



Research on the Development Path of Coastal Tourism in Coastal Provinces Against the Backdrop of "Carbon Peak and Carbon Neutrality"

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ABSTRACT

In order to cope with climate change, China proposes "carbon peak and carbon neutrality" goals. The low carbon development of coastal tourism is essential for the tourism industry to assist in achieving the "carbon peak and carbon neutrality" goals. By defining the connotation of the low carbon development of coastal tourism, this paper uses the driving-state-response model to construct the conceptual framework of index system, analyzes the low-carbon development of coastal tourism in coastal provinces, and proposes the mutual cooperation and constraints among administrative departments of tourism, coastal tourism and tourists to reduce the damage to coastal and offshore ecosystems and achieve the low carbon development path of coastal tourism to increase carbon sinks and reduce carbon emissions, thereby providing suggestions for the low carbon development of coastal tourism in China.

Keywords: "carbon peak and carbon neutrality" goals, coastal tourism low carbon development framework, path, coastal provinces, principal component analysis.

1. INTRODUCTION

Climate change is a global issue. The mutual influence between tourism and global change was recognized in 2003^[1, 2]. In the same year, the UK proposed the concept of low carbon economy^[3]. In 2009, the concept of low carbon travel was proposed^[4]. China also responds positively and assumes its responsibilities. In 2020, China commits to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060, which is conducive to improving environmental quality and industrial development, and has global significance and economic development opportunities. Low carbon development is an important way to transform industries development models and achieve the "carbon peak and carbon neutrality" goals.

In 2020, the coastal tourism achieved an added value of 1.3924 trillion yuan throughout the year, accounting for 47% of the added value of major marine industries and 34% of the added value of tourism and related industries across the country. It is a pillar industry of the marine economy as well as an important part of the

tourism industry. During the continuous development of coastal tourism, human beings exploit and enjoy coastal resources, but destroy the marine ecological environment, making coastal tourism move towards high carbon development. In order to cope with climate change, it is necessary to actively follow the global trend of green and low carbon transformation, change the development status of coastal tourism, and take the green and low carbon development path that gives priority to ecology.

The low-carbon development of coastal tourism is conducive to protecting the Marine environment, promoting industrial and energy transformation, increasing the development and investment of renewable energy such as wind power and photovoltaic, promoting high-quality economic development, and helping China commit to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060.

At present, domestic and foreign scholars mainly study the low carbon development of coastal tourism from three aspects, namely, theories on the low carbon development of coastal tourism^[7, 11], carbon emission

measurement of coastal tourism^[5, 6, 9, 10, 12, 19] and countermeasures for the development of low carbon travel^[8, 14, 15, 16]. To sum up, for the low carbon development of coastal tourism, the academic circles often conduct quantitative analysis to analyze the current status and existing problems of coastal tourism, and mostly make development recommendations in terms of countries and destinations. However, only few experts and scholars study the low carbon development path of coastal tourism from the perspective of the industrial chain covering administrative departments of tourism, coastal tourism and tourists.

Therefore, against the backdrop of the "carbon peak and carbon neutrality" goals, this paper defines the connotation of the low carbon development of coastal tourism, uses the driving-state-response model, constructs the conceptual framework of the index system, use principal component analysis to estimate the low-carbon development status of coastal tourism in coastal

provinces , and explores a development path suitable for our national conditions to provide new ideas for the low carbon development of coastal tourism and scientific basis for government decision-making.

2. MATERIALS AND METHODS

2.1. The Connotation of Low Carbon Development of Coastal Tourism

With the vigorous promotion of ecological civilization construction, the low carbon concept has been deeply rooted among the people. As an important link to realize low-carbon tourism, the low-carbon development of coastal tourism has drawn more and more attention. This section defines the connotation of low carbon development of coastal tourism through the extension of the concept of low carbon travel.

