A Study on the Impact of Tourism Resources Development on Ecological Environment

Shujuan Fan¹,Xu Ying Yang²

¹HeBei Institute of International Business and Economics, Qinhuangdao, 066311, China,
²Cangzhou Normal University, Cangzhou, 061001, China

Abstract

With the rapid development of China's economy, people’s living quality and demands for consumption are increasing gradually. As tourism can satisfy the spiritual and cultural requirements of people, it has emerged as one of the topmost recreational activities and boosts the fast development of the tourism industry. Local governments have initiated the exploitation of tourism resources in order to promote economic structural transformation. However, problems of untargeted development and overdevelopment arise from the inadequacy of local tourism resources or lack of exploitation experience, which not only fails to promote tourism, but causes severe damages to the natural ecological environment in the locality. Therefore, based on the environmental carrying capacity of tourist attractions, this paper analyzed the impact of tourism resources development on the ecological environment, and put forward the development strategy of sustainable development. Our research outcomes provide reference for the development and utilization of tourism resources.

Keywords: Tourism Resources, Ecological Environment, Environmental Carrying Capacity

1. RESEARCH OVERVIEW

1.1 Research background

At present, the Chinese government highly focuses on exploiting tourism resources. In the Opinions of the State Council on Accelerating the Development of Tourism Industry, it is clearly specified to make the tourism industry a strategic backbone industry of the national economy, so as to promote the reform and innovation of China's service industry and to optimize the structure of the economic system. To implement this idea, local governments have carried out the development activities of tourism resources. However, due to the lack of scientific and reasonable planning, the topography and landforms are destroyed, the natural environment is polluted, and the economic balance has been broken. To settle such issues, we suggest to intensify the efforts of studying on tourism resource development and to formulate feasible and pragmatic strategies to control the negative effects of tourism resources development. In this way, the tourism resources are expected to be development sustainably so as to realize the healthy development of the tourism industry.

1.2 Literature review
The development of tourism resources should be done with the attention paid to ecological environment protection, with the core purpose of healthy and sustainable development, and under the fundamentals of unified planning and overall management; Related departments can carry out ecological technical training and management, so as to ensure reasonable development of tourism resources (Yang et al., 2000). The development of tourism resources has to follow the relevant provisions of the Law of the People's Republic of China on Environmental Impact Assessment, the stakeholder theory and the sustainable development theory, so as to balance the protection of natural environment and the development of tourism resources (Gao, 2014). The factors influencing tourist experience include the protection level of natural ecological landscape dominated, supplemented by service quality, brand image, and traffic conditions. To realize healthy and sustainable development of tourism attractions, tourism resources must be developed with the core of natural environment protection and the improvement of infrastructure construction (Feng et al., 2014). The protection level of natural ecological resources directly reflects the prospects of the tourist attractions. The development of tourism resources will damage soil, the atmosphere, and water resources in several ways. Therefore, it is important to rationally develop and utilize tourism resources; on the premise of healthy development of tourism resources, related departments should ensure the protection of ecological resources by means of publicity, education and proper planning (Shi, 2013).

2. ESTABLISHING THE ENVIRONMENTAL CARRYING CAPACITY EVALUATION SYSTEM IN TOURIST ATTRACTIONS

2.1 Describing environmental carrying capacity of tourist attractions

The environmental carrying capacity indicators are related to the resource characteristics of tourist attractions, the interdependency between the ecological environment and the tourist attractions, and the local supportive power on the development of tourist attractions. The environmental carrying capacity evaluation system includes four subsystems: economic, social, ecological, and resource, as shown in Figure 1.

![Figure 1. Indicators of environmental carrying capacity of tourist attractions](image-url)
Among them, the environmental indicators are an important basis for ensuring the healthy and sustainable development of tourist attractions; ecological indicators determine the quality of tourism resources; economic indicators reflect the local supportive power on the development and construction of tourism resources; social indicators reflect the social bearing capacity of tourism resources development in the locality (Lv et al., 2011).

2.2 Environmental carrying capacity evaluation index weight

According to Figure 1, the scale of tourism resources can reflect the reserve capacity of developable tourism resources, and the grade of tourism resources directly determines the value and quality of local tourism resources (Wang and Wang, 2011). By assigning values to them according to the standards of national-level scenic spots, we can generate the following (1) formula of tourism resource combination degree:

$$\sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

(1)

Among them, n represents the total amount of local tourism resources; $x_i$ represents the proportion of tourism resources to the tourism industry resources in the area; $\bar{x}$ is the average value of the proportion of total resources to the tourism industry resources (Zhang et al., 2016). According to the formula, the lower the combination degree of tourism resources is, the more reasonable the local tourism resources are allocated. In the tourist attractions, if the tourist density is set to $x$, the total number of visitors is set to $a$, and the local population is set to $i$, we can generate this formula: $x = \frac{a}{i}$. The value is directly related to the psychological capacity of tourists for the scenic area. The lower the value is, the better the psychological ability of the tourists is.

