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Application of green design concept to control pollution in coastal landscape ecotourism planning

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ABSTRACT

In this paper, the application of green design concept in coastal landscape ecotourism planning is proposed. From the perspective of green design concept, keep the tourism demand and tourism supply in coastal landscape ecotourism areas in an ideal state, and determine the transport carrying tools of tourists and their occupied facilities or space modulus in a specific time through the combination of quantitative and qualitative methods, so as to obtain the characteristic data of tourism destination carrying capacity. Build the judgment model of the elements of the environmental carrying capacity of coastal landscape ecotourism, judge and analyze the elements of the environmental carrying capacity of coastal landscape ecotourism, and plan the determined influencing elements of the environmental carrying capacity of coastal landscape ecotourism. The results show that the weight of the core elements of this method is always high, and the planned location is more consistent with the expected location.

Keywords: Green design concept perspective; Coastal landscape ecotourism; Environmental carrying capacity; Impact factors planning; Spatial scale

1. Introduction

Coastal landscape ecotourism is an important link in the study of coastal landscape ecotourism. The background of the study is: at present, in many resource-rich areas, tourism has developed into a dominant or leading industry [1]. However, tourism environment is fragile and complex, which is easy to be destroyed and disturbed by man-made and natural factors [2]. With the industrialization and large-scale development of this industry, many areas have begun to build resorts and other tourism enterprises to speed up its expansion. However, this phenomenon has also caused problems such as weak load or overload operation of coastal ecotourism scenic spots, and serious excessive pollutant emissions. The rise of green design concept provides a new idea for the development of coastal landscape ecotourism, which can improve the regional environmental carrying capacity [3,4]. However, the influence of green design concept on factor planning can deeply study the development space of coastal landscape ecotourism and promote the development of ecotourism.

At present, great progress has been made in the research of ecotourism. Cisneros-Montemayor et al. [5] puts forward the contribution of Mexican shark ecotourism to the blue economy, with particular attention to whale sharks, white sharks, hammerhead sharks and other pelagic species associated with coral reefs, as some of Mexico's most important marine ecotourism sites. This has generated important jobs and millions of dollars in income, but the true implementation of ecotourism requires education and conservation as part of activities and for the benefit of local communities, thus making the industry socially, economically and ecologically sustainable. In Mexico, this includes addressing potential negative impacts such as overcrowding of vessels, inadequate supply, uneven distribution of benefits and costs of ecotourism and protection, and a broader lack of governance capacity to ensure environmental sustainability and social equity in coastal development. Ecotourism provides key incentives and opportunities to improve ocean management in the context of a blue economy that is centred on sustainability and local interests. Does ecotourism contribute to ecosystems [6,7]. Based on the data of ecotourism demonstration villages in western China, this paper examines whether and how local residents' participation in ecotourism affects their ecotourism by PLS-SEM method. The results show that different forms of participation in ecotourism affect ecological behavior in different ways. Decision-making participation has the strongest positive impact on ecological perception, but it fails to translate into actual ecological behavior. The influence of capital participation on ecological behavior is positive, direct and multidimensional. Enterprise participation directly reduces the intensity of resource use, but this effect is offset by the increase of economic cognition and the reverse effect caused by it [8]. Although the above scholars have studied this, when planning the influencing factors of the environmental carrying capacity of coastal landscape ecotourism, due to the different management levels of each scenic spot, it is difficult to obtain the data of the carrying capacity of characteristic tourism destinations, and the weight of the core elements is low. In order to solve the above problems, this paper puts forward the application of green design concept in coastal landscape ecotourism planning, and draws effective conclusions.

2. Green design concept perspective coastal landscape ecotourism influencing factors planning method

2.1. Obtain travel destination carrying capacity characteristics data

From the perspective of green design concept, keep the tourism demand and tourism supply in the coastal landscape ecotourism area in a relatively ideal state [9], and determine the transport carrying tools of tourists and their occupied facilities or space modulus in a specific time through the combination of quantitative and qualitative methods, so as to obtain the characteristic data of tourism destination carrying capacity, including tourism resource carrying capacity data, tourism psychological carrying capacity data, tourism ecological carrying capacity data and tourism economic carrying capacity data [10]. The specific contents of data acquisition are shown in Table 1.

In the data of tourism ecological carrying capacity, the importance of meteorological condition data is self-evident. Meteorology is the general term of atmospheric physical phenomena and physical processes that often appear in the earth's peripheral atmosphere. It is composed of temperature, humidity, wind, cloud, thunder, electricity, rain, snow and other elements. Both weather and climate are the synthesis of meteorological elements. Weather refers to the synthesis of meteorological elements in a short time and a small range, and climate refers to the synthesis of meteorological elements in a long time and a large range. Meteorological climate has a profound influence and restriction on the natural environment and human life. Meteorological climate factors are the biggest background conditions for human tourism activities. They reflect atmospheric phenomena and laws in their own different forms, and can form rich and colorful landscapes, wonderful colors and sounds of nature. Therefore, they may become tourism resources to attract tourists with their unique non physical landscape image, especially the climate landscape, which is of the most universal significance. It can not only restrict the law of weather activities, create a variety of landscape images, and form different phenological landscapes, but also an important factor and condition for tourists to travel, which makes the local meteorological and climatic data extremely important.

