

Study on the countermeasures of ecological civilization construction in Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract. Guangdong-Hong Kong-Macao Greater Bay Area (GBA) is highly developed, characterized by obvious geographical advantages, excellent natural resources, continuous improvement of environmental quality, and accumulation of scientific and technological innovation elements. It is an important space carrier and hinterland for the construction of "the Belt and Road initiative". However, the long-term, high-speed, and extensive development model has also caused the Greater Bay Area to carry more debt in the environment and history. Therefore, in order to construct the pattern of ecological civilization construction in GBA, it is urgent to establish and improve the evaluation system and policy system of ecological civilization from the top-level design, and to construct the pattern of high-quality ecological space, green industry and joint defense.

1 Introduction

The construction of GBA is another important regional developmental strategy based on the coordinated development of Yangtze River Delta and Jing-Jin-Ji Area. In recent years, the economic and social development of GBA has been sustained and rapid. The ecological environment protection and governance efforts have been continuously increased. The ability of regional economic and environmental coordinated development has been continuously improved, and good internal and external conditions have been provided for building a high-quality ecological civilization demonstration area and a pilot area. We need to seize the strategic opportunity to accelerate the development of GBA clarify the outstanding problems faced by the ecological environment protection, learn from the international advanced experiences, and build a world-class beautiful bay area with high standard^[1].

2 Analysis on the basis and advantages of ecological civilization construction in GBA

2.1 Obvious regional advantages

GBA is geographically connected with Southeast Asia and South Asia in the south, the West Coast Economic

Zone of the Straits and Taiwan in the East, the Yangtze River Economic Belt in the north and the Beibu Gulf Economic Zone in the West. It has Hong Kong's international shipping center, as well as ports and aviation hubs such as Guangzhou and Shenzhen, which have the world's leading throughput. It is a bridge for China to connect the world and move towards globalization. At the same time, it is located in the front of China's coastal opening up, and has the advantage of "one country, two systems". It is the hinterland of the Pan PRD region. It is also one of the regions with the highest degree of openness and the strongest economic vitality in China, and plays an important role in the construction of "the Belt and Road initiative".

2.2 Highlight the vitality of regional development

In 2018, GBA 's GDP reached US \$1.64 trillion, and its total economic output exceeded that of Tokyo Bay area and San Francisco Bay area. Its total amount of foreign trade, total amount of foreign capital utilization, annual throughput of port containers, and annual throughput of airport passengers are also based on the international advanced level. It is one of the most potential regional economies in the world (table 1^[2]). And its population size and area of GBA are more than twice that of San Francisco Bay Area, New York Bay Area and Tokyo Bay area, which brings great developmental potential for GBA.

Table 1 Comparison of economic and social development level between GBA and three international bays

Index (in 2018)	the Bay Area of Guangdong-Hong	New York Bay Area	San Francisco Bay Area	Tokyo Bay Area
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	Kong-Macao			
Population (10000)	7116	2285	765	3503
Area covered (10000 km ²)	5.59	3.37	1.80	1.34
Population density (people/km ²)	1273	678	425	2614
Urbanization rate (%)	86.60	>90	>96	>94
GDP (Trillions of dollars)	1.64	1.5	0.8	1.24
PGDP (Ten thousand dollars)	2.30	6.56	10.46	3.54
Port container throughput (10000 TEU)	6520	637	227	766

2.3 Obvious advantages of natural resources endowment

GBA is located at the intersection area of the three major ecological systems of ocean, river and land. It has rich marine, biological and environmental resources, as well as unique geographical landscape and ecological value. There are various types of ecosystem such as mangrove in it. Its forest coverage rate is more than 50%. Its total length of coastline is about 3200km. And it has abundant rainfall, superior climate conditions and strong environmental carrying capacity.

2.4 High concentration of scientific and technological innovation elements

Guangdong, Hong Kong and Macao are rich in science and technology education resources, with a large number of universities, scientific research institutes, high-tech enterprises and national science projects. Its output quality of regional scientific and technological achievements has been continuously improved. Its transformation market is broad, and its innovation factors are attractive. The output value of the province's environmental protection industry of Pearl River Delta (PRD) accounting for 90%, providing strong technical support for the construction of ecological civilization in GBA.

2.5 Continuous improvement of ecological environment

In recent years, the prevention and control of pollution in GBA has been increasing, and the quality of atmospheric environment is leading in the country (Figure 1). In 2018, the average concentration of PM_{2.5} in GBA is 28μg/m³, of which 32μg/m³ is in the PRD. The urban air quality (AQI) compliance rates are 28.1 and 9.2 percentage points higher than those in the Yangtze River Delta and Jing-Jin-Ji Area respectively [3]. The quality of drinking water sources in GBA is 100% stable and up to standard. The water quality of the Pearl River Basin is better than that of the Yangtze River, the Yellow River and the Songhua River. The water quality of the heavily polluted river basins such as Maozhou River and Guangzhou-Foshan cross-border rivers have improved significantly. The overall ecological situation is excellent, and all 9 cities in the PRD have won the title of National Forest City.