3. The matter-value evaluation model of the environmental carrying capacity

3.1 Establishing the Matter Element Matrix of Tourism Environmental Carrying Capacity

The environmental carrying capacity of the tourist area is determined by the environmental carrying capacity, its characteristics and its characteristic value. If $N$ is the environmental carrying capacity, $c$ is the characteristics of the environmental carrying capacity, $v$ is the characteristic value of the environmental carrying capacity, and if the environmental carrying capacity in a scenic spot has the characteristics of $c_1, c_2, ..., c_n$, we can express the environmental carrying capacity with the following formula(2):

$$R = \begin{bmatrix} N, & c_1, & v_1 \\ c_2, & v_2 \\ \vdots & \vdots \\ c_n, & v_n \end{bmatrix}$$

(2)
Among them, R represents the matter element of the environmental carrying capacity. The environmental carrying capacity is composed of a number of factors. So if the number is k, then the formula (3) will become:

\[
R_k = \begin{bmatrix}
N_k, & c_{k1}, & v_{k1} \\
& c_{k2}, & v_{k2} \\
& \vdots & \vdots \\
& c_{kn}, & v_{kn}
\end{bmatrix}
\]

(3)

This formula gives the initial data of a factor influencing the environmental carrying capacity.

3.2 Determination of classic domain and joint domain

In the above formula, we can establish the matter-element matrix of the influencing factor k of the environmental carrying capacity of the tourist area:

\[
R_{kj} = \begin{bmatrix}
N_{kj} & c_{k1} & \langle a_{j1k}, b_{j1k} \rangle \\
& c_{k2} & \langle a_{j2k}, b_{j2k} \rangle \\
& \vdots & \vdots \\
& c_{kn} & \langle a_{jnk}, b_{jnk} \rangle
\end{bmatrix}
\]

(4)

In the formula (4), j = 1, 2, 3, \( N_{ki} \) is the jth evaluation grade of the kth influence factor of the environmental impact capacity of the tourist area, \( c_{ki} \) represents the corresponding evaluation index, and \( \langle a_{jki}, b_{jki} \rangle \) is the value range of j, i.e. the classical domain. The matter element matrix of the influencing factor k is:

\[
R_{kp} = \begin{bmatrix}
N_{kp} & c_{k1} & v_{p1} \\
& c_{k2} & v_{p2} \\
& \vdots & \vdots \\
& c_{kn} & v_{pn}
\end{bmatrix} = \begin{bmatrix}
N_{kp} & c_{k1} & \langle a_{kp1}, b_{kp1} \rangle \\
& c_{k2} & \langle a_{kp2}, b_{kp2} \rangle \\
& \vdots & \vdots \\
& c_{kn} & \langle a_{kpn}, b_{kpn} \rangle
\end{bmatrix}
\]

(5)

In the formula (5), \( p \) is the total grade of the kth influence factor, \( V_{pi} = \langle a_{kp1}, b_{kp1} \rangle \) is the value range of \( c_{ki} \).
3.3 Calculating the correlation function and subsystem correlation degree

First of all, the environmental carrying capacity indexes are calculated by using the following formulas (6):

\[
p(v_{ki}, v_{kji}) = \left| v_{ki} - \frac{1}{2} (a_{kji} + b_{kji}) \right| - \frac{1}{2} (b_{kji} - a_{kji})
\]

\[
P(v_{ki}, v_{kp}) = \left| v_{ki} - \frac{1}{2} (a_{kp} - b_{kp}) \right| - \frac{1}{2} (b_{kp} - a_{kp})
\]  

(6)

We arrange these formulas and acquire the correlation function of \( c_{ki} \):

\[
y_j(v_{kj}) = \frac{P(v_{ki}, v_{kji})}{P(v_{ki}, v_{kp}) - P(v_{ki}, v_{kp})}
\]  

(7)

Then, the correlation degree between the influencing factors \( k \) and \( j \) is calculated by using the formula below:

\[
y_{kj}(N_k) = \sum_{i=1}^{nk} a_{ki} k_j(v_{ki})
\]  

(8)

Among them, \( a_{ki} \) is the weight of \( c_{ki} \), meaning the weight algorithm of each sub index in the \( k \)th influence factor (Yu et al., 2016).