For the data of tourism resource carrying capacity, the calculation equation:

$$F_C = \frac{G}{G_1} \times \frac{H}{H_1} \tag{1}$$

where F_C represents the actual limit daily capacity of resources; G represents the opening hours of the tourist destination every day; G_1 represents the actual tour time of each tourist; H represents resource area; BB H_1 represents the minimum standard of space for each tourist. For the data of tourism psychological carrying capacity [11,12], the calculation equation:

$$F_R = \frac{G}{G_1} \times J \times F_C \tag{2}$$

Table 1
Specific contents of data acquisition

Serial number	Data type	Specific content of data
1	Tourism resources carrying capacity	Actual limit daily capacity of resources
2	Tourism psychological carrying capacity	When tourists can get greater satisfaction, the maximum tourism activity capacity that the region can carry
3	Tourism ecological carrying capacity	The ability to treat tourism pollutants through artificial methods and ecological environment absorption and purification methods, as well as the ability of local unique meteorological climate tourism to carry
4	Tourism economic carrying capacity	It refers to the reception capacity of basic tourism facilities, related facilities and industrial supporting facilities, represented by the actual supply capacity of entertainment and accommodation facilities

where F_R represents daily psychological capacity; J represents the reasonable capacity per unit area of space.

For the data of tourism ecological carrying capacity, the calculation equation:

$$M_f = \frac{L\sum_{i-1}^{n} S_i T_i + \sum_{i-1}^{n} Q_i}{\sum_{i-1}^{n} P_i} \tag{3}$$

where M_f represents daily ecological capacity; n represents the number of specific types of pollutants; S_i represents the specific amount of i pollutants absorbed and purified by the ecological environment; T_i represents the specific purification time of i pollutants; Q_i represents the amount of i pollutants treated manually every day; P_i represents the actual amount of pollutant (Type i) produced by each tourist per day, L indicates the regional scope of meteorological tourism resources.

For the data of tourism economic carrying capacity, the calculation equation:

$$\begin{cases} T_e = \dfrac{\sum_{i-1}^{m} D_l}{\sum_{i-1}^{m} E_l} \\ T_h = \sum_{i-1}^{n'} B_j \end{cases} \tag{4}$$

where T_e represents the daily carrying capacity of food supply tourism; m represents the specific types of food consumed by tourists; D_l represents the daily supply of l kinds of food; E_l represents the l food demand per person per day [13,14]; T_h represents the daily carrying capacity of accommodation beds and tourism; B_j represents the specific number of beds in j tourist areas; n' represents the actual type of accommodation facilities.

2.2. Judgment and analysis of environmental carrying capacity elements of coastal zone landscape ecotourism

Based on the characteristic data of tourist destination carrying capacity, the judgment model of environmental carrying capacity elements of coastal landscape eco-tourism is constructed to judge and analyze the environmental carrying capacity elements of coastal landscape eco-tourism. Three indicators are used to judge and analyze the elements of environmental carrying capacity of coastal landscape ecotourism in the constructed judgment model of environmental carrying capacity of coastal landscape ecotourism, as shown in Table 2.

The judgment model of influencing factors of coastal zone landscape ecotourism environmental carrying capacity:

$$\begin{cases} F_{ij} = R_j \times W_i \\ I_{ij} = 1 - X_i \\ y_{ij} = \dfrac{F_{ij} \times I_{ij}}{\sum_{i=1}^{n} \left(F_{ij} \times I_{ij}\right)} \times 100\% \\ Y_{ij} = \sum y_{ij} \end{cases} \tag{5}$$

where R_j represents the index classification weight corresponding to the i index; W_i represents the corresponding weight of the i index; X_i represents the corresponding standardized value of single index.

Using the constructed coastal zone landscape ecotourism environmental carrying capacity element judgment model, the carrying capacity elements are judged and analyzed to determine the influencing elements.

2.3. Planning of influencing factors of environmental carrying capacity of coastal landscape ecotourism

Through the judgment and analysis of the elements of the environmental carrying capacity of coastal landscape ecotourism, the planning determines the influencing elements of the environmental carrying capacity of coastal landscape ecotourism. In the planning process, first of all, collect the data related to the factors affecting the environmental carrying capacity of coastal zone landscape ecotourism, including DEM data, image remote sensing data, survey and monitoring natural resources data, statistical socio-economic data, website monitoring data, electronic map data, tourism area vector map data, land use data and meteorological data [15]. The specific sources are shown in Table 3.