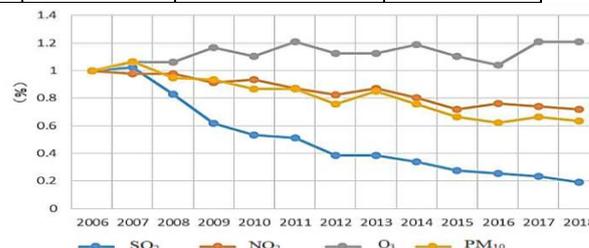


Figure 1 Trend of annual average concentration of air pollutants in GBA

3 Challenges and problems of ecological civilization construction in GBA

3.1 The top-level design of ecological civilization construction is still imperfect.

The construction of ecological civilization in GBA lacks a scientific and effective evaluation system, and it can't reflect the characteristics of GBA. This system is not in line with the international standard, its evaluation standard and statistical caliber are not unified. The mechanism of cooperation among the three regions is still not perfect, which is mostly limited to "one thing, one discussion". Most of the cooperation carriers are joint meetings in the form of consultation, and the mechanism of collaborative governance still needs to be improved. There are great differences in judicial system and law enforcement mode between Guangdong, Hong Kong and Macao. The region has not formed a stronger strike force against environmental crimes.

3.2 In terms of green development level, there is still a gap between GBA and world-class Bay district.

In 2018, the average annual concentration of PM_{2.5} in GBA is still 2-3 times of that in San Francisco, New York and Tokyo Bay area. The problem of regional ozone pollution is becoming increasingly prominent. There are lots of black and smelly water bodies in the PRD. There 159 black and odorous water have not completed treatment. According to the statistical data [1] (Figure 2), in terms of the utilization level of resources and energy, there is a large gap between Guangdong Province and the international advanced level. In the structure of primary energy consumption, the proportion of raw coal consumption in Guangdong Province is more than twice that of developed countries (20%), the energy consumption per ten thousand yuan of GDP is

1.5-2.5 times of the average level of developed countries such as the United States and Japan, and the

water consumption per ten thousand yuan of GDP is 30% higher than the average level of Japan.

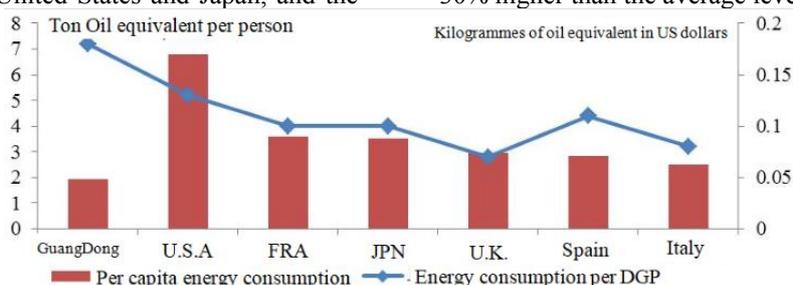


Figure 2 Comparison of energy efficiency between Guangdong Province and major developed countries

3.3 Damage to important ecological spaces and typical ecosystems

Due to the frequent illegal development activities in the nature reserve, the situation of illegal occupation and cross-border use of forest land resources still exists in the northern ecosystem in Guangdong Province, which leads to low ecological quality and ecological barrier function to be improved. According to statistics, the volume of arbor forest is only 58.3 m³, which is 54% of the world average level, and less than 1/5 of the European countries with developed forestry.

The PRD has a high development intensity (Figure 3), high resource load and huge environmental pressure. In 2018, the PRD region carried 55.6% of the province's population and 80.2% of the province's GDP with 30.5% of the province's land area. The emission intensity of main pollutants per unit area is 4-7 times that of the whole country. The emission intensity of COD and ammonia nitrogen per unit area in Shenzhen is the highest, 21 times and 30 times of the national average. The emission intensity of SO₂ and NO_x per unit area in Dongguan is the highest, 34 times and 28 times of the national average.

