Construction of Life Cycle Assessment Model of Carbon Emission in Hui Cultural Tourism Destination——Taking Huangshan City as an Example

Xue Mi*, Lei Zhao, Nan Ding
School of Huangshan University, Huangshan, 245000, China

*Corresponding author e-mail: mixue@hsu.edu.cn

Abstract. Tourists travel behaviours generate tourism waste, consume carbon energy, and emit carbon dioxide. To estimate and evaluate the carbon emissions and ecological environment of tourism destinations can provide data support for local tourism sustainable development programs. Considering the characteristics of the integration of Huangshan City’s Hui culture and ecological environment, a life cycle assessment model of carbon emissions from Hui culture tourism destinations is established. According to the model, this paper proposes that increasing more activities in the scenic spot, managing carbon emission of enterprises related to scenic spot, and promoting the concept of green consumption.

1. Introduction
The Chinese nation is pregnant with more than 5000 years of rich ecological culture. Culture, ecology and tourism are an organic whole which connect and influence each other. Tourism is the carrier of culture and ecology is the basis of tourism. Cultural tourism is an important support for the revitalization of tourism industry, and an important measure to excavate tourism resources potentialities and create the new situation of tourism industry. Hui culture is the embodiment of material and spiritual civilization in ancient Huizhou. It refers to the typical regional culture gestated and formed in Huizhou since Song Dynasty [1]. With the deeply integration of culture and tourism, the increase of carbon emissions, the loss of resources and the destruction of ecological environment in the process of tourism have a negative impact on the sustainable development of tourism destinations. The contradiction between tourism and ecological environment is increasing in recent years. It is predicted that by 2025, the proportion of global carbon dioxide emissions will increase by 10%. Therefore, how to integrate culture, ecology and tourism into sustainable development has become a hot spot of tourism research.

With the rapid development of tourism, scholars have been exploring the sustainable development of tourism in China. In terms of carbon emission research, Xie Yuanfang. and Zhao Yuan. constructed the measurement method of China’s tourism carbon emission based on the tourism consumption glass coefficient, and made an empirical analysis of the Yangtze River Delta region [2]; Wei Yanxu. studied China’s tourism traffic emissions and regional differences based on the traffic passenger turnover data [3]; Wang Kai, et al. discussed the relationship between tourism economic growth and carbon emission, and put forward China’s economic growth and carbon emission are in a state of decoupling [4]; Han Yuanjun, et al. evaluated the efficiency of inter-provincial tourism industry and carbon
emission [5]. In the aspect of ecotourism sustainability research, Dong Wei, et al. constructed the ecotourism capacity index system from the perspective of evaluation of regional ecotourism capacity [6]; Lu Xiaoli discussed the perception and participation of ecotourism residents from the perspective of individual [7]; Wang Jin et al. established the ecotourism livelihood results and livelihood capital evaluation system based on the framework model of sustainable livelihood [8]; Lu Xiaobo analyzes the obstacles to the sustainable development of ecotourism in nature reserves [9].

2. Overview of research area
Huangshan City in Anhui Province is located at the junction of Anhui, Zhejiang and Jiangxi. It is the main birthplace of Huizhou culture, with unique ecological sceneries and tourism resources. There are three 5A level scenic spots, namely Huangshan mountain, Xidi, Hongcun villages and huizhou cultural tourism zone (Chengkan, Tangmo, Qiankou residential buildings, ancient town of Huizhou and Baojia memorial archway groups). Huangshan mountain is a world-class natural and cultural heritage, and luoxidi-Hongcun villages are world-class cultural heritage. In addition, there are 20 scenic spots with 4A level, mainly including Huashang grottoes, Donghuangshan resort, Emerald Valley, Taiping Lake, Jiulong waterfall, Xin'an River Landscape, Xiongcun village, Qiyun mountain, Saijinhua scenic spot, Nanping scenic spot, Guniujiang, Furong valley, Fengle lake, Zui hot spring, Xin'an River Waterfront Tourism Zone, Huangshan Tiger Forest Park, daguling, Xiuning ancient rock, New Fourth Arm ruins, Lixi scenic spot District. With the development of tourism, the contradiction between carbon emissions problems and ecological sustainable development has always been the focus in tourism industry.