Some types of data are processed. Firstly, DEM data is processed, and the obtained DEM data is cropped, projected, transformed and spliced through ArcGIS 10.2. Then, the terrain elevation classification map of the cut data is generated according to several categories, including elevation

Table 2
Model indicators

Index serial number	Indicator name	Indicator symbol	Index meaning
1	Factor contribution	F_{ij}	Indicates the specific impact degree of single indicator in the overall objective
2	Index deviation	I_{ij}	Indicates the difference between the actual evaluation value of a single indicator and 100%
3	Obstacle degree	(Y_{ij}, y_{ij})	It respectively represents the degree to which the single index and classified index affect the environmental carrying capacity of coastal zone landscape ecotourism in the i year

Table 3
Relevant data of influencing factors of landscape ecotourism environmental carrying capacity in coastal zone

Serial number	Data type	Data sources
1	DEM data	It comes from the elevation digital data products provided by the cloud data geospatial platform of the Network Information Computer Center of the Chinese Academy of Sciences, which can achieve a spatial resolution of 30 m
2	Image remote sensing data	The oli/TM 5/8 Landsat digital satellite product is adopted, with a spatial resolution of 30 m and a total of 4 scenes. The product is also provided by the cloud data geospatial platform of the Network Information Computer Center of the Chinese Academy of Sciences
3	Survey monitored natural resource data	Obtain land use data from the Department of Land and Resources Obtain water resources data from water resources hydrology bureau, water resources yearbook and bulletin Obtain sea area type data at the Institute of Oceanography Obtain the eco-environmental status data in the Environmental Status Bulletin Obtain sea water quality data in the Marine Environment Bulletin
4	Statistical socio-economic data	Data such as the participation rate of NCMS, the actual proportion of education expenditure, residents' disposable income (per capita), the proportion of actual output value of various industries, per capita GDP and population proportion are obtained from the financial reports of counties, statistical bulletins of social development and national economy at all levels, municipal yearbooks and various statistical yearbooks
5	Website monitoring data	PM2.5 concentration data from various weather monitoring platforms
6	Electronic map data	Electronic functional planning drawing from each region
7	Vector map data of tourist area	From the administrative vector map of each region
8	Land use data	It comes from the remote sensing interpretation land cover type data product provided by the scientific data resources and environment research center of the Chinese Academy of Sciences
9	Meteorological data	From the website of Local Meteorological Bureau

less than 500 m, 500 m to 1 km and more than 1 km, and the elevation map is transformed into vector map. The terrain slope classification map of the cut data is generated according to other categories, including terrain slope less than 3°, 3°–8°, 8°–15°, 15°–25° and more than 25°, and the slope map is transformed into vector map.

Land use data processing: crop the land use data and get the land use type distribution map of the region based on DEM data.

The processing steps include cutting, splicing, atmospheric correction and radiometric calibration.

Process the electronic map data, implement image registration and define projection on the electronic map data through ArcGIS 10.2 software, draw it as a vector map, and fully plan the information in the map.

Finally, the statistical socio-economic data need to be processed. The processing steps include offset processing and standard extremum processing, and finally obtain dimensionless data.

The data planning software used is KXEN, and the specific information of the software is shown in Table 4.

The specific process is as follows: the processed relevant data are divided into four categories, including spatial bearing capacity influencing factor category, living environment bearing capacity influencing factor category, service facility bearing capacity influencing factor category and psychological comprehensive bearing capacity influencing factor category. According to these four categories, the influencing factors are planned in the above data. Among them, the categories of influencing factors of space carrying capacity need to be planned using the semi-structured calculation model and related analysis algorithm in the software, and the influencing factors include meteorological conditions, etc; The categories of factors affecting the living environment carrying capacity need to be planned by using the structured calculation model, prediction algorithm and cluster analysis algorithm in the software; The categories of influencing factors of service facility carrying capacity need to be planned by using semi-structured calculation model, cluster analysis algorithm and association analysis algorithm in the software; The categories of influencing factors of psychological comprehensive carrying capacity need to be planned by using the structured calculation model and correlation analysis algorithm in the software. The influencing factors of coastal zone landscape ecotourism environmental carrying capacity included in the category of influencing factors of spatial carrying capacity after planning are as follows: number of tourists and scope of scenic spots. The influencing factors of coastal landscape ecotourism environmental carrying capacity included in the category of influencing factors of living environment carrying capacity are as follows: solid waste, atmospheric environment, water environment,