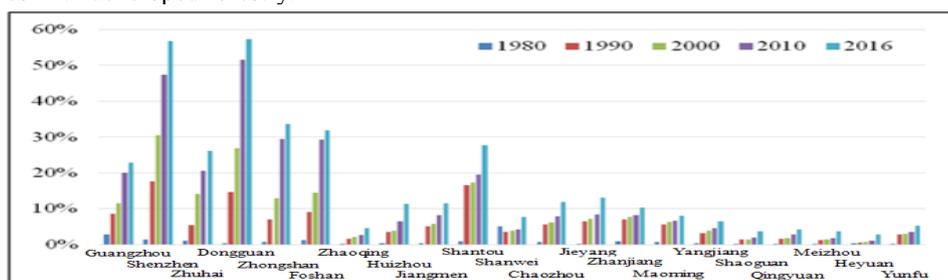


Figure 3 Changes of land development intensity in cities above local level in Guangdong Province from 1980 to 2016

The contradiction between the protection and development of the southern coastal zone is prominent, and large-scale industrial enterprises, real estate, tourism, port and wharf projects occupy a large number of natural shorelines. The natural shoreline retention rate of GBA decreased from 90% in 1973 to 34.5% in 2016, which is lower than that of the Bay Area of San Francisco (Figure 4).

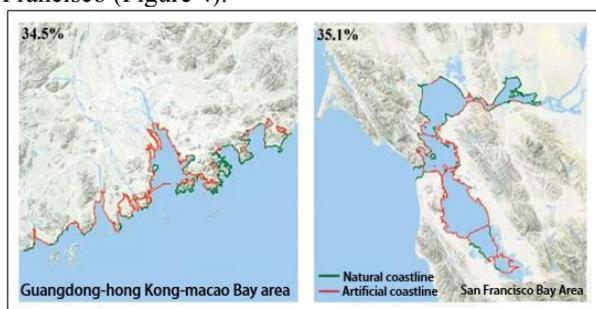


Figure 4 Proportion of natural coastline in GBA and San Francisco Bay Area in 2016

The quality of marine ecological environment in GBA is not optimistic. The density of bottom fishery

resources in the northern continental shelf of the South China Sea in Guangdong Province is less than 1/9 of that in the 1970s. Typical ecosystems in the land sea ecotone, such as mangrove, coral reef, seagrass bed, have been damaged. In the past 40 years, the total area of coastal mangrove has declined by 72.1% [4]. Large-scale land reclamation has reduced the area of the Pearl River Estuary Bay Area by more than 15%. The phenomenon of excessive discharge of municipal sewage outlets is prominent, 28.8% of the sewage outlets monitored in 2017 exceed the standard discharge [5]. The water quality of the coastal waters of the Pearl River estuary is poor in four categories, and the water eutrophication phenomenon occurs from time to time.

3.4 The industrial structure and layout of the PRD still need to be optimized.

The low-end industry in the PRD has a large stock and heavy pollution. Most parts of PRD are in the process of transformation from industrial economy to service economy (Figure 5). Industrial structural pollution is still prominent. The industrial added value of traditional industries such as textile, papermaking, clothing, food

manufacturing and leather only account for about 10% of the industrial added value, but the discharge of wastewater, COD and ammonia nitrogen account for more than 50% of the industrial discharge of Guangdong Province. The phenomenon of industrial homogeneity competition is still prominent. The

industrial spatial layout is not reasonable, and the development of village level industrial parks is all over the city. There are some large-scale heavy polluting enterprises in the urban built-up area, some of the parks are located in environmentally sensitive areas, and the potential risks of ecological environment are prominent.

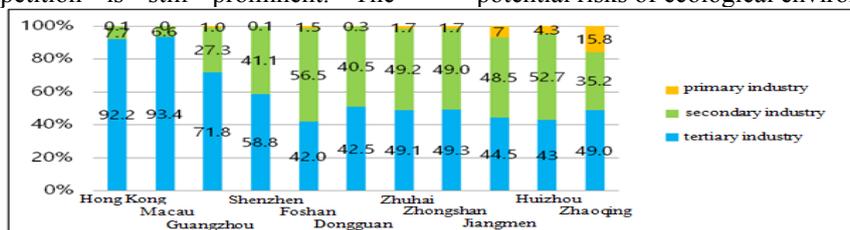


Figure 5 GDP composition of every city in GBA in 2018

3.5 The awareness of the whole people's co governance and sharing is not strong enough.

Compared with the world-class Bay area, there is still a significant gap in the ecological civilization literacy of the public in some areas of GBA. The initiative and enthusiasm to practice green lifestyle is still insufficient. The construction of ecological civilization still relies too much on the administrative means of the government, some policies and measures that are conducive to green and low-carbon are difficult to implement due to the lack of effective incentive means, and the endogenous power of the construction of ecological civilization is insufficient.

4 Suggestions on the construction of ecological civilization in GBA

We should make full use of and give full play to the advantages of natural environment and scientific and technological innovation resources in accordance with the global vision, innovation integration and win-win cooperation, fully connect with the world-class bay area, and build GBA into a demonstration area for natural ecological protection, green development, ecological environment guidance and institutional innovation.