4. THE IMPACT OF EXPLOITATION OF TOURISM RESOURCES ON ECOLOGICAL ENVIRONMENT - A CASE STUDY OF NANYANG CITY, HENAN PROVINCE

Tourism resources can be divided into three dimensions: 1. social resources, which is the local culture forming out of human production, construction or historical and geographical factors; social resources are equal to social tourism resources, such as historical sites and ethnic customs; 2. economic resources, which occupy a small proportion of the total tourism resources and arise from economic trade; Jingdezhen porcelain is one of the economic resources (Wang and Zhu, 2012); 3. natural resources, which are produced from the nature with a unique aesthetic value, such as air, rivers, vegetation, and soil. It is more common and eco-influential to develop natural resources.

4.1 The impact of tourism resource development on local vegetation

Tourism resources development must be accompanied by the construction of tourism infrastructure including streets, car parks, pedestrian streets, tourist hotels and other service facilities. A large amount of lands must be reserved for the construction purposes, which will reduce the vegetation coverage rate. The proportions of vegetation coverage rate and service facility floor area in each forest park in Nanyang city are shown in Table 1:
Table 1 proportions of vegetation coverage rate and service facility construction in each forest park in Nanyang city

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Area (HA)</td>
<td>4,924</td>
<td>10,569.3</td>
<td>23,198</td>
<td>5,600</td>
</tr>
<tr>
<td>Vegetation Coverage Rate</td>
<td>95%</td>
<td>98%</td>
<td>97.8%</td>
<td>98.6%</td>
</tr>
<tr>
<td>Infrastructure Floor Area (hectares)</td>
<td>230</td>
<td>204</td>
<td>503</td>
<td>392</td>
</tr>
</tbody>
</table>

Nanyang City is located in the demarcation line of the north-south climate in China, with rich ecological resources and a wide range of southern and northern plants. This city is one of the major areas for natural and ecological protection. The tourism resources developed in Nanyang city are largely natural resources. Among them, Baotianman National Nature Reserve is known as the “green heart of the central regions”. The undeveloped area has a large amount of endangered animals and plants and complex forest structures, which is rarely seen for primeval forests. In exploiting tourism resources, quite some original vegetations are destroyed in favor of building parking lots, roads, streets, hotels, etc. The diversity of plants and animals is threatened, and the living environment of many endangered animals and plants is damaged. As a result, the ecological structure in the Baotiannan National Natural Reserve degrades. The infrastructure construction work is a great waste of the local vegetation resources (Wang et al., 2012). This problem is also raised in other forest parks or nature reserves. In the above example, more than 200 hectares land are reserved, seriously reducing the vegetation coverage rate.

4.2 The impact of tourism resources development on the atmospheric environment

The atmospheric environment has a direct impact on the quality of tourism resources, mainly reflected in the high content of negative ions, air humidity and moderate temperature. The temperature and humidity are calculated by the following formula:

\[
\text{THI} = t - 0.55 \times (1 - f) \times (t - 14.4)
\]  \hspace{1cm} (9)

Among them, THI is the air temperature and humidity index, t is the atmospheric temperature, and f is the local relative humidity. The concentration of negative ions is another factor of air quality. As negative ions are a product of activities such as photosynthesis, the concentration of negative ions is generally high in nature reserves. The Chinese government has formulated some standards for the concentration of negative ions, as shown in Table 2:
Table 2 standard of negative ion concentration in China

<table>
<thead>
<tr>
<th>Air class</th>
<th>air quality</th>
<th>The concentration of negative ions (/cm⁻³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Very fresh</td>
<td>&gt;2,000</td>
</tr>
<tr>
<td>B</td>
<td>fresh</td>
<td>1,500-2,000</td>
</tr>
<tr>
<td>C</td>
<td>Relatively fresh</td>
<td>1,000-1,500</td>
</tr>
<tr>
<td>D</td>
<td>Relatively unfresh</td>
<td>500-1,000</td>
</tr>
<tr>
<td>E</td>
<td>unfresh</td>
<td>≤500</td>
</tr>
</tbody>
</table>

The air pollution factors in natural tourism scenic spots are mainly reflected in the following aspects:

First, hotels and other catering enterprises may burn fuels like natural gas, coal, liquefied petroleum gas to maintain business, but many waste gases will release from fuel combustion, especially from fuel combustion for heating purposes. Waste gases from coal burning are a severe pollution to the air in scenic spots (Sun et al., 2006).

Second, car exhaust and flowing dusts from running vehicles will greatly increase the concentration of air particles and exhaust gas.

Third, scenic spots with higher environmental quality will attract more tourists. The CO₂ from respiration will increase in amount.

Despite the negative influence of the above three pollutant sources on the scenic spot air environment, a scenic spot can maintain high-level air quality thanks to its strong self-purification ability and the small total amount of the three pollutant sources.

