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Study on Planning Scheme of Egypt National Railway Network

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Abstract: Referring to the experience of China's railway construction and incorporating with the Egyptian national economic characteristics and traffic trends, based on the analysis of passenger and freight transport volumes and the main transport corridors, the planning scheme of Egyptian national railway network is proposed. The scheme includes the inter-city network, regional backbone network and the surrounding countries' communication with considering the Mediterranean coast, Nile Delta and Suez Canal coastal key areas.

Introduction

Egypt is located in the eastern part of North Africa with its territory stretching across Asia and Africa. It is not only the Asian and African land transport hub, but also the ocean route shortcut between the Atlantic and the Indian Ocean, occupies a very important strategic position. Egypt crosses Asia and Africa continents, most part in northeastern Africa, and only the Sinai Peninsula which is in the east of the Suez Canal is in southwest Asia. Egypt connects Libya in the west, the Sudan in south, the Red Sea also Palestine and Israel in the east, and the Mediterranean in the north, and has a very important position in the economic communication of Asia, Africa and Europe.

Egypt is not only the most populous country in the Middle East, but also the second largest country in Africa. It has been a leading position for a long time in the economic and technological fields in Africa and has played an important role in international affairs in Arab and African and has a strong influence in Africa and the Middle East. It is currently in the forefront of rapid economic development, and vigorously attracts foreign investment and creates job opportunities. As the railway transport has the advantages of large transport capacity, low cost and all-weather operation, and so on, the construction of modern railway system has an obvious effect on Egyptian resource development, industrial development, inter-city personnel communication strengthening, tourism promoting and employment increasing. The transportation infrastructure will be definitely an important area for future investment in Egypt [1-4].

Natural and socio-economic characteristics

Natural characteristics

The Egyptian land crosses Asia and Africa, and is separated from the Europe by the Mediterranean. Egypt administrative division is divided into 27 provinces, 8 economic zones, 94% of the land area is desert, and the coastline is about 2900km, shown in Figure 1. The world's longest river Nile runs from the south to the north with total length 6700km, and 1530km long in Egypt. By natural geography, Egypt can be divided into four districts: the Nile Valley and Delta, the western Libyan Desert, the Eastern Arabian Desert and Sinai Peninsula. Egypt is rich in water resources, the most important source is the Nile water. According to the river distribution agreement signed by the nine countries along the Nile River, currently Egypt has the Nile water share of 55 billion cubic meters, accounting for Egypt's total fresh water resources about 90%.

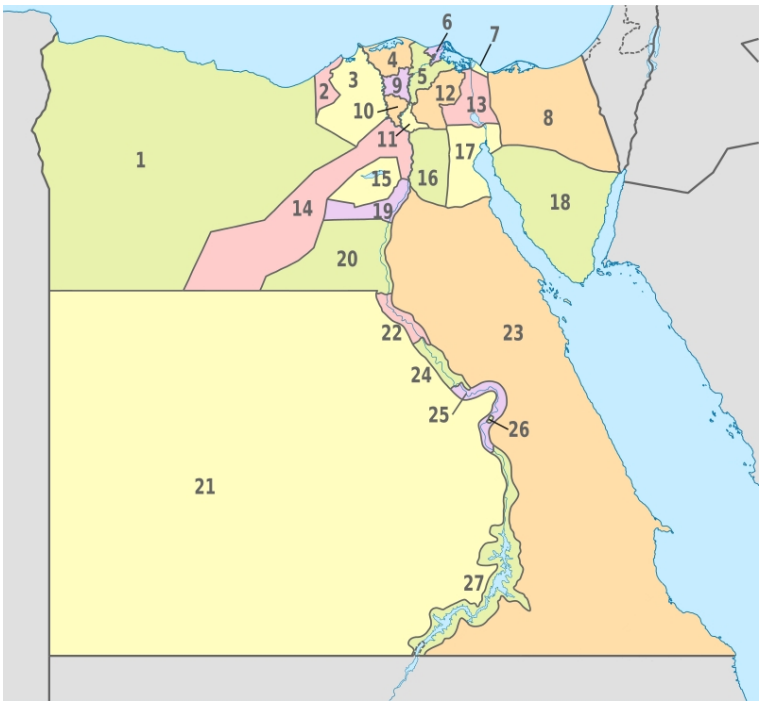

Figure 1 Division of administrative regions of Egypt

Administrative Region and Population Distribution

Egypt is divided into 27 provincial administrative regions, mainly distributed in the Nile Basin and the Nile Delta.