Table 4
Data planning software information

Serial number	Project	Specific information
1	Name	KXEN
2	Renewal algebra	Fourth generation
3	Features	Combined application
4	Planning algorithm	A variety of algorithms, including prediction algorithm, cluster analysis algorithm, association analysis algorithm, etc.
5	Integrate	Mobile system, prediction model, data management
6	Distributed computing model	Parallel processing of data related to computing devices and mobile data
7	Data model	Semi structured computing model, unstructured computing model and structured computing model

social noise, building noise, industrial noise, traffic noise and other environmental noise. The influencing factors of the environmental carrying capacity of coastal landscape ecotourism included in the category of service facility carrying capacity are as follows: reception capacity factors such as the distribution degree of reception facilities, the perfection degree of equipment, type, scale and quantity, internal transportation, parking lot configuration, accessibility and other transportation capacity factors, as well as upgrading facilities, service facilities Infrastructure and other scenic spot service capacity elements. The environmental carrying capacity of coastal landscape ecotourism is included into the category of influencing factors of psychological comprehensive carrying capacity. The influencing factors are: the actual capacity of residents of tourism destinations to accept the number of tourists in terms of psychological perception and the maximum degree of congestion that tourists can tolerate.

3. Application of green design concept in the planning of environmental carrying capacity of coastal landscape ecotourism

3.1. Establish the planning model of tourism environmental carrying capacity

With the development of regional tourism resources, it is particularly important to protect its meteorological and other environmental resources. The environmental carrying capacity of coastal landscape ecotourism refers to the highest value of tourism development intensity that a tourism destination can bear on the basis of maintaining a high-performance ecosystem. Because the carrying capacity of scenic spots is a very complex conceptual system, its influencing factors are numerous and extensive. In addition, the situation of each scenic spot is different, and the indicators involved are also different. Therefore, it is difficult to give a generally applicable evaluation index system of the carrying capacity of scenic spots. At present, there are many studies on the evaluation index system of coastal landscape ecotourism environmental carrying capacity. However, there are also some misunderstandings or problems, such as overemphasizing quantitative evaluation, ignoring the qualitative selection of the index system, or the imperfect index system, or ignoring the regional and special requirements of tourism environmental carrying capacity.

3.1.1. Ecological footprint and ecological productive land

China's tourism season is strong, which is directly related to China's climate characteristics. In summer, the temperature is generally high in China, and tourists mostly travel for the purpose of summer vacation. Their tourist routes obviously flow northward, to the mountains and to the seashore; Season is on the contrary, showing a trend of southward flow. Due to the diversity of climate types in China, the characteristics of seasonal climate changes are also different. For example, in Guangdong and Guangxi provinces, because spring and autumn are rainy and warm, winter and summer are the most suitable tourism seasons; Hainan Province is extremely hot in summer, and the suitable tourist season is from October to April of the next year; Sichuan Basin is rainy in autumn, so it is more suitable to travel here in spring; however, the east coast, North China and Northwest China of the mining university are still in summer and autumn as the peak tourist seasons. Due to the influence of this weather and climate, the number of tourists in the tourist destination will change significantly, which leads to the difference of the ecological footprint of the tourism environment. Therefore, the ecological footprint can be used to calculate the tourism environmental carrying capacity. The ecological footprint method transforms the resources consumed by each person into a global unified regional area measure with ecological productivity.

The ecological production area required for consumption and waste discharge in the coastal landscape ecotourism area is used to represent the ecological load caused by human activities (i.e., the demand for ecological footprint). The area of ecological production land in this area can be used as the ecological supply performance, that is, the supply of ecological footprint. Compare the two, measure and analyze the sustainability of regional economic system.

In the calculation process, the consumption of various resources and energy is transformed into the area of basic ecological production land. In order to obtain more accurate calculation results, it is necessary to multiply a balance factor before each type of biological production area and convert it into a unified comparable biological production area. The calculation equation is as follows:

$$E_F = N_{\mathrm{ef}} + N\sum_{i=1}^{n}\left(\frac{r_i c_i}{p_i}\right) \tag{6}$$

where E_F represents the total ecological footprint, N represents the population of the tourist destination under the influence of meteorological conditions, ef represents the per capita ecological footprint, and i represents the types and inputs of consumer goods, c_i represents the per capita consumption of category i goods, p_i represents the average production capacity of category i consumer goods, and r_i represents the production balance coefficient.

From the concept of ecological footprint, it is easy to find that the regional ecological carrying capacity under certain environmental conditions depends on the relationship between all biological production areas (i.e., the supply of ecological footprint) and biological production areas (i.e., the demand of ecological footprint). Due to the consumption of local residents, the sustainable development of environmental resources can be achieved.

3.1.2. Calculation of ecological footprint supply of tourist destination

The supply of ecological footprint in a region is equal to the sum of the available land for biological production in the region. Therefore, the supply expression of environmental ecological footprint of tourism destination is:

$$E_{\mathrm{FS}} = \sum_{i=1}^{6}\left(r_i m_i\right) + \sum_{j=1}^{n}\left[\frac{\left(I_j - E_j\right)r_j}{p_j}\right] \tag{7}$$

where E_{FS} represents the ecological footprint supply of the tourism destination, and m_i as the land area for various biological production, obtains data information through the statistics of environmental resources in the tourism area. I_j is the annual import volume of the jth consumer item, the data is from the regional trade records, and E_j is the annual export volume of the j consumer item, p_j is the world average production capacity of category j consumer goods, and r_j is the land balance factor for biological production of category j consumer goods.