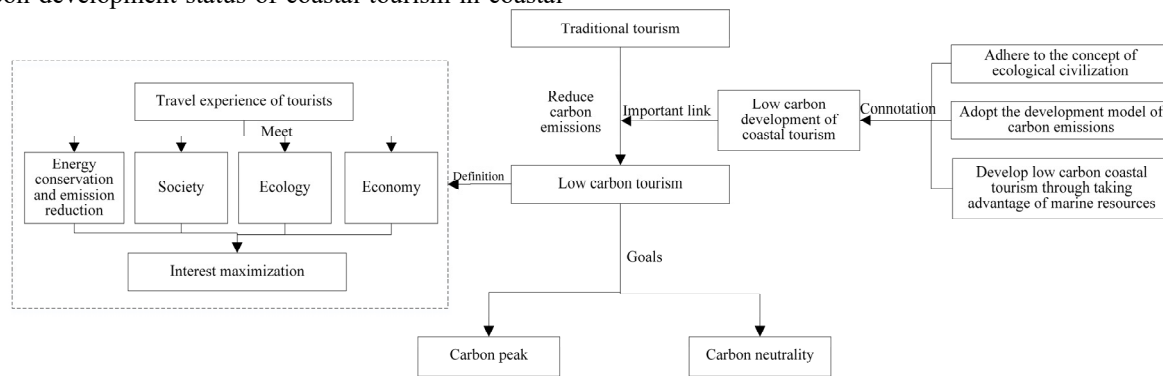


Figure 1 The connotation of low carbon development of coastal tourism

2.1.1. Definition of Low Carbon Travel

Guided by the theory of sustainable development and the concept of green and low carbon development, low carbon travel is the development model that adopts low carbon technologies and reasonably allocates tourism resources to satisfy tourists' travel experience, achieve energy conservation and emission reduction and maximize social, ecological and economic benefits^[18]. In short, low carbon travel is a tourism form that reduces carbon emissions on the premise of meeting social, ecological, economic and public interests.

2.1.2. The Connotation of Low Carbon Development of Coastal Tourism

As an important link in the realization of low carbon travel, the low carbon development of coastal tourism practices the development process of transforming from high carbon emissions to low carbon emissions. Under the guidance of ecological civilization, the low carbon development of coastal tourism is the process that takes advantage of marine resources, achieves energy conservation and emission reduction and maximizes

social, ecological, economic and public interests to reduce energy consumption, environmental pollution and greenhouse gas emissions. From the perspectives of development theory, method and model, the connotation of low carbon development of coastal tourism is to adhere to the ecological civilization concept, adopt the development model that reduces carbon emissions, and take advantage of marine resources to develop low carbon coastal tourism.

2.1.2.1 Adhering to the Concept of Ecological Civilization

In the thought of ecological civilization, the concepts of green development, circular development and low carbon development intersect and overlap with each other, forming an organic and unified whole. In order to integrate the construction of ecological civilization into the development process of coastal tourism, it is necessary to change the development concept, form a spatial pattern that promotes efficient and intensive use of resources and protects ecological environment, which is beneficial to restoring ecological environment of bays, increasing carbon sinks, reducing carbon emissions and mitigating climate change.

2.1.2.2 Adopting the Development Model that Reduces Carbon Emissions

In order to achieve the low carbon development of coastal tourism, the government, research institutes and enterprises should play the main role of innovation to integrate low carbon technologies into production and operating activities. Based on the development needs, enterprises should introduce management thinking of low carbon development, and research institutes should make efforts to research and develop technologies to achieve the efficient use of traditional energy and clean energy, reduce energy consumption and CO₂ emissions, and promote the sustainable development of enterprises.

2.1.2.3 Taking Advantage of Marine Resources to Develop Low Carbon Coastal Tourism

Based on "natural carbon sinks"^[13], coastal tourism should give play to the advantage of marine energy utilization, increase carbon sinks, encourage the use of clean energy, and exploit models with low energy consumption, low pollution, and low emissions to develop the low carbon coastal tourism and enable people to feel the nature and enjoy a tour with sunshine, sands and beaches.

2.2. Coastal tourism low-carbon development framework

The development of coastal tourism creates economic value for tourist destinations. Meanwhile, it damages the coastal ecosystem to varying degrees, affects coastal environment and reduces tourist visits. Under the guidance of ecological civilization, the development model of coastal tourism has begun to pay attention to the protection of the ecological environment of the bays, and turned to the development direction of low energy consumption, low emissions, and low pollution.

According to the driving-state-response mode, the framework of coastal tourism low-carbon development is constructed, and the relationship and influence between economy and environment are discussed. Coastal tourism low-carbon development framework is a coastal tourism by internal and external pressure to promote industrial transformation (driving), change the current situation of the development of coastal tourism resources, energy, pollution and so on (state), the country, the coastal tourism and tourists would like to change the status quo and take measures (response), for the future development path, Coastal tourism in order to achieve low carbon development goals, as shown in figure 2.

