td>Industrial development area</td></tr>
<tr><td colspan="3">East Port Said/Shatt/Oyoun Moussa/Sharm El Sheikh Road: An existing road extending for 444 km targeting recreational and environmental tourism, mining industries, and logistics, depending on the integration between the Suez Canal road and the desert back of South Sinai, exploiting the Suez Canal and ports and airports in Port Said and Sharm El-Sheikh. Growth poles on the road (Port Said, Ismailia, Suez, Ras Sidr, and Sharm El-Sheikh).
The urban development area is 29179.00 acres at the edges and 1464 acres along the road; and the agricultural development area is 4195.00 acres at the outskirts; and 82664 along the road, the industrial development area is 1471 acres at the outskirts and 235 acres for free zones; and the area of nature reserves on the road is 5360 acres.</td><td colspan="5">  </td></tr>
<tr><td></td><td colspan="2">Urban development area</td><td></td><td colspan="2">Agricultural development area</td><td></td><td>Industrial development area</td></tr>
<tr><td></td><td colspan="2">Area of free zones</td><td></td><td colspan="2">natural reserves area</td><td colspan="2"></td></tr>
</table>

Nuweiba/Taba Road: An existing road extending for 80 km, targeted for the development of recreational and environmental tourism and logistics, relying on attracting international tourism through the port of Nuweiba and Taba Airport. Growth poles on the road (Taba/Nuweiba). The area of the urban mass in the current situation is 1454 acres on the outskirts, 1500 acres along the road, and the agricultural development area is 300 acres at the edges.



Urban development area | Agricultural development area

2.Galala zone

Beni Suef/Zafarana Road:An existing road extending for a length of 158 km, targeting the marble industries, mining activities, manufacturing industries, medical and archaeological tourism, depending on the integration of industry between Cairo and Beni Suef and recreational tourism in the Red Sea, taking advantage of Ras Ghareb Port and Ain Sokhna Port. Growth poles on the road (Beni Suef /Zaafarana).The urban development area is 5890 acres at the outskirts; and 686 acres along the road, and the agricultural development area is 3269 acres at the outskirts, and industrial development area is 1294 acres at the outskirts.

Urban development area | Agricultural development area | Industrial development area

Sheikh Fadl /Ras Ghareb and Minya /Ras Ghareb roads: Existing roads extending for a length of 246 km, 250 km, respectively, were targeted for marble industries and mining activities, depending on the integration of industry between Cairo and Minya, recreational tourism in the Red Sea and archaeological tourism in Minya, taking advantage of the port of Ras Ghareb. Growth poles on the two roads (Minya/Beni Mazar/Ras Ghareb).

Sheikh-Fadl/Ras Ghareb: Urban development area is 2948 acres at the outskirts, and 732 acres along the road, Agricultural development area is 7682 acres along the road.

Minya /Ras Ghareb: Urban development area is 5177 acres on the outskirts, and 5915.5 acres along the road, the agricultural development area is 1213 acres on the outskirts and 2037 acres along the road.

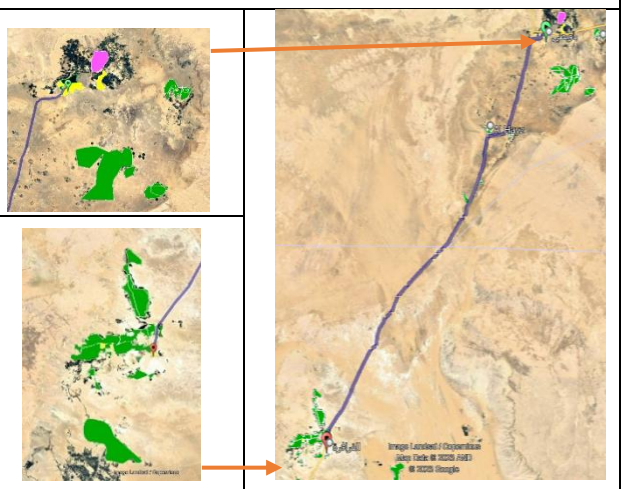
Urban development area | Agricultural development area

3.northern Western Sahara zone

Bahariya Oasis/Farafra Road: An existing road extending for 140 km targeting ecotourism, palm cultivation, livestock development, food, and mining industries; relying on mediation between the governorates of Giza, New Valley, and Matrouh .

Growth poles on the road (Bawiti/Farafra).

The urban development area is 2758 acres on the outskirts, the agricultural development area is 5467 acres along the road, and the area of nature reserves is 4267 acres on the outskirts.



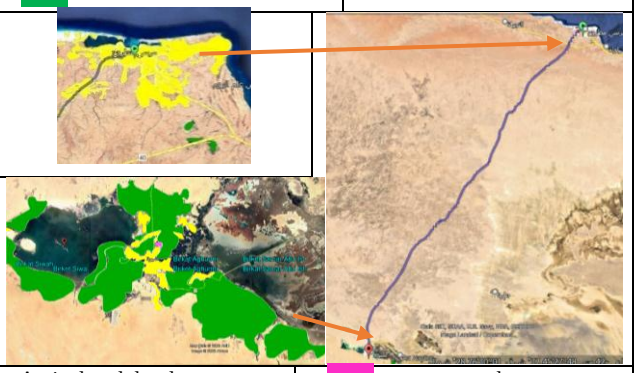
Urban development area | Agricultural development area

Wadi El-Natroun/El Alamein Road: An existing road that extends for a length of 300 km targeting agricultural development, pastoring, mining, manufacturing, food, and logistics services; relying on Marina El Alamein, ports, and airports nearby for export,and growth poles on the road (Wadi El Natroun /El Alamein). The urban development area is 11914 acres on the outskirts; and 500 acres along the road, and the agricultural development area is 4805 acres on the outskirts: and 7682 acres along the road.

Urban development area | Agricultural development area

Matrouh/Siwa Road: An existing road extending for 323 km targeting grazing activities, livestock, ecotourism, food, and craft industries; depending on integration with the North Coast; and exporting products through Matrouh and Siwa airports.