In order to protect the biodiversity of this area, at least 12% of the biological production land area should be reserved as the supply of regional ecological footprint. Therefore, considering the ecological balance factor, it is necessary to meet the supply of environmental ecological footprint of tourism destination, and the value of ecological balance factor is shown in Table 5.

Table 5
Classification of ecological balance factors

Land type	Equilibrium factor
World average productivity	1.00
Main cultivated land	2.28
Marginal cultivated land	1.90
Forest/petrochemical energy land	2.46
Grassland	0.56
Ocean	0.41
Inland waters	0.41
Construction land	2.27

3.1.3. Calculation of ecological footprint demand of tourism destination

The ecological footprint demand of tourist destination usually refers to the total amount of resources consumed by the whole population in the region and the total area of biological production land required to absorb all wastes generated by these populations. The biological production area required by the resident population is used as the ecological footprint of the tourism destination, and the biological production area required by tourists is used as the tourism ecological footprint. Due to the great differences in behavior and consumption characteristics between the two, the ecological footprint demand should be calculated separately. The specific methods are as follows.

- It is necessary to reasonably calculate the tourism background ecological footprint, and the calculation equation is:

$$E_{F1} = N_1\mathrm{ef}_1 + N_1 u\sum_{i=1}^{n}\left(\frac{C_i r_i}{P_i}\right) \tag{8}$$

where E_{F1} represents the background ecological footprint of tourism destination, N_1 represents the number of permanent residents of tourism destination, and ef_1 represents the average ecological footprint of permanent residents of tourism destination; i represents the type of consumer goods, P_i represents the average production capacity of i consumer goods, C_i represents the per capita consumption of i goods, and r_i represents the production balance coefficient, u represents an ecological environmental impact factor. The data required in Eq. (8) can be obtained from local social statistics.

- Tourism ecological footprint refers to the total area of all local resources consumed by tourists and the biological production land required to absorb all waste generated by these populations. In terms of calculation methods, according to the different data used, it can be divided into comprehensive method and component method.

On the basis of data classification, the comprehensive method uses the macro statistical data of tourism destinations to calculate the corresponding ecological footprint. The expression is:

$$E_{F2} = N_2\mathrm{ef}_2 + \sum_{i=1}^{n}\frac{\left(p_i + I_i - E_i\right)r_i}{P_i - E_{F1}} \tag{9}$$

where E_{F2} represents the tourism ecological footprint, ef_2 represents the per capita tourism ecological footprint, and N_2 represents the daily average number of tourists at the tourism destination, p_i represents the annual output of the i consumer item, P_i represents the world average production capacity of the i consumer item, and I_i represents the annual input of the i consumer item, E_i represents the annual output of the i consumption item, and r_i represents the production balance coefficient. Therefore, the per capita tourism ecological footprint ef_2 equation is:

$$\mathrm{ef}_2 = \frac{\sum_{i=1}^{n} \left(p_i + I_i - E_i\right) r_i / P_i - \mathrm{EF}_1}{N_2} \tag{10}$$

Obtain the data information of corresponding land types and various consumption items, and calculate the ecological footprint of tourists. The expression is:

$$\mathrm{EF}_2 = N_2 \mathrm{ef}_2 = N_2 \sum_{i=1}^{n} \frac{C_i r_i}{P_i} \tag{11}$$

The expression of per capita tourism ecological footprint:

$$\mathrm{ef}_2 = \sum_{i=1}^{n} \frac{C_i r_i}{P_i} \tag{12}$$

where E_{F2} represents the tourism ecological footprint, ef_2 represents the per capita tourism ecological footprint, and i represents the category of consumption items, N_2 represents the average daily number of tourists in the tourist destination, P_i represents the average production capacity of i consumer goods in the world, C_i represents the average consumption of i consumer goods, and r_i represents the production balance factor. Taking the relevant parameters and average ecological footprint of many consumer goods as use constants, the operability and accuracy of the calculation are improved to a certain extent.

3.2. Determination of ecological carrying capacity of tourism environment

Applying the concept of ecological footprint to realize the sustainable development of economy and environment in tourism areas needs to meet the needs of ecological footprint and ensure that resources and environment, including meteorological resources, are not overexploited, that is, $\mathrm{EF}_S \geq E_{F1} + E_{F2}$. On this basis, through the above calculation methods, the evaluation model of tourism environmental ecological carrying capacity N is obtained, namely:

$$N = E_{\mathrm{FS}} - E_{F1} \tag{13}$$

In other words, the ecological carrying capacity of the tourism environment is equal to the quotient of the effective supply of tourists and the average ecological footprint minus the local ecological footprint.