In recent years, the population of Egypt has exploded, and the population is 91.5 million by the year of 2015. The annual growth rate of population is more than 2%, and is expected to be 100 million in 2019. The population is highly concentrated, with about 96% of the population living in the Nile Valley and the Delta region. As shown in Figure 2, the top 20 cities such as Cairo, Alexandria, Giza and so on are in the Nile Delta, the Nile Valley and the Suez Canal.

Since 1996, most of the big cities with more than one million people have a population growth rate higher than 24% per year, and the population aggregation effect to the metropolitan area is more obvious. Take the Egyptian capital city Cairo, which is located in the northeastern part of Egypt and across the Nile, as an example. Cairo is the largest city in Africa and the Arab world, is the political, economic, cultural and transportation center of the Middle East. The population is close to 19 million by 2015 and is expected to exceed 20 million by 2018, more than 20% of the Egyptian population.

Economic characteristics

Egypt's nominal GDP in 2015 was $ 330.779 billion, which is 3.6% average annual growth rate since 2006. Egypt has an open market economy with a relatively complete industrial, agricultural and service system. Among the GDP, the share of industry is about 16%, agriculture is about 14%, and service is about 50%. The four pillar industries are oil and gas, tourism, remittances and the Suez Canal.

The service sector includes tourism and the Suez Canal. Egypt has a long history, and has many historical sites and rich in tourism resources. The main tourist attractions are the Pyramids, Sphinx, Luxor Temple, Aswan high dam, Sharm el-Sheikh and so on. The annual reception of tourists is about 10 million people, and can directly realize employment of 500,000 people. The Suez Canal is the convenient route from Europe to the Indian Ocean and the western Pacific, and 10% of the world's trade through sea transport through the Suez Canal. The income of the Suez Canal is $ 5.2 billion in 2011.

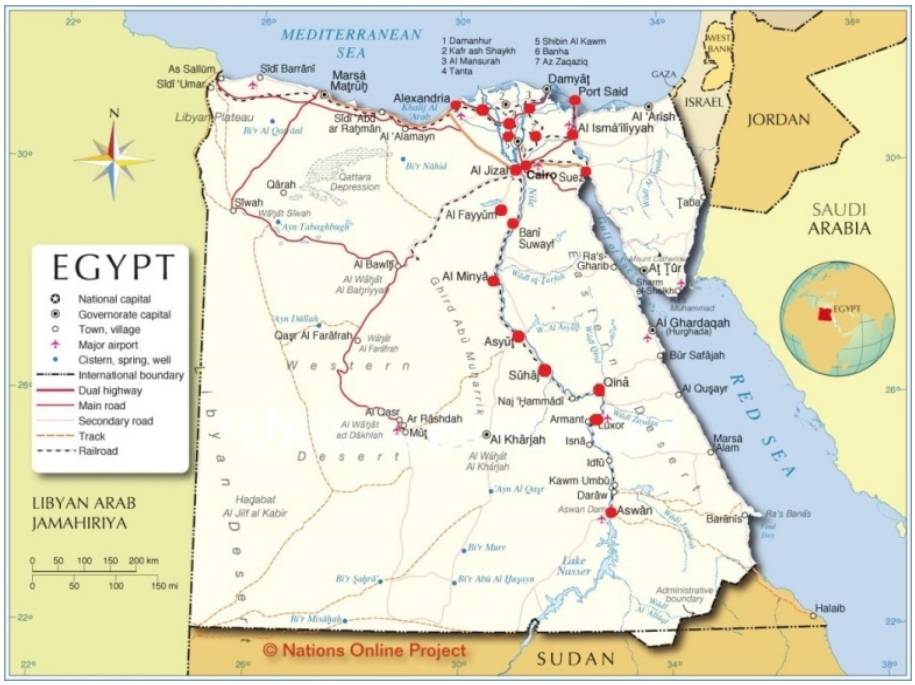

Figure 2 Distribution of 20 most populous cities in Egypt

Traffic status and characteristics

Railways

Egypt is the second country to have railways in the world just after the United Kingdom. At present, the Egypt has a total railway length of 5195 kilometers which is mainly used for passenger transport, and traffic volume was 311 million passengers and 1592 million tons km of cargos in 2012 (World Bank data). Because of the low Technical standards of existing railways and lack of transport capacity, the Egyptian National Railway Bureau plans to invest about 60 billion Egyptian pounds for railway construction, and hope to vigorously improve the safety and efficiency of the railway system.