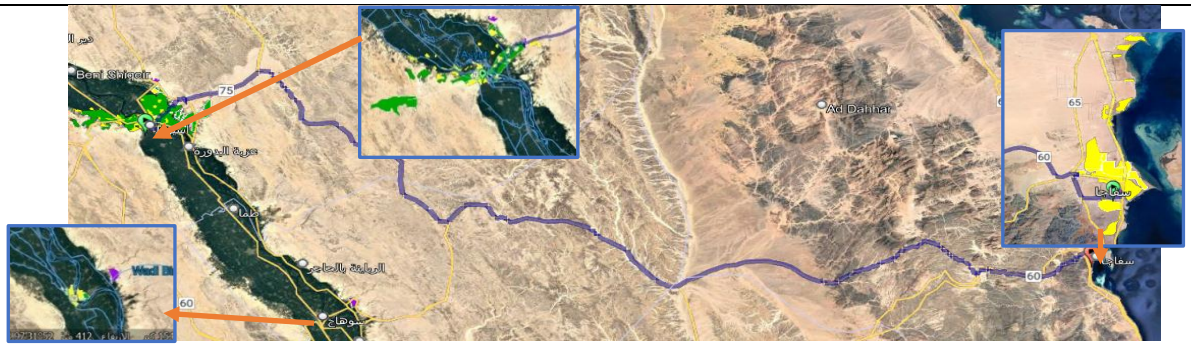
The urban development area is 10487 acres on the outskirts, and 4380 acres along the road, and the agricultural development area is 3755 acres along the road; and the area of nature reserves is 28.5 acres at the edges.



Urban development area | Agricultural development area | natural reserves area

4-South of Red Sea Coast Zone

Upper Egypt/Red Sea Road (Assiut/Safaga) is an existing road extending for 361 km targeting agricultural development, mining, and tourism activities, depending on Assiut Airport and tourism development on the Red Sea coast. Growth poles on the road (Assiut /Sohag /Safaga).The urban development area is 15690 acres on the outskirts, and 5960 acres along the road, and the agricultural development area is 1360 acres on the outskirts and 8211 acres along the road, and the industrial development area is 893 acres on the outskirts



	Urban development area		Agricultural development area		Industrial development area

Qena/Safaga Road: An existing road extending for a length of 165 km has been targeted for agricultural development, mining, and tourism activities, depending on Qena Airport and tourism development on the Red Sea coast. Growth poles on the road (Qena – Safaga).the urban development area is 6068 acres on the outskirts; and 1767 acres along the road, and the agricultural development area is 2610 acres along the road.

	Urban development area		Agricultural development area

Source: Adapted by the researcher through review (General Authority For Urban Planning, 2016a; General Authority for Urban Planning, 2016b)

9. Correlation between development factors on the roads targeted by the study

Exploring the relationship between factors affecting the development of existing roads (diverse case study methodology) Using the 'various case study' methodology to analyze development on roads, using the correlation test in the SPSS program to study the correlations between development areas (urban mass, industrial areas (The General Authority For Investment, 2015) agricultural land area, free zone area (The General Authority For Investment, 2015), natural reserves (Central Agency For Public Mobilization, 2017)) through Google Earth 2020 maps.

And demographic and social factors related to population distribution according to (sex, age, and marital status, type of house and its ownership, number of workers according to level of education and employment sectors, average family size, the rate of crowding (Central Agency for Public Mobilization and Statistics, 2019a) average wages (Central Agency for Public Mobilization and Statistics, 2019b), car ownership rate (Central Agency for Public Mobilization and Statistics, 2019b), per capita GDP (Ministry of Planning and Economic Development,2022), per capita share of total development areas) including the following:

9.1. The correlation between development factors to support road development

(1) The direct correlation between urban development area at the peripheries and the area of (agricultural development, industrial development, free zones) at the peripheries.
(2) The direct correlation between the area of agricultural development on the outskirts and the area of agricultural development along the roads.
(3) The direct correlation between the area of industrial zones at the periphery and the area of free zones at the periphery.
(4) The direct correlation between the area of the free zones on the outskirts and the area of the natural reserves on the outskirts.
(5) The direct correlation between the length of the road, urban development, and the border free zones
(6) The area of urban and industrial development and the length of roads were not linked to any development factors.

9.2. The correlation between road development and population characteristics

(1) The direct correlation between (urban development area - industrial development area - free zones area) at the peripheries and the number of (populations, families), and the type and age of the population.

(2) The direct correlation between (urban development area - industrial zones area - free zones area) at the peripheries and the distribution of the population according to social status.

9.3. The correlation between road development and the number of workers according to educational levels

(1) The direct correlation between the number of workers at all levels of education, and the area of urban development at the outskirts.

(2) The direct correlation between the number of workers at all levels of education, and the area of industrial development at the peripheries, except for (literacy eradication).

(3) There is a direct correlation between the number of workers at all levels of education and the area of the free zones at the periphery, with the exception of those with Ph.D and master's degrees.

(4) The direct correlation between the number of workers at all levels of education and the urban development area along the road with those with Ph.D degree.

(5) The direct correlation between the number of workers at all levels of education and the industrial development area along the road with those with Ph.D and master's degrees.

9.4. The correlation between road development and the number of workers according to their main jobs

(1) The direct correlation between the number of workers according to the main jobs (managers, specialists, technicians, clerks, sales representatives and workers in service activities, craftsmen, factory operating workers, - workers in primary jobs), the area of urban development and the area of the free zones on the outskirts.

(2) The direct correlation between the distribution of workers according to main jobs and the area of industrial development at the periphery, with the exception of qualified workers in agriculture.

(3) The direct correlation between the distribution of specialized workers in agriculture and workers operating factories and the area of outskirts natural reserves.

9.5. The correlation between road development and the number of employees according to the employment sector

(1) The direct correlation between the area of urban development on the outskirts and the number of employees and workers in all employment sectors

(2) The direct correlation between the area of the free zones on the outskirts and the number of employees and workers in all employment sectors, with the exception of the government, cooperative, and association sectors.

(3) The direct correlation between the area of industrial zones on the outskirts and the number of employees and workers in all employment sectors, with the exception of the cooperative sector.

(4) The direct correlation between the area of natural reserves on the outskirts and workers in the employment sectors (general e diplomatic).