3.3. Comprehensive planning

In the environmental impact assessment, the assessment of pollutants should not only detect the substances with large quantity and high concentration, but also pay attention to the detection of other harmful substances with small quantity. Although the dose of these substances is very small, their impact on the environment cannot be ignored.

Coastal landscape ecotourism is established on the basis of avoiding damage to the environment and local residents. According to this principle, the weighting algorithm cannot be simply used for carrying capacity planning because it will ignore the impact of some maximum or minimum indicators. Therefore, in order to avoid this defect, the atmospheric impact assessment method is adopted. The advantage of this method is that it not only considers the average level in the index system, but also pays attention to some large or small indicators, and plays a decisive role in the environment, so as to enhance the objectivity of the measurement results. The evaluation of environmental carrying capacity of coastal landscape ecotourism should also follow this principle. Due to the different tourism resources of different tourist destinations, the particularity of influencing factors should be considered when measuring the environmental carrying capacity of coastal landscape ecotourism: some tourist destinations focus on the maximum value of influencing factors, while others focus on the minimum value of influencing factors. The advantage of this method is that it not only considers the maximum and minimum factors of environmental impact, but also considers the overall situation of the environment.

The calculation process of air pollutant assessment method is very convenient. The specific derivation process is as follows:

Set C_i to represent the actual quantity or quality of environmental factors in the environment of the tourism destination, S_i to represent the ideal value of environmental factors of the tourism destination, and $C_i \times S_i$ to represent the evaluation index of the evaluation factor. When measuring the environmental carrying capacity of coastal landscape ecotourism, the obtained environmental indicators need to meet the conditions of sustainable development and coastal landscape ecotourism. In index calculation, the average value of $C_i \times S_i$ and the maximum and minimum values of $C_i \times S_i$ should be fully considered.

According to the tourism environment atmospheric impact assessment equation $I'_1 = X^2 + Y^2$, because x is one of the maximum or minimum values within several $C_i \times S_i$ values, and y is the average of all $\frac{C_i}{S_i}$ values. It is necessary to fully consider adding a large weight to the average value. The weight value of x is 1, and the weight value of y is $x \times y$. The expression obtained by processing is:

$$I_1 = xy \tag{14}$$

The above calculation method has the advantages of simple calculation process and convenient practical operation, and is suitable for the application of green design concept in coastal landscape ecotourism planning.

4. Experimental test

The application of the green design concept in coastal landscape ecotourism planning is tested, and the selected coastal landscape ecotourism area is an open scenic spot, which integrates sightseeing, cultural relics protection and residents' residence, and promotes the coastal landscape ecotourism mode. The coastal landscape covers an area of about 140 ha, of which the water area can reach 34 hectares. More than 40,000 households live in the scenic area, and 25 community residents' committees have been set up, with a permanent population of more than 100,000. This scenic spot has been appraised as a national 4A class scenic spot.

The scenic spot shall provide tourists with complete sports, recreation, shopping, sightseeing, transportation, accommodation, catering facilities within the scenic spot and in the outer protective belt, and constantly perfect and rectify the facilities of public security, greening and environmental sanitation, fire prevention, drainage, road traffic, etc. The tourism management model for this area is shown in Fig. 1.

The coastal landscape is selected as the area, and the core factor weight of the coastal landscape eco-tourism planning method under the concept of green design is taken as the experimental data when the transportation value is 0.25–0.45. In order to avoid the lack of contrast caused by the single result of this experiment, two original methods were used as the contrast method in the experiment, including the methods of Cisneros-Montemayor et al. [5] and Ren et al. [7]. Three methods are used to plan the key factors of the environmental carrying capacity of coastal landscape eco-tourism in the selected areas, and the weights of the core factors are obtained as the experimental data.

The comparative experimental results of the weight values of the core elements of the factors affecting the environmental carrying capacity of coastal landscape eco-tourism by using the methods of this paper, the methods of Cisneros-Montemayor et al. [5] and Ren et al. [7] are shown in Table 6.

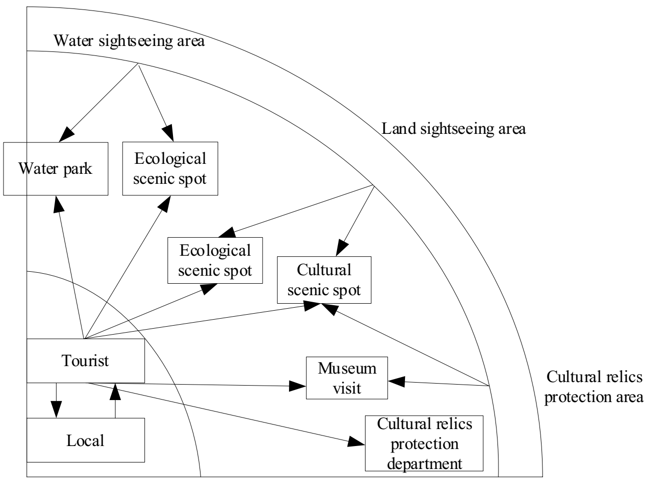

Fig. 1. Tourism management model of coastal landscape.