The gravest and worst threats to air quality in scenic spots come from the harmful gases released from straw burning around the area. It is common for nearby villagers to burn the large amount of unused straws in situ lest they occupy extra space. If burned, straws will produce massive noxious gases that not only does harm to the health of villagers but also reduces the air quality in the scenic spots.

All in all, it is necessary to strengthen the control and management of atmospheric environment to enhance air quality.

4.3 Impact of tourism resources development on water resources

The Han River, Huai River, and Yellow River flow through Nanyang city. With numerous rivers, this city ranks first in Henan province in terms of total runoff, runoff per head and runoff per acre. The Danjiangkou Reservoir near Nanyang is an important hub of the South-to-North Water Diversion Project. The water quality has reached the national standard. This reservoir is famous for its water storage and reservoir capacity. In the South-to-North Water Diversion Project, the capacity and surface height of Danjiangkou Reservoir has been greatly lifted, which effectively alleviate the problem of water shortage in the northern region (Jia and Zhang, 2006). The development of tourism resources will also have a great impact on water resources, mainly on the following
First, it is common for some scenic spots to block the dam and store water to develop drifting activities, which will change the water flow state. Moreover, in lack of overall planning, there will be quite some water-dependent tourist attractions faced with water shortage and thus hardly maintaining normal operation. As a result, a large amount of tourism project funds that have been invested cannot make a profit. For some other scenic areas with large water storage, microbes reproduce in the still water, and it is difficult to clean the waste or sewage discharged into the reservoir. Over time, the water becomes turbid and severely polluted.

Second, the bad behavior of throwing litter into the water will cause grave water pollution and bring negative consequences to the development of water resources. The waste and excreta treatment capacities in rivers flowing through Nanyang city in recent years are shown in Figure 2:

![Figure 2](image)

**Figure 2. Waste and excreta treatment capacities in rivers flowing through Nanyang city**

According to the data in figures and tables, with the continuous development of water resources in Nanyang City, the number of tourists and their wastes and excreta are increasing. Due to the limited ability in garbage treatment, the waste and excreta accumulate and pollute water. It will destroy the ecological balance in the locality and, if permeating into the groundwater, threaten local people with unsafe water.

### 4.4 Impact of tourism resources development on soil resources

Tourism resources in mountains are the emphasis of tourism resource development. The mountainous tourism resources in Nanyang City, Henan Province, are mainly concentrated in Funiu Mountain or Tongbai Mountain. The soil properties in Nanyang are listed in Table 3:

**Table 3 Soil characteristics in Nanyang**

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Soil subtype</th>
<th>Altitude ( meter )</th>
</tr>
</thead>
<tbody>
<tr>
<td>yellow soil</td>
<td>brown soil、rough bone brown soil</td>
<td>800-1,300</td>
</tr>
</tbody>
</table>
In exploiting tourism resources, soil resources are influenced by the following major factors:

First, hotels, roads, entertainment and other infrastructure that are constructed in scenic spots will occupy those lands that would otherwise serve for vegetation growth. As a result, the vegetation coverage rate is reduced greatly, which impedes the ecological balance and damages the diversity of plants and animals in the scenic spot (Yang, 2005).

Second, when tourists tread on the grass-covered soil, not only is the soft soil loaded with pressure and tend to harden, but the litter layer and humus layer will be destroyed. Consequently, the soil becomes less fertile and the plants grow in adverse conditions.

Third, waste water in hotels and other entertainment places is treated unplanned and without management. In most cases, waste water is poured directly onto the ground, and a variety of harmful elements in waste water will permeate the wastewater. This will not only change the acid-base property of soil, but also remold the ecological structures of the scenic spot.

Finally, with the expansion of infrastructure construction area, the vegetation coverage rate decreases and the soil becomes loose. Rain will erode soil and further causes the waste of soil resources in natural scenic spots.

5. CONCLUSION

The environmental carrying capacity standards should be obeyed no matter in exploiting tourism resources or in the normal operation of a scenic spot. Only in this way can the scenic spots be developed sustainably. In exploiting tourism resources, the construction of infrastructure will cause damage to local vegetations and reduce the vegetation coverage rate. Meanwhile, if hotels and other entertainment enterprises operate improperly by discharging large amounts of untreated gases and waste water, they will pollute the air, soil and water resources in the locality and bring consequences to the ecological environment in the tourism attraction. Therefore, it is necessary for related departments to make overall plans and formulate rules of enterprise operation and management before exploiting tourism resources. In this way, the tourism resources will be exploited and utilized sustainably, and the tourism industry will develop in a higher level.

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