9.6. The correlation between road development and the type of housing

(1) The direct correlation between the area of urban development on the outskirts and the number of residents living in (a kiosk - a shop - an independent room - one or more rooms in a unit – an apartment).

(2) The direct correlation between the area of industrial areas on the outskirts and the number of residents living in them (a shop - an independent room - one or more rooms in a unit – an apartment).

(3) The direct correlation between the area of the free zones on the outskirts and the number of residents living in (a kiosk, a shop, one or more rooms in a unit - an apartment).

(4) The direct correlation between the area of the urban areas along the road and the number of residents living in one or more floors.

(5) The direct correlation between the area of industrial areas along the road and the number of residents living in (a separate room, one or more floors).

9.7. The correlation between road development and housing ownership

(1) The direct correlation between the area of urban development and industrial areas on the outskirts, and the type of housing tenure.
(2) The direct correlation between the area of free zones on the outskirts and the type of home ownership, except for (gifted holdings).
(3) The direct correlation between the area of natural reserves on the outskirts and the ownership of housing with a system (in-kind benefit, furnished apartments).

9.8. The correlation between road development and the level of income of individuals

(1) The direct correlation between the area of agricultural development at the periphery and the per capita share of development.

(2) The direct correlation between the agricultural development area along the road, and (crowding rate, average family size, per capita GDP, per capita share of development areas).

9.9. Interconnection between road development and the logistical connectivity of border areas (airports -ports)

The direct connection between the areas of (urban development, industrial development, free zones, natural reserves) at the edges by transporting (passengers at airports - goods at ports).

Table 2 summarizes the correlation between road development and the characteristics of the population, the distribution of those employed to obtain work, and the standard of living.

From it the following is evident:

(1) Although there is a correlation between demographic factors relating to the characteristics of the population and their employment and the areas of urban development, industrial zones, and free zones area at the growth poles, none of them are reflected in development along the roads (there is no correlation between the development of the growth poles and the development along the road).

(2) Agricultural development at the growth poles was reflected in agricultural development along the roads, including the share of the standard of living and the per capita share of development areas.

(3) Demographic factors related to the characteristics of the population, their work, and the type of housing did not effect on the development of agricultural areas at the growth poles.

(4) The emergence of urban clusters along roads is related to the type of housing (separate room, one or more floors).

(5) The development of industrial zones and free zones and the provision of employment opportunities in the growth poles were not reflected in the development of new areas that provide attractive job opportunities for residents along the roads.

(6) The correlation between the development of the border parties and the development of logistics areas for transporting passengers at airports and transporting goods at ports.

Table 2. The correlation between road development and the Demographic characteristics of the population.

	developmental factors at the poles of growth					**developmental factors along the way**				
	population	**workers**	**housing**	**living**	**logistic**	**population**	**workers**	**housing**	**living**	**logistic**
Urban development	■	■			■			■		
Agricultural development				■					■	
Industrial development	■	■	■		■			■		
free zones	■	■	■		■					
natural reserves		■	■		■	■				

■ Correlation with all factors ■ Correlation with most factors ■ Correlation with some factors

Source: by researcher according to the statistical analysis of the program SPSS

10. Arranging roads with development opportunities

The roads are classified according to development opportunities to predict the priority roads for development and the factors that most influence road development.

10.1. At the level of development opportunities for the road and growth poles

(1) Port Said/Sharm El Sheikh Road is the highest in developing growth poles (urban, industry, agriculture, tourism), followed by (Beni Suef/Al- Zaafarana, Upper Egypt/Red Sea (Assiut/ Safaga), Wadi El-Natroun/El Alamein) Roads in developing growth poles (urban, agriculture, industry)
(2) Wadi Al-Natroun/Alamein Road is the highest road in agricultural development along the road, with the beginning of agricultural development on the roads of (Sheikh Fadl/Ras Ghareb, Beni Suef/Al-Zaafarana-Nuweiba/Taba-Al-Arish/ Rafah-Al-Wahat/Al-Farafra-Qena/Safaga- Assiut/Sohag/Red Sea).
(3) Upper Egypt/Red Sea Road (Assiut/Safaga) is the highest in urban and industrial development along the road.

Figs. 6 and 7 show the opportunities for road development at the growth poles and along the road.

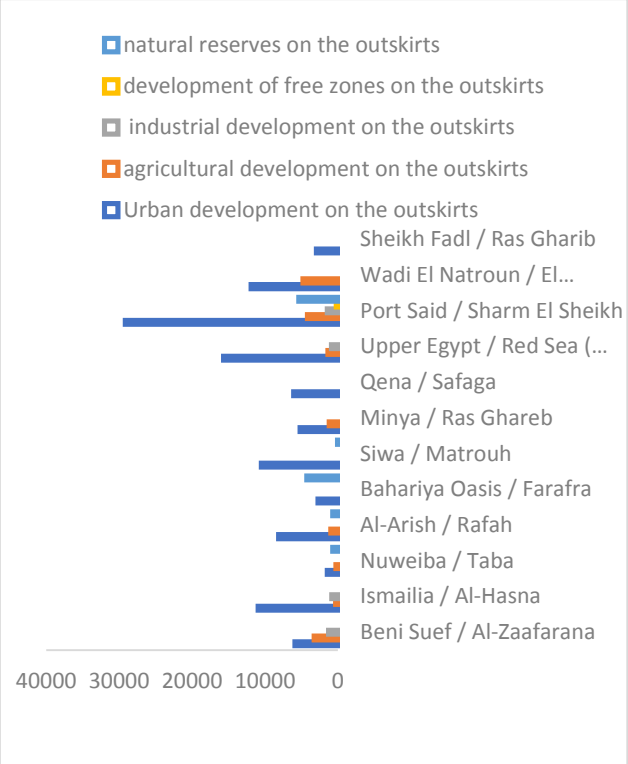


Fig. 6. Road development at growth poles Demographic characteristics according to population characteristics
Source: by researcher according to google earth maps

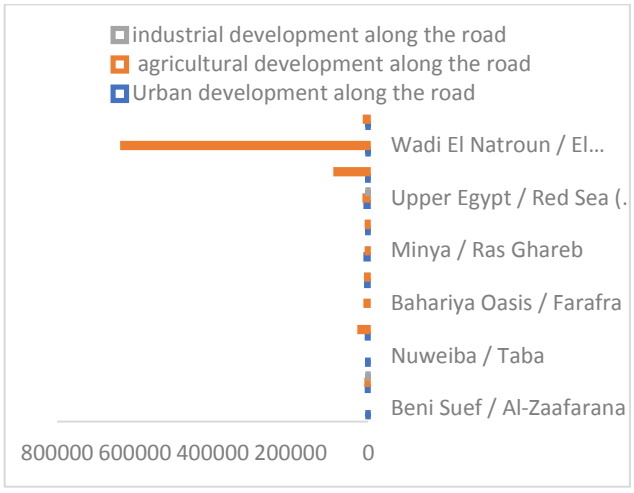


Fig. 7. Development along roads Source: by researcher according to google earth maps.