According to the comparative experimental results of the core factor weights of the selected areas in Table 6, the core factor weights of the proposed method are greater than those of the methods of Cisneros-Montemayor et al. [5] and Ren et al. [7]. The reason is that this method makes use of the concept of ecological footprint to achieve the sustainable development of economy and environment in tourism areas. It needs to meet the demand of ecological footprint and ensure the resources and environment not to be over-developed.

In order to verify the feasibility and effect of green design in coastal landscape ecotourism planning, the planning information was input into the experimental management space, waiting for the analysis of experimental results. Construct the coastal landscape ecotourism structure map, mark the data points of the internal tourism sites, and plan the marked data points into different operation areas according to the spatial structure scheme. Match the planning content information, manage the location information of coastal landscape eco-tourism spots while processing the structure, and avoid the leakage of location information. Integrate the data from the study and conduct experimental operations simultaneously. Construct the operational parameters as shown in Table 7.

In the course of experimental research, pay attention to monitoring the state information of the planning data at

Table 7
Experimental parameters

Project	Data
Number of space layout zones	3
Regional concentration range	40–70 km
Division type	Nature and humanities
Classification method	Dialectical way of looking at things

Table 6
Comparison experimental results of weight values of core elements

Traffic carrying value	Core element weight value		
	Paper method	Method of Cisneros-Montemayor et al. [5]	Method of Ren et al. [7]
0.26	0.134	0.103	0.098
0.27	0.128	0.106	0.097
0.28	0.138	0.087	0.108
0.29	0.137	0.106	0.093
0.30	0.144	0.108	0.097
0.31	0.122	0.085	0.080
0.32	0.213	0.109	0.082
0.33	0.127	0.108	0.096
0.34	0.125	0.103	0.102
0.35	0.135	0.101	0.106
Average value	0.1403	0.1016	0.0959

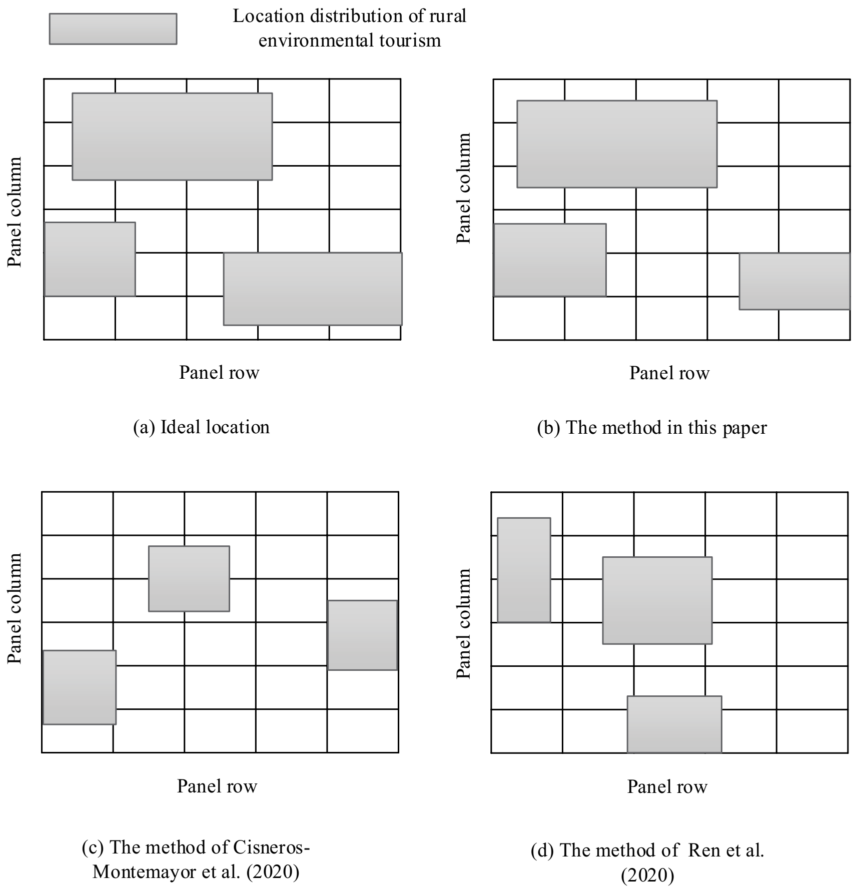

Fig. 2. Comparative map of distribution of different methods.

all times, ensure the invariance of the position, adjust the abnormal state in time, control the data of operation to be always in the operable range, and draw the comparison chart of the experimental results of the planning effect of coastal ecotourism as shown in Fig. 2.