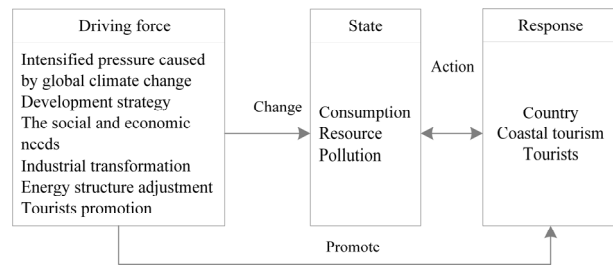


Figure 2 The Driving-State-Response Model2.2.1. Establishment a Low Carbon Development Index System for Coastal Tourism

On the basis of the low carbon development framework of coastal tourism to formulate a scientific, reasonable and systematic evaluation index system. The target layer is low-carbon coastal tourism development, the criterion layer is driving, state and response. According to data accessibility, the paper draws lessons from domestic and foreign low-carbon tourism evaluation system, In the end, 11 indicators including the third industry gross domestic product, area of coastal and coastal wetlands, per capita disposable income, length of continental coastline, energy consumption, inbound overnight tourists, per capita expenditure of overnight tourists, hotel employees, hotel operating profit, entertainment place employees and entertainment place operating profit were selected.

2.2.1. Building a low-carbon development model for coastal tourism

The paper use principal component analysis to construct the model. The standardization of the original data is to eliminate the dimensional differences between indicators to make the data comparable. By analyzing the relationship among indicators, the final goal is determined, the correlation coefficient and characteristic value are analyzed. The contribution rate in Table 1 can be used to determine the number of principal components. The first three items accumulate to 82.7%, which exceeds 80%. Therefore, the first three items are taken as the principal component factors to calculate the loading status of each factor on the original index, as shown in Table 2.

Table 1. Total variance of interpretation

ingredients	Initial eigenvalue		
	total	% of the variance	accumulate %
1	5.212	47.382	47.382
2	2.199	19.991	67.373
3	1.686	15.326	82.699
4	0.879	7.991	90.689
5	0.553	5.024	95.713
6	0.296	2.687	98.401

7	0.104	0.947	99.347
8	0.045	0.406	99.754
9	0.027	0.244	99.998
10	0.000	0.002	100.000
11	0.000	0.000	100.000

Table 2. Component matrix

	Ingredients		
	1	2	3
Zscore(the third industry gross domestic product)	0.931	0.231	-0.172
Zscore(area of coastal and coastal wetlands)	0.625	0.102	-0.511
Zscore(per capita disposable income,)	0.298	0.869	0.246
Zscore(length of continental coastline)	0.641	-0.515	-0.030
Zscore(energy consumption)	0.640	-0.043	-0.657
Zscore(inbound overnight tourists,)	0.783	-0.180	0.395
Zscore(per capita expenditure of overnight tourists)	0.126	0.839	-0.363
Zscore(hotel employees)	0.945	0.086	-0.089
Zscore(hotel operating profit)	0.362	0.496	0.691
Zscore(entertainment place employees)	0.892	-0.214	0.224
Zscore(entertainment place operating profit)	0.772	-0.277	0.280

Therefore, the response low-carbon development function of coastal tourism can be obtained.

$$F=5.212 \times (0.179X_1+0.12X_2+0.123X_4+0.123X_5+0.15X_6+0.181X_8+0.171X_{10}+0.148X_{11})+2.199 \times (0.395X_3+0.382X_7)+1.686 \times 0.41 \times X_9 \quad (1)$$

F is the comprehensive index of low-carbon development of coastal tourism, X_1 is the area of coastal and coastal wetlands, X_2 is area of coastal and coastal wetlands, X_3 is per capita disposable income, X_4 is length of continental coastline, X_5 is energy consumption, X_6 is inbound overnight tourists, X_7 is per capita expenditure of overnight tourists, X_8 is hotel employees, X_9 is hotel operating profit, X_{10} is entertainment place employees, X_{11} is entertainment place operating profit.

3. DISCUSSION AND SUGGESTIONS

Under the conceptual framework of low carbon development of coastal tourism, taking coastal province

as an example, this paper analyzes the development status of coastal tourism in 2019 by inductive analysis, comparative analysis and principal component analysis to provide suggestions for the future development of coastal tourism, which is conducive to the realization of the "double carbon" goal. The data in this paper come from China Energy Statistical Yearbook and China Cultural Relics and Tourism statistical Yearbook.