10.2. At the level of demographic factors of the Population

(1) Population and number of families, followed by the Ismailia/Al Hassana Roads and the Upper Egypt/Red Sea (Assiut/Safaga) Road.
(2) Port Said/Sharm El Sheikh Road is the highest in the distribution of population according to social status, followed by the Upper Egypt/Red Sea (Assiut/Safaga), Ismailia/Al Hassana, Beni Suef/Zafarana Roads.
(3) Sheikh Fadl/Ras Gharib, Beni Suef/Al-Zaafarana, Nuweiba/Taba, Al-Arish/Rafah, Al-Wahat/Farafra, Qena/Safaga, Siwa/Matrouh, Minya/Ras Ghareb, and Wadi Al-Natroun/Alamein are the lowest roads inpopulation andnumber of families.

Figs. 8 and 9 show the demographic factors of population characteristics and social status on the roads.

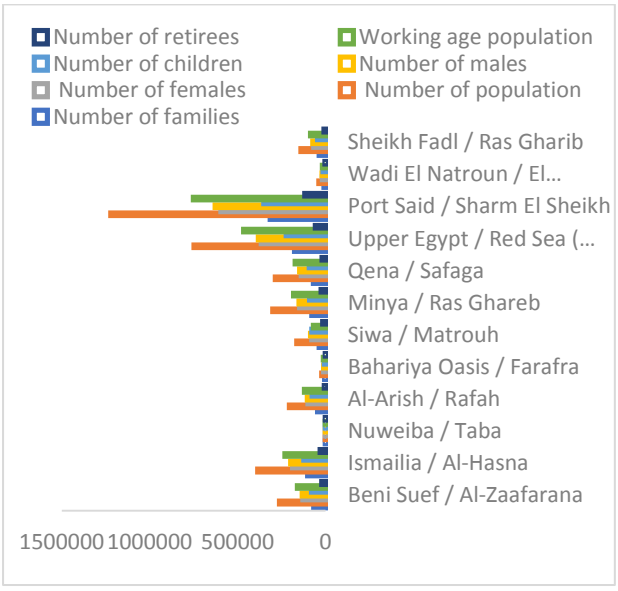


Fig. 8. Demographic characteristics according to population characteristics Source: by researcher according to crowding (Central Agency for Public Mobilization and Statistics, 2019a).

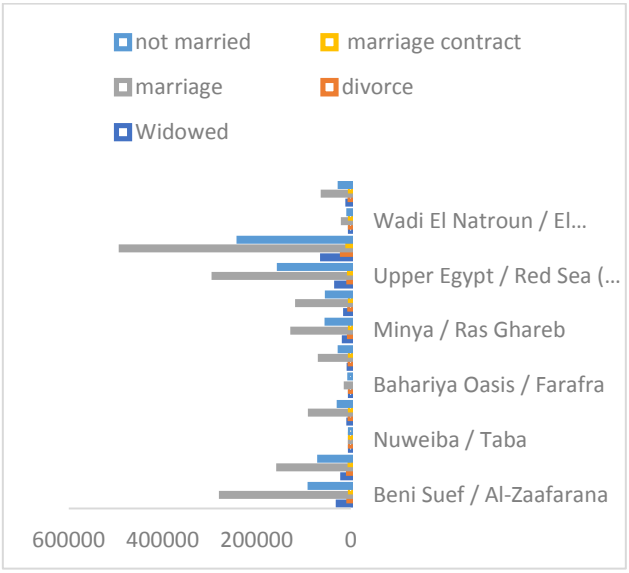


Fig. 9. Demographic characteristics according to the social status of the population Source: by researcher according to source crowding (Central Agency for Public Mobilization and Statistics, 2019a).

10.3. At the level of workers and employment Opportunities

Port Said/Sharm El Sheikh, Upper Egypt/Red Sea (Assiut/Safaga) Roads are the highest in the number of workers according to educational level, main jobs, and employment sector. Figs. 10-12 show the demographic factors for the number of workers and their distribution according to educational status and jobs on the roads.

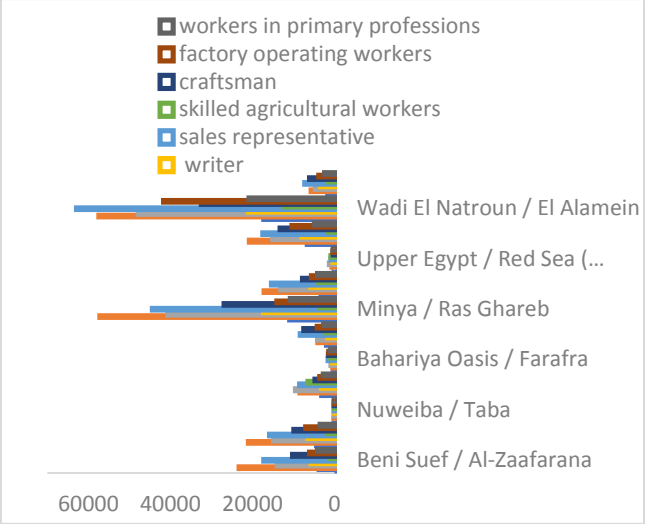


Figure 11 Distribution of employees according to job type
Source: by researcher according to (Central Agency for Public Mobilization and Statistics, (2019 a))