As can be seen from Fig. 2, the distribution of the proposed method is close to the ideal geographical location, and its rationality is higher than that of other traditional planning methods. The planning rationality of the methods of Cisneros-Montemayor et al. [5] and Ren et al. [7] is not ideal, and the two methods are far from ideal geographical location distribution. The reason for the difference lies in the fact that this paper studies the planning of the coastal ecotourism site according to the real idea of the heart, and assists the regional structure plan.

5. Conclusion

The weights of the core elements of the proposed method are larger than those of other methods. The distribution of the proposed method is close to the ideal geographical location. At the same time of getting the structure data, it manages the position information of the plan, adjusts the data state continuously, controls the data in the reasonable operation state, and manages the concentrated area of the coastal zone landscape ecotourism place, grasps the key control place, and has higher planning rationality. In the future, the GIS technology can monitor the position of the coastal landscape ecological tourist information, location information for preliminary judgment, the division of densely populated areas of information, to control the population flow phenomenon of densely populated areas, isolates the rural and urban mechanism, and on the premise of internal research to realize centralized control of data information. Although the research method has improved the internal operating system of structural planning data, the management control and site selection regulation of coastal eco-tourism destinations are relatively weak.

Availability of data and materials

The data used and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

[1] P. Tian, L.D. Cao, J.L. Li, R.L. Pu, H.B. Gong, C.D. Li, Landscape characteristics and ecological risk assessment based on multi-scenario simulations: a case study of Yancheng coastal wetland, China, Sustainability, 13 (2021) 149, doi: 10.3390/su13010149.
[2] A.R. Enríquez, A.B. Bestard, Measuring the economic impact of climate-induced environmental changes on sun-and-beach tourism, Clim. Change, 160 (2020) 203–217.
[3] T.T. Cai, M.Y. Dong, H.N. Liu, S. Nojavan. Integration of hydrogen storage system and wind generation in power

systems under demand response program: a novel p-robust stochastic programming, Int. J. Hydrogen Energy, 47 (2021) 443–458.

[4] Y.X. Zhao, J.H. Zhang, W.G. Wu, F. Teng, R.M. Kelly, K. Sun, Y. Liu, D.P. Qu, Y. Liu, Y. Zhu, Assessing environmental carrying capacity of sea cage culture in the Yellow Sea, China, using a coupled diffusion model, Aquaculture, 520 (2020) 735009, doi: 10.1016/j.aquaculture.2020.735009.

[5] A.M. Cisneros-Montemayor, E.E. Becerril-García, O. Berdeja-Zavala, A. Ayala-Bocos. Shark ecotourism in Mexico: scientific research, conservation, and contribution to a blue economy, Adv. Mar. Biol., 85 (2020) 71–92.

[6] M. Bi, L. Sun, Optimization of visual cognitive effect of ecological landscape in coastal periphery, J. Coastal Res., 103 (2020) 1130–1134.

[7] L.J. Ren, J. Li, C. Li, P.Y. Dang, Can ecotourism contribute to ecosystem? Evidence from local residents' ecological behaviors, Sci. Total Environ., 757 (2020) 143814, doi: 10.1016/j.scitotenv.2020.143814.

[8] K. Zong, Marine resource exploration streamer control model based on artificial neural network, J. Coastal Res., 103 (2020) 855–859.

[9] E.E. Becerril-García, E.M. Hoyos-Padilla, O. Santana-Morales, M.A. Gutiérrez-Ortiz, A. Ayala-Bocos, F. Galván-Magaña, An estimate of the number of white sharks *Carcharodon carcharias* interacting with ecotourism in Guadalupe Island, J. Fish Biol., 97 (2020) 1861–1864.

[10] A.N. Montero-Quintana, J.A. Vázquez-Haikin, T. Merkling, P. Blanchard, M. Osorio-Beristain, Ecotourism impacts on the behaviour of whale sharks: an experimental approach, Oryx, 54 (2020) 270–275.

[11] T. Krabokoukis, S. Polyzos, Examining the relationship between tourism seasonality and tourism carrying capacity indexes for the Greek prefectures, Munich Personal RePEc Archive, 15 (2020) 12–20.

[12] Y.X. Tang, X.L. Yang, X. Shen, X.F. Hou, Z.B. Wang, Study on the eco-tourism environmental carrying capacity of Medog tourism destination, J. Plateau Agric., 3 (2019) 700–707.

[13] H.-H. Chang, C.D. Meyerhoefer, COVID-19 and the demand for online food shopping services: empirical evidence from Taiwan, Am. J. Agric. Econ., 103 (2020) 448–465.

[14] M. Hussein, C. Law, I. Fraser, An analysis of food demand in a fragile and insecure country: Somalia as a case study, Food Policy, 101 (2021) 102092, doi: 10.1016/j.foodpol.2021.102092.

[15] X.J. He, A.G. Xu, Y. Li, High-resolution remote sensing image object extraction based on color morphology, Comput. Simul., 36 (2019) 333–338.