3.1 Development of Coastal Low Carbon Tourism in Coastal Provinces

Measure the regional development of coastal tourism in coastal provinces, and obtain the ranking of low-carbon development according to the comprehensive index of low-carbon development of coastal tourism in Coastal provinces, as shown in Figure 3. the coastal province of coastal tourism low carbon development degree is different, the darker the color of the region in the picture. In 2019, Guangdong province ranked first, followed by Jiangsu, Shandong, Shanghai, Zhejiang, Fujian, Hebei, Liaoning, Tianjin, Guangxi and Hainan.

Ranking of Coastal Low carbon Tourism Development in Coastal Provinces

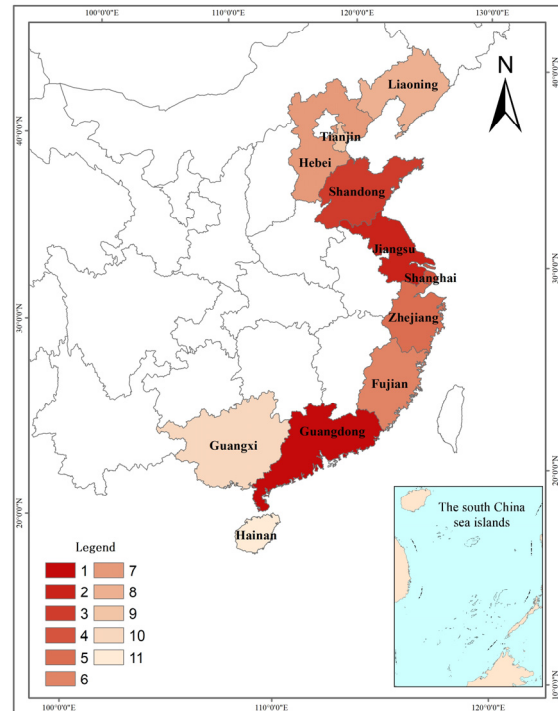


Figure 3 Ranking of Low Carbon Tourism Development in Coastal Provinces

3.2 The Low Carbon Development Path of Coastal Tourism

The low-carbon development of coastal tourism varies in various coastal provinces, and coastal tourism

should be developed according to local conditions. Administrative departments of tourism, coastal tourism business and tourists should jointly explore the path suitable for the low carbon development of coastal tourism in China from the perspective of the industrial chain of coastal tourism as shown in Figure 4.

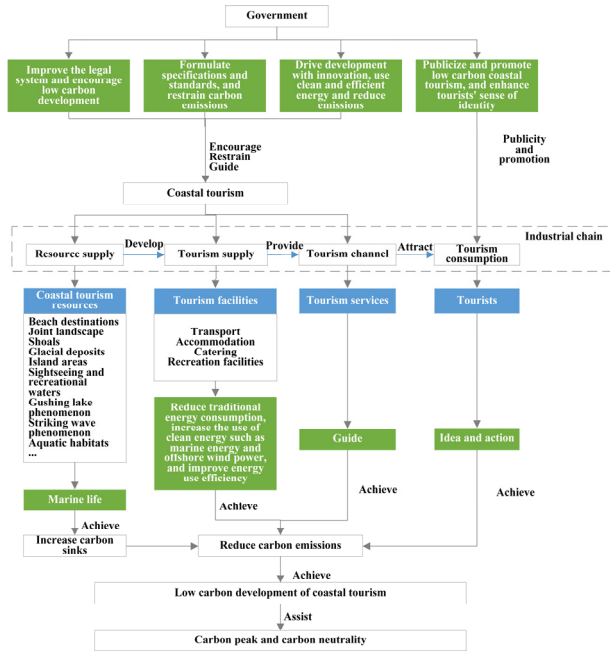


Figure 4 Low carbon development path of coastal tourism

Relying on the rich tourism resources, coastal tourism should develop tourism facilities, provide tourism services, attract tourists, and form a relatively complete industrial chain of resource supply, tourism supply, tourism channels and tourism consumption, and associate with many important industries. All industries in the industrial chain should jointly transform their development concepts and apply low carbon technologies. With the support of administrative departments of tourism and tourists, they should protect the marine environment, increase carbon sinks, reduce the discharge of pollutants, achieve the synergy of energy conservation, carbon reduction and pollution reduction, continuously improve the quality of ecological environment, and promote the achievement of the "carbon peak and carbon neutrality" goals.