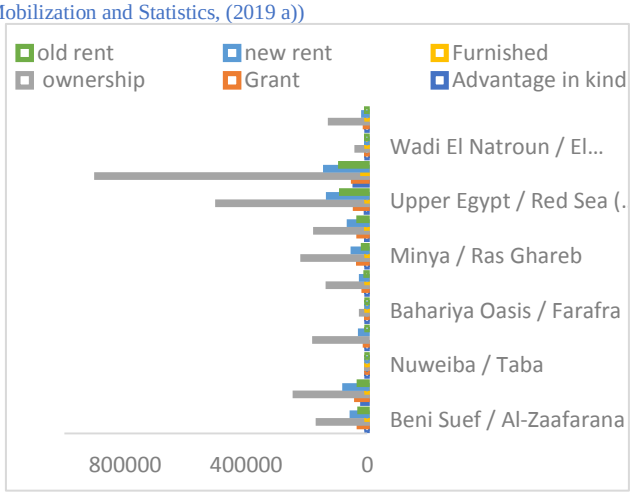


Figure 12 Distribution of employees according to employment sectors
Source: by researcher according to (Central Agency for Public Mobilization and Statistics, (2019 a))

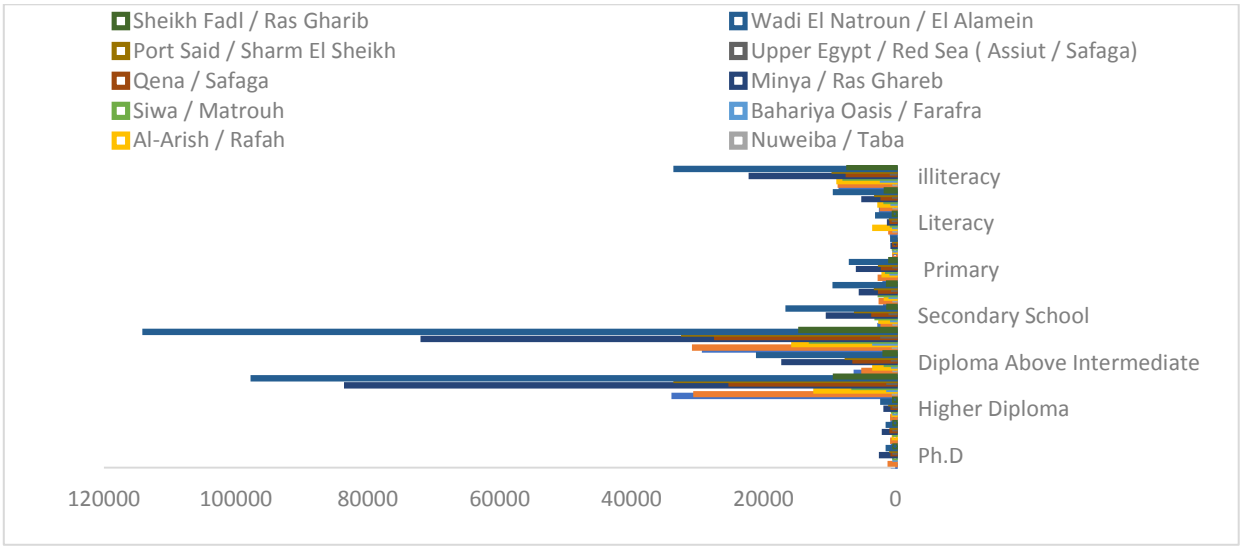


Fig. 10. Distribution of workers according to educational qualification Source: by researcher according to (Central Agency for Public Mobilization and Statistics, 2019a).

10.4. At the level of housing type and ownership

(1) Port Said/Sharm El Sheikh Road is the highest in number of housing factors (type and possession of housing), but it is the highest in the number of individuals living in a booth and a shop (the lowest level of housing), and the lowest in the rate of crowding and average family size, followed by the Upper Egypt/Red Sea Road. (Assiut/Safaga).
(2) The roads (Ismailia/Al-Hasna, Sheikh Fadl/Ras Gharib, Beni Suef/Al-Zaafarana, Nuweiba/Taba, Al-Arish/Rafah, Al-Wahat/Farafra, Qena/ Safaga, Siwa/Matrouh, Minya/Ras Gharib, Wadi Al-Natroun/Al-Alamein) are the highest. In the rate of crowding and average family size, and the lowest in the type of housing and housing ownership.

Figs. 13 and 14 show the demographic factors for the type of housing and its ownership on the roads.

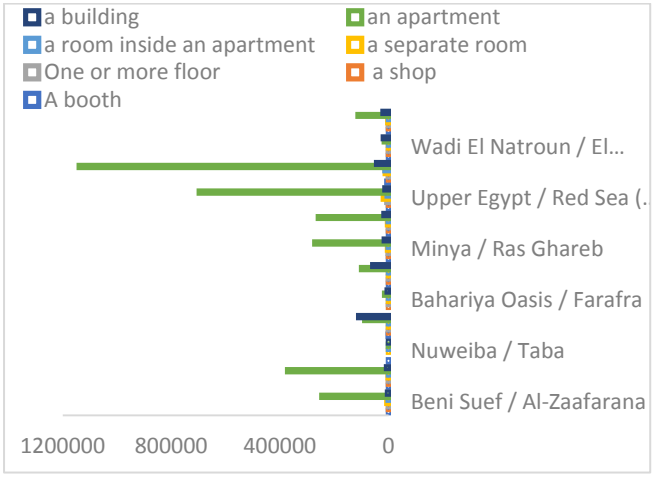


Fig. 13. Distribution of population according to housing type Source: by researcher according to (Central Agency for Public Mobilization and Statistics, 2019a).