The passenger volume was dropped from 667 million in 2000 to 183 million in 2014, which was an average annual drop of 8.83%. Railway freight transport from 2000 to 2010 was remained at 4,000 million tons km, but had a sharp decline to 1600 million tons km from 2011 to 2014. At the same time between 2000 and 2014, the population in Egypt grew more than 2% per year, and the nominal GDP increased from $ 99.839 billion in 2000 to $ 301.499 billion in 2014, with an average annual growth rate of 8.21%. The rapid growth of population and economy scale presents an obvious contrast against the stagnation of railway mileage and the decline in passenger and freight traffic, which indicates that Egypt railway traffic in the past 20 years has not been effectively developed, the railway development status is far from being able to meet the current economy, population development, and urgent needs to be improved.

Subways

Currently only the capital city Cairo has subways, and total six lines are, among which three lines (No.1,2,3) are in operation with a total length about 77.9 km and 63 stations, and the daily traffic volume is about 4 million passengers.

Cairo Metro Line 1 is the oldest in the Cairo subways with its first section of 29km operating in 1987. The whole line is 44.3km long with 35 stations in total. The unidirectional transport capacity is 60,000 passengers per hour, and the maximum operating speed is 80km/h. Metro Line 2 is 21.6km long among which 13km is underground, and there are 20 stations among which 12 stations are underground. Metro Line 3 is now from Attaba to Ahram (Heliopolis), total length 12km with 9 stations. Line 3 later will connect Cairo International Airport to Cairo University and Imbaba, with a total length of about 50km. The planned Metro Line 4 is from the Halham region to the new Cairo

area, across two tributaries of the Nile with a length of 24km, and will connect the eastern and western parts of the Greater Cairo region.

The number of passengers in the Cairo subways increased from 650,000 in 2000 to 750,000 in 2014with an average annual growth of about 0.96%. But the growth rate of subway passengers is much lower than the growth rate of local urbanization and population growth rate, which indicates that the Cairo subway traffic development is far behind the demands of local economic and urbanization development, the needs for development are very urgent.

Highways

The construction of Egyptian road network is relatively slow. The current road network basically connects most of the towns and villages, and undertakes 95% of the cargo transportation. By the end of 2015, the Egyptian Highway (asphalt) has a total length of 168,376km. The national highway network is divided into nine highway corridors, and the main trunks are: Cairo - Alexandria Highway (240km), Cairo - Aswan Highway (2000km), Red Sea Highway (350km), Mediterranean Highway (1100km) and so on.

During the period from 2004 to 2015, the Egyptian road mileage increased 2.2 times from 75,321 km to 1, 68,376 km with average annual growth rate of 6.8%. At the same time, the number of registered motor vehicles increased 2.4 times from 4,497,167 to 8, 548, 748 with an average annual growth rate of 7.7%. The growth of the road lags behind the growth of motor vehicles. Now the traffic condition is further deteriorated and the road congestion is more serious.

Shipping and aviation

Egypt is the international commercial and maritime center with port cargo handling capacity 234.45 million tons and 10 million TEUs, and has a total number of 179 berths with 32.1 km's long, the total storage area of which is 4.013 million square meters. The major ports are the Mediterranean port of Alexandria, Port Said, Dumat Harbor and the port of Suez in the Red Sea, Seifaye Harbor and other 62 ports, the total annual throughput is 8 million containers, the port trade volume is 101 million Tons. In 2014, Egyptian port container traffic amounted to 8,810,990 international standard box, 4.4 times of the year 2000 (1,625,601 international standard box), the average annual growth rate of container traffic reached 10.38% in 15 years.

Egypt has 30 airports including 11 international airports, most of the airports are mainly used for military and supplemented by commercial purposes. The main airports are Cairo, Sharm el-Sheikh, Holga Gorda, Alexandria and Luxor airport. Cairo Airport is an important international airport, the new Cairo Airport Terminal 3 (total cost of about 400 million US dollars) is the largest terminal in North Africa and the annual passenger traffic volume is 11 million passengers, which increases the Cairo Airport passenger transport Capacity from 9 million to 20 million per year. Since 1980, Egypt's air traffic has continued to grow especially since 2000. Egyptian Airways passenger traffic in 2015 (10,159,464 passengers) is twice the passenger volume of 2006 (4,988,262 trips). The air cargo volume reached to 397.53 million tons in 2015, and increased 28.5% compared with 2006 (309.434 million tons). Thus, it can be seen that the Egyptian air passenger traffic in recent 10 years has been significantly improved, which indicates that the Egyptian residents travel demand has been increased.