4.1 Establish and improve the top-level design of ecological civilization construction in GBA.

Set up a scientific evaluation system of ecological civilization with the characteristics of GBA in accordance with the first-class international standards, so as to define the direction and goal for the construction of ecological civilization in GBA. The evaluation system must fully consider the current situation of regional eco-environmental protection, development objectives, international first-class eco-environmental quality requirements, differences in the three regional environmental governance concepts and systems, and highlight the natural endowment of the river network in GBA and the characteristics of industrial development with manufacturing, ect. We will speed up efforts to establish a system of joint prevention

and control of the ecological environment that is subject to legal constraints, led by the government, dominated by enterprises, participated by the public, and encouraged by the market.

4.2 Continue to increase pollution prevention and control efforts.

In line with the international advanced Bay Area's ecological environment level and environmental governance system, we should increase environmental access and governance, and continually improve the quality of regional ecological environment. We should strengthen the protection of drinking water sources such as the Dongjiang and Xijiang rivers, accelerate pollution control in key polluted river basins, promote pollution control in the Pearl River Estuary, Daya Bay and Daguang Bay areas, and strengthen the supervision and control of land-based sources entering the sea. Deepen regional joint prevention and control, and promote continuous improvement of regional air environment quality. We should accelerate the prevention and control of soil pollution in line with the national soil pollution prevention route.

4.3 Building a high-quality ecological spatial pattern.

According to the general requirements of building a new pattern of regional development of "one core, one belt and one area", strengthen the protection of the ecosystem in the northern Ecological Development Zone, and build a solid ecological security barrier around GBA. Scientific planning of urban development pattern, rational distribution of industrial land, promoting the development of industrial agglomeration, and optimizing the ecological spatial layout of the central plain area. We should implement classified and classified management of the coastline, optimize the utilization of the coastline, and build a blue coastal zone in GBA. We should strengthen the protection of the ecological environment of Daya Bay-Renping Peninsula, Pearl River Estuary, Wanshan islands and Chuanshan islands, and build a barrier for the ecological security of the Pearl River Estuary. We should promote the

protection of ecosystems such as mountains, rivers, forests, fields, lakes and grass, and islands, and increase the protection and restoration of damaged ecosystems such as beaches and wetlands

4.4 Strive to improve the level of regional green development.

We should give full play to the leading advantages of GBA in terms of location, economic level and innovation capacity, as well as implement green leadership; and promote the formation of a spatial pattern, industrial structure, production mode and life style that can save resources and protect the environment in an all-round, regional and whole process way. We should promote the development of advanced equipment manufacturing industry on the West Bank of the Pearl River and advanced electronic information industry innovation cluster on the east bank, support the R & D and production of energy conservation and environmental protection, new energy, optoelectronic equipment and other advantageous industries; accelerate the construction of modern service industry system, and realize " green industrial development and environmental protection industrialization ". We should widely advocate a green and low-carbon lifestyle, promote the full coverage of garbage classification, build a low-carbon and green transportation system, and improve the public's green and low-carbon travel environment.

4.5 Encourage the public to participate in the construction of ecological civilization through multiple channels

Fully integrate the ideas, systems and action systems of ecological environment protection in GBA, establish the connection mechanism of legal system and standards in GBA, build a multi-level environmental protection cooperation mode, and build an open environmental protection exchange and cooperation platform. Encourage the public to participate in the construction of ecological civilization through multiple channels,

create ecological culture with the characteristics of GBA, and lay a solid humanistic foundation and a good social atmosphere for the construction of ecological civilization in GBA.

5 Conclusion

As mentioned above, the GBA has objective conditions for building a pattern of high-quality ecological civilization. As long as we adhere to the path of sustainable development, build a circular economic system, continue to increase pollution prevention and control efforts, and continue to improve the quality of the ecological environment, the GBA will become a model of ecological civilization.

Reference

1. Wan Jun, Li Xing, Guan Yang et al. Strive for Collaborative Protecting, Shared Growth and Green Development, Build a Beautiful Bay Area of Guangdong-Hong Kong-Macao[J]. *Environmental Protection*, 2019(4):8 -11.
2. Statistics Bureau of Guangdong Province, Guangdong survey team of National Bureau of Statistics. National economic and social development statistics bulletin of Guangdong in 2018. Guangdong 2018.
3. Department of ecological environment of Guangdong Province. Bulletin on the environmental situation of Guangdong Province in 2018. Guangdong, 2018:2~5.
4. Guangdong Provincial People's Government, State Oceanic Administration. General planning of comprehensive protection and utilization of coastal zone in Guangdong Province
5. Department of ocean and fishery of Guangdong Province. 2017 state of Marine Environment Bulletin of Guangdong Province. Guangdong, 2017 :28~31.