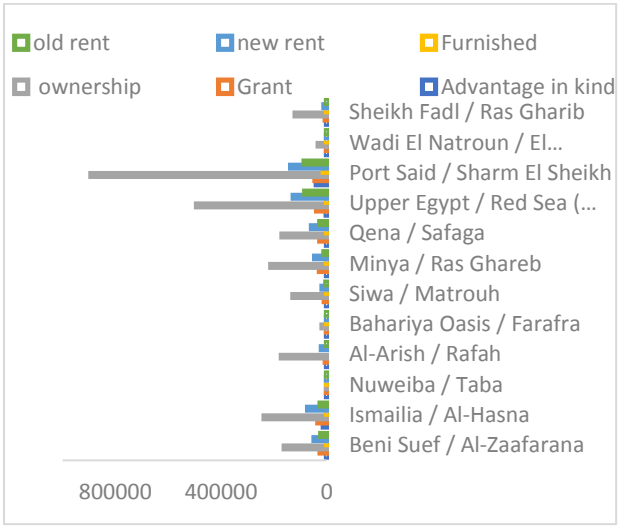


Fig. 14. Distribution of population according to housing tenure Source: by researcher according to (Central Agency for Public Mobilization andStatistics, 2019a).

10.5. On the standard of living and income

(1) The Oasis/Farafra road is the highest in the rate of wages and vehicle ownership, followed by the roads Ismailia/Al-Hassanah, Sheikh Fadl/Ras Gharib, Beni Suef/Al-Zaafarana, Nuweiba/Taba, Al-Arish/Rafah, Qena/Safaga, Siwa/Matrouh, Minya/Ras Gharib, Port Said/Sharm El Sheikh, Upper Egypt,/Red Sea (Assiut-Safaga) average wages for males only.
(2) Wadi El-Natroun-Alamein Road is the highest in terms of per capita GDP and total development area, and despite that, it is the highest in average family size and crowding rate.

Figs. 15 and 16 show the demographic factors for the standard of living, income, and individuals' share of road development.

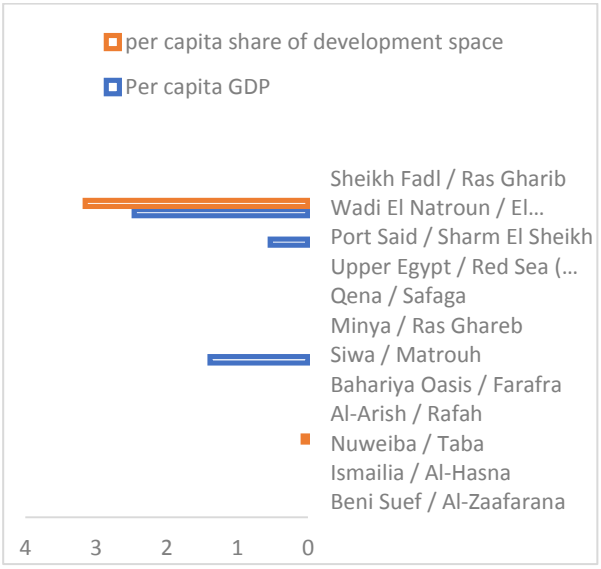


Fig. 15. Per capita GDP and road development Source: by researcher according to GDP (Ministry of Planning and Economic Development, 2022).

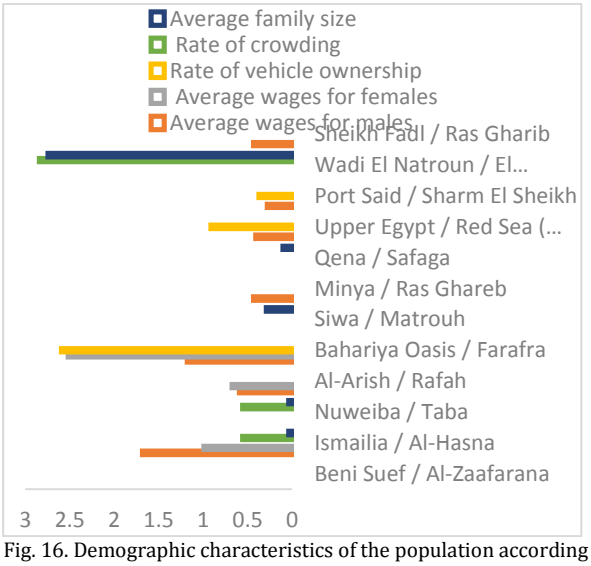


Fig. 16. Demographic characteristics of the population according to standard of living Source: by researcher according to (Central Agency for Public Mobilization and Statistics, 2019b).

10.6. At the level of developing logistical areas (airports-ports)

The Port Said/Sharm El Sheikh Road is the highest in the development of logistical areas (passenger transport at airports - goods transport at ports), followed by the Upper Egypt/Red Sea (Assiut-Safaga) Road in transporting passengers at airports.

Fig. 17 shows the distribution of developing logistical areas (airports-ports).

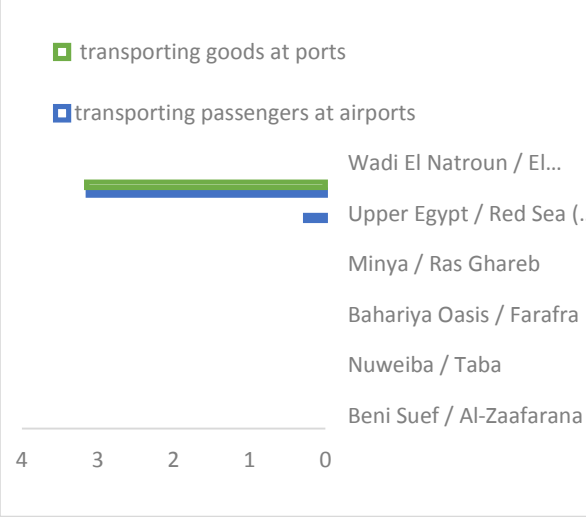


Fig. 17. Distribution of developing logistical areas (airports-ports) Source: by researcher according to (Central Agency for Public Mobilization and Statistics, 2018; Maritime Transport Sector, 2022).

11. Predicting the future of road development

By applying the Durbin Watson regression test. In SPSS to predict the factors affecting development along roads, the following were found:

(1) Urbanization and industry along the road will be affected by (61 %, 67.9 %), respectively due to increasing residents in one or more floors.
(2) Agriculture along the road will be affected by 99 % (per capita share of the total development area- the presence of skilled workers in agriculture) increase.
(3) Per capita development along the road will be affected by 99.4 % by increasing (agricultural areas along the axis-crowding rate) and reducing dependence on workers according to educational level (reading and writing without qualifications).