Railway network planning

Planning principle and purpose

According to the planning characteristics of the railway network, the following principles need to be met:

1) To improve the quality of transport: the planning of modern railway passenger and freight transport network should meet the city-intensive intercity passenger flow, and the needs of fast passenger transport in major tourist areas, the existing railway speed up, railway crossing modification and transport safety enhancement;

2) To enhance transport capacity: separating the passenger and freight lines in busy areas; the existing railway line modification.
3) To optimize the network layout: the main port, tourist attractions, capital cities, industrial areas should be connected; and also connecting to neighboring countries' railway network.

In the construction planning, the national railway mileage will reach to 15,000 km, among which the high speed passenger dedicated railway line will be about 2000km, then the Nile Delta region rapid passenger network will be built up; All provincial cities, major port cities, tourist attractions will have rail connection; also linking to Jordan, Sudan and other countries' railway networks. Completing the existing railway expansion and safety upgrades, and most of the railway lines are electrified.

Planning program

According to the distribution of Egyptian population, ports, major cities, the main tourist attractions, the plan for the Egyptian fast passenger and passenger and freight sharing railway lines is made. Fast passenger railways include high-speed railways and the Nile Delta intercity railways. Passenger and freight sharing lines mainly include the railways for modifying regional development and improving the railway network and the railways interconnecting with foreign countries.

Fast passenger railways

1) High-speed railways: to meet the long-distance passenger transport between major cities along the Nile River, achieve 2-3 hours travel from Cairo to the coastal cities, and provide a fast and comfortable passenger transport service for the Nile River tourism. The Alexander - Aswan high-speed line is proposed, the target speed is 300-350 km/h.
2) Nile Delta Intercity Railways: To meet the rapid passenger transport between the major cities of the Nile Delta, as well as the urban development needs of the Cairo metropolitan area, to reach the surrounding satellite cities within 0.5h from the central city of Cairo, major cities to Cairo and Alexandria within 1 h, and 2h between major cities. Therefore, the intercity railways are planned and the target speed is 160-200 km/h.

Through the above plan, the high-speed railways and intercity rapid passenger EMU lines will be built to meet the densely populated areas of the Nile Delta and the Nile transport needs, forming 0.5h, 1h and 3h traffic circles around the city Cairo.

Passenger and freight sharing lines

To speed up the modernization of the railways in Egypt and meet the economic development of the Egyptian national industry, ports and remote areas, and improvement of the national railway network layout, the following passenger and freight sharing lines are suggested to be built, the target speed is 80-100 km/h.

1) Regional development and improvement networks: for example, for the Mediterranean coast railway, the main purpose is to form a transport corridor between South Sinai and Suez, to strengthen the link of eastern coast of Suez Bay to the Nile Delta region;
2) International railway corridor for foreign countries: For example, the Egyptian-Saudi Arabia-China railway channel is to form Egypt's international route to the Middle East and west Asia; The Egyptian-Sudan railway channel is to connect the south from Sudan to the eastern African countries by railways, forms the international channel for the Mediterranean to the east African region.
3) Mediterranean coastline: for example, the line of east Suez Canal is to form a longitudinal channel in the east of the Suez Canal to enhance the transport capacity of the Suez transport corridor. And the Red Sea coast railway is to strengthen the development of the Red Sea coast region and promote the development of related ports.

Conclusions

Based on the analysis of Egyptian economy and population in recent years, this paper puts forward an improvement plan for Egyptian national railway network in the light of the development of Egyptian traffic situation. Through the above network planning, 5510km new lines including 1990km fast passenger lines, 3520km passenger and cargo sharing lines are to be constructed. Then the national railway network density will reach to 1550km per thousand square kilometers. In addition, through the speed up, expanding and electrification of the existing railways, the Egyptian railways will eventually build a modern railway transport system with a great capability of freight carrying and fast passenger transport. The transport service quality will be greatly improved to meet the needs of the rapid economic development of Egypt.

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