3.2.1 Administrative Departments of Tourism

The administrative departments of tourism should improve the legal system, formulate specifications and standards, make innovations, publicize and promote low carbon coastal tourism, and encourage, restrain and guide coastal tourism and tourists.

3.2.2 Coastal Tourism

Starting from the three elements of tourism in the upstream and midstream industrial chain of coastal tourism, this section discusses the low carbon development path of coastal tourism and the ways to increase carbon sinks and reduce carbon emissions by taking advantages of marine resources and marine renewable energy.

3.2.2.1 Coastal Tourism Resources

With dual characteristics of marine and terrestrial resources, coastal tourism resources correspond to the supply of upstream resources in the industrial chain. At the same time, since marine natural resources have the advantages of increasing carbon sinks, the carbon burial rate of coastal ecosystems is 15 times higher than that of the terrestrial ecosystems^[16]. Therefore, it is conducive to improving the carbon sink ability by promoting the efficient and intensive use of resources, protecting and restoring marine ecosystems, building the characteristic marine tourism environment, and protecting rare habitats.

3.2.2.2 Tourism Facilities

Tourism facilities correspond to the upstream tourism supply in the industrial chain, including transportation, accommodation, catering and amusement equipment. Through reducing the consumption of traditional energy, increasing the use of marine energy, offshore energy, other clean energy and improving energy rate and efficiency, introducing green and low carbon facilities and equipment, and recommendable to replace disposable products with biodegradable and recyclable products, carbon emissions can be reduced and low carbon development can be promoted.

3.2.2.3 Tourism Services

Tourism services correspond to the midstream tourism resources and channels in the industrial chain. Tourism services refer to all activities and feelings of material and spiritual needs provided by tourism service personnel for tourists, covering all links in the tourism process, with energy conservation and emission reduction ways. It is necessary to strengthen tourism management, promote the low carbon concept, and exert a subtle influence on tourists.

3.2.3 Tourists

Tourists correspond to the downstream tourism consumption in the industrial chain, and they serve as the recipients and providers of feedback for the upstream and midstream information in the industrial chain. Tourists' acceptance of low carbon travel is good for the reasonable resource allocation in the upstream and midstream of the industrial chain, change their

consumption concepts and behaviors, give positive feedback to low carbon development, and promote low carbon development.

4. CONCLUSION

The low carbon development of coastal tourism is an effective way to achieve the "carbon peak and carbon neutrality" goals. With the connotation of the low carbon development of coastal tourism as the basis, this paper has built a framework for low carbon development of coastal tourism, analyzed the low-carbon development of coastal tourism in coastal provinces with principal component analysis, and probed the path for low carbon development. It will contribute to the sustainable development of coastal zones in coastal provinces and provide scientific basis for the low-carbon transformation of coastal tourism industry by the government. The conclusions are as follows:

Firstly, the connotation of the low carbon development of coastal tourism is to take advantage of marine resources, reduce carbon emissions, and develop coastal tourism under the guidance of the idea of ecological civilization.

Secondly, the conceptual framework for low carbon development of coastal tourism is driven by external power and internal demand, national policies, responded positively coastal tourism and tourists, and changed the development mode of coastal tourism to low carbon development.

Thirdly, taking coastal provinces as an example, the principal component analysis method is adopted to explore the low carbon development status of coastal tourism. Guangdong ranks first and Hainan ranks last.

Fourth, According to the measure of low-carbon development of coastal tourism in coastal province, the transformation plan to low-carbon development mode is put forward, coastal province rely on the joint transformation of development concepts and the application of low carbon technologies by all sectors in the industrial chain, the low carbon development of coastal tourism should integrate the low carbon development concept into various links. The administrative departments of tourism should improve the legal system, formulate specifications and standards, make innovations, publicize and promote low carbon coastal tourism, and encourage, restrain and guide coastal tourism and tourists. Coastal tourism should respond actively, and increase carbon sinks and reduce carbon emissions relying on the advantages of marine resources and marine renewable energy. Tourists should support low carbon development, change their consumption concepts and behaviors, give positive feedback to low carbon development, and promote low carbon development.

AUTHORS' CONTRIBUTIONS

Kang Wanchao contributed to design the study, perform the research, analyse data, and write the paper. Teng Xin contributed to improve central idea and revised the manuscript. Tang Xiya contributed to make suggestions for ideas and help to check the paper, the remaining authors contributed to make suggestions for ideas.

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