(Fig. 18) shows the factors influencing road development in the future.

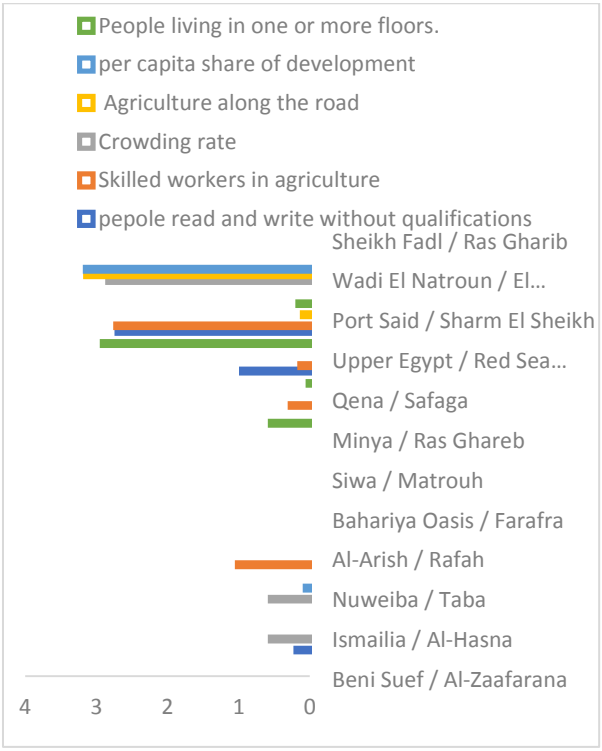


Fig. 18. Factors influencing road development in the future Source: by researcher according to the statistical analysis SPSS.

Among them, the research examines the role of roads in developing border areas as follows:

(1) The possibility of developing urban and industrial development along the roads (Assiut/ Safaga, Minya/Ras Gharib, Port Said/Sharm El Sheikh).

(2) The possibility of developing agricultural development along the roads (Wadi El Natroun/ El Alamein, Port Said/Sharm El Sheikh, Al Arish/Rafah, Upper Egypt/Red Sea, Qena/ Safaga, Nuweiba/Taba).

(3) The possibility of developing the per capita share of the total development areas depending on the rate of crowding and agricultural development along the roads (Wadi El Natroun/El Alamein, Port Said/Sharm El Sheikh, Ismailia/Al Hasnah, Nuweiba/Taba), with the possibility of a decrease in the per capita share of development along the Wadi El Natroun road. Alamein to increase unqualified workers (read and write without qualification.

12. Results

(1) The effect of the presence of roads as a contributing factor in supporting connectivity and increasing development areas to form growth poles.
(2) There is no correlation between the formation of growth poles on the roads and the development along the road, except for agricultural development.
(3) Roads did not achieve their targeted population attraction to the border areas, despite the variety of development opportunities and available resources (there is no correlation between road development and demographic factors related to improve the standard of living, except in agricultural development).
(4) Irrational development in the use of agricultural activity as a unilateral activity in desert areas, for example, agricultural activity only is influential in (integration between the development of growth poles and development along the road increasing the per capita share of the local product and development areas future development of roads).
(5) Relying on unilateral agricultural development did not achieve the target population attraction, for example, Wadi El Natroun/El Alamein Road (the highest in (agricultural development, crowding rate, per capita development rate due to the decrease in population) and the lowest in urban development), Port Said/Sharm El Sheikh Road (Highest in urban development, lowest in per capita development rate due to the increase in population).
(6) Lower wage increases failed to achieve the target population attraction, for example, Oasis/Farafra Road (the highest in average wages and the lowest in developmental factors).
(7) Urban development areas do not indicate their quality, as a correlation between development areas and housing have emerged (booth, shop, room).
(8) Although there was a correlation between development in the peripheries (urban development, industrial development, free zones, and natural reserves), and the formation of logistics areas (passenger transportation, airports, and goods transportation in ports), this did not reflect in development along the roads.
(9) Future urban and industrial development will be affected by the quality of housing (residents of one or more floors).
(10) Agricultural development in the future will be affected by increasing the per capita share of development and providing qualified workers.
(11) The per capita share of development along the road in the future will be affected by population attraction, crowding rate, labor qualification, and agricultural development.
(12) The impact of the existing logistical areas on the Port Said/Sharm El Sheikh and Upper Egypt/Red Sea (Assiut-Safaga) Roads has not appeared in the future on the formation of new development poles along the roads, despite their acquisition of most of the development factors.

13. Research discussion

The research presented an exploratory analytical study to track development on the roads connecting the border areas, (North Sinai, South Sinai, Matrouh, New Valley, Red Sea), which are targeted by the development plan 2052, as they are the area's most requiring to support development and achieve equality between the population and place across the entire Republic.

The study confirmed that roads are the main driver of urban growth, due to their impact on increasing development areas and reaching areas marginalized from development.

The research problem is summarized as the dependence on roads for movement, connectivity, and supporting development. The presence of aroad alone is not enough to achieve urban development.

The vast areas around the roads must be exploited while linking to demographic, social, and economic characteristics to attract residents and support development.

Reviewing previous studies shows the link between road development and achieving connectivity between regions and the demographic factors that affect the need for population movement (work, study, marriage, divorce, widowhood, accompanying a spouse, entertainment).

It was found that population movement and support connectivity between regions are affected by the characteristics of the population according to gender, age, and marital status, and the number of workers by education levels, type of job, employment sector, type and ownership of housing, income level, and ownership rate of car.
The research relies on a methodology for studying various cases to measure road development, using the correlation test in SPSS, to measure the relationship between road development and demographic factors in the population.

Research also relies on a methodology for predicting development models assuming the continuation of the status quo, relying on Durbin Watson regression in SPSS to predict the factors. Influencing the development of border areas by supporting connectivity and road development.

By reviewing road development, it was revealed that there is no correlation between the development of the peripheries, and the growth poles with the development along the roads, in order to open up new development horizons for vast areas along roads and to reach the marginalized places from development, except in agricultural activity.

It was also shown that demographic factors related to the characteristics of the population and their employment are related to the urban development area, industrial areas, and the free zones area of growth poles, while this was not reflected in support for development along roads.

While the development of urban clusters and industrial areas along the roads was linked to the type of housing and its ownership, while the development of agricultural area along the roads was linked to the standard of living and income of the population.

By tracking road development opportunities, the following was revealed:

(1) Diversity of development opportunities on all roads.

(2) The strength of the growth poles on the Port Said/Sharm El Sheikh Road did not affect the development along the road. Despite it being the highest in development of the peripheries and all demographic factors related to population, housing, and number of workers, it does not appear to be among the highest in the development along the road.

(3) The increase in urban development and the provision of housing on the Port Said/Sharm El Sheikh road did not affect the quality of development and the standard of living.
Despite being the lowest in the rate of crowding, it did not appear to be the highest road in terms of averages wages, per capita share of development, and per capita GDP.

(4) Demographic factors related to population, housing, and the number of workers have contributed to support urban and industrial development near the growth poles on the Upper Egypt/Red Sea Road (Assiut, Sohag, Safaga), but there is still no development in large areas along the road.

(5) Agriculture development associated with increasing the per capita share of the domestic product and the total development areas of the Wadi Natroun/Alamein road failed to attract residents, as it is the highest road in agricultural development, the per capita share of the domestic product and the development areas, and among the lowest roads in all demographic factors related to population, housing, and employment opportunities.

(6) The lack of urban development on the Wadi Natroun/Alamein Road, it led to a high rate ofn crowding compared with the average family size.

(7) Demographic factors related to the number of populations, families, and social stability contributed to the start of urban and industrial development on the Ismailia/Al-Hasna Road in the Sinai region.

(8) Social stability (distribution of population according to social status) on the Beni Suef/Al-Zaafarana Road has not contribute to increase opportunities for road development.

(9) Despite the beginning of urban and industrial development on the Siwa/Matrouh-Minya/Ras Gharib roads, it still has not yet achieved its population attraction target (the lowest roads in all demographic factors)

(10) Increasing average wages and car ownership rate on the Oasis/Farafra Road, have not affected the development road (the lowest roads in all development factors).

(11) Roads (Sheikh Fadl/Ras Gharib, Nuweiba/Taba, Al-Arish/Rafah, Qena/Safaga) are the lowest in all factors related to development, population, and employment.

Assuming that the factors affecting road development
continue in the current situation, the research predicts that urban and industrial development along the road will continue to depend on the type of housing (residents of one or more floors), and the dependence of agricultural development along the road on the level of income and the standard of living of individuals (per capita share of the total development area, presence of skilled workers in agriculture), and a reduction in the per capita share of development areas by increasing agricultural development along the roads and attracting residents to increase the rate of crowding (very low on most roads), and raising labor efficiency by reducing reliance on unskilled labor (reading and writing without qualifications).

It is to increase urban and industrial development area along the roads (Upper Egypt/Red Sea (Assiut/ Safaga) Minya/Ras Gharib, Port Said/Sharm El Sheikh), and to increase the areas of agricultural development through roads.)Wadi El-Natroun/El-Alamein, Port Said/Sharm El-Sheikh, Al-Arish/ Rafah, Upper Egypt/Red Sea (Assiut/Safaga), Qena/ Safaga, Nuweiba/Taba).

14. Conclusion

The research presented an exploratory analytical study to predict the impact of connectivity on the development of the border areas in Egypt (North Sinai, South Sinai, Matrouh, New Valley, Red Sea), to achieve a balance between population and place, through optimal exploitation of the vast areas along the roads; And the formation of new development poles, as targeted by the 2052 Development Plan.

With the research relying on the methodology of studying different cases to track the development of damaged roads connecting the border areas and predicting the most influential factors in road development using statistical tests in the SPSS program, it was found that despite the diversity of development opportunities on different roads and the correlation of demographic factors to the characteristics of the population, housing, living standards, and special logistical factors.

By supporting development through airports and ports with development, there is no relationship between the development of the periphery and the formation of new growth poles along the roads except in agricultural activity only, and despite the concentration of development opportunities and poles on the Port Said/Sharm El Sheikh road (Port Said, Ismailia, Suez, Sharm El Sheikh) because it is the highest in terms of development opportunities for the formation of logistical areas, and all demographic factors related to population, provision of housing, and the number of workers, it did not appear among the highest in developing the vast inter-spaces along the road.

While demographic factors have contributed to the support of urban and industrial development near the growth poles on the road of Upper Egypt/ The Red Sea (Assiut, Sohag, Safaga), it is not yet inhabited by development along the road, and agricultural development associated with the increase in the per capita share of domestic product and gross domestic product has not been successful.

Development areas on the Wadi Natroun/Alamein Road attract residents because it is one of the lowest roads in terms of all demographic factors relating to population, housing provision, and employment opportunities.

Among them, the research recommends the use of all available resources to support development opportunities attraction of the population, in order to achieve integration between the growth poles and the development of new areas along the roads, taking into account improving the quality of housing and qualified workers in order to achieve an increase in the per capita share of gross domestic product and development areas, benefited from the experiences of previous successful global experiences.

By reviewing some global experiences, lessons learned regarding reducing regional disparities were identified through:

(1) Linking rapidly developing regions to poorer regions, improving the exploitation of natural resources, and linking logistical areas to different regions.

(2) Improving the performance of economic institutions by supporting tripartite cooperation between government, the commercial sector and universities, and coordination between different regions to abandon the private interest for the public interest with implementation guarantees to support future competitive projects.

(3) Increasing opportunities for investment, labor regulations, and flexibility in employment to develop areas that are marginalized from development.

(4) Preserving the environment by moving polluting factories away from population-concentration areas, while developing intelligent industrial cities, linked to intelligent transport networks in accordance with technological progress in the development of (highways, railway lines, airports, ports).

(5) Preserving agricultural land and natural reserves from damage caused by invasion and environmental damage by road development.

It takes into account the start of a group of roads as an experimental phase to test and explore development opportunities, maximize the positives of achieving social justice by achieving parity between different regions, and avoid the negatives associated with the indirect effects of road development from an environmental and economic point of view by directing capital to more feasible projects to support development.

Conflicts of interest
I haven't conflicts in interest.

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