3. Life cycle assessment framework
Life cycle assessment originated in the 1960s that Coca Cola company tracked and quantified the whole process of beverage containers from raw materials to final waste treatment in the United States. In 1993, the society of environmental toxicology and Chemistry (SETAC) summarized the basic structure of life cycle assessment into four complementary parts: defining objectives and determining the scope; inventory analysis, impact assessment and improvement assessment (Figure 1). As an effective model of environmental management, life cycle assessment (LCA) can quantitatively analyze and evaluate the current ecological environment conflicts, which is the theoretical support of environmental decision-making by government.

![Figure 1. Life Cycle Assessment Framework.](image)

4. LCA Model of carbon emission in Hui Cultural Tourism Destination
Basis of the tourism products and services, the British Carbon Trust Institution put forward the life cycle analysis method of carbon footprint. According to the process and input-output process of products and services, scholars comprehensively analyzed the whole process of carbon emissions [10].
Around tourism products and services, tourists' activities in the tourist destination produces resource consumption, resulting in carbon emissions. According to the life cycle assessment model, this paper proposes the life cycle assessment model of Hui cultural tourism carbon emissions (Figure 2).

![Figure 2. LCA of Hui cultural tourism carbon emissions.](image)

Based on the framework of life cycle assessment, according to the nature of tourism products and services, the new model divides the tourism carbon emission inventory into accommodation, traffic and restaurant eating, and visiting (entertainment and buying), which is the formation formula:

\[
TCF = T_a + T_t + T_r + T_v
\]

In the formula, \( TCF \) is the total amount of tourism carbon emissions, \( T_a \) is the carbon emissions generated by using air conditioning, lighting and bathing for tourists' accommodation; \( T_t \) is the carbon emissions generated by the means of transportation in the tourist destination, including buses, sightseeing vehicles, battery cars, cable cars, etc.; \( T_r \) is the carbon emissions generated by the catering provided by the tourist destination; \( T_v \) is the carbon emissions generated by the tourists' visit, entertainment and purchase behaviors. According to the 2006 IPCC national carbon emission inventory guidelines and related literature [11-12], the tourism carbon dioxide emission coefficient is summarized in Table 1. Through the table parameters, quantitative or qualitative analysis is carried out to evaluate the impact of tourists on environmental pollution and ecological damage. Based on the results of the impact analysis, government can systematically evaluate the improvement ways of carbon emissions in the whole tourism life cycle, seek opportunities to reduce carbon emissions in tourism destinations, and realize the sustainable progress of tourism environment.
Table 1. CO₂ emission coefficients.

| Title                  | Parameters |
|------------------------|------------|
| Foodstuff              | 4.549      |
| Vegetables             | 0.602      |
| Poultry                | 4.000      |
| Seafood                | 0.500      |
| Fruits                 | 0.540      |
| Star rated hotel       | 20.600     |
| Homestay               | 15.900     |
| Ordinary Hotel         | 7.9        |
| Electric energy        | 0.997      |
| Gasoline               | 2.970      |
| Coal                   | 2.012      |

There is an inseparable relationship between tourism carbon emission and ecological sustainable development. Tourism destination can attract more tourists only if it realizes ecological sustainable development; however, the development of tourism industry is always accompanied by ecological environment damage and environmental pollution caused by tourism carbon emission, which has a negative impact on ecological sustainable development. Therefore, how to realize the sustainable and coordinated development of carbon emission and environment through tourism whole life cycle is worth thinking.

Huangshan City is a famous Hui cultural tourism destination. The landscape and ancient village buildings of Xidi and Hongcun, the world cultural heritage, all reflect the Huizhou Culture. Compared with natural scenic spots, tourists pay more attention to deep experience, stay longer and spend more time on accommodation and catering in cultural scenic spots. In the whole process of tourism life cycle, the ecological efficiency of consumption, entertainment and transportation is higher than catering and accommodation. On the premise of constantly increasing cultural tourism income of Huangshan City, tourism activities in the scenic area should be increased, such as the corresponding Hui culture "festivals, exhibitions, performances, competitions", improving the consumption of tourism products and the entertainment; low-carbon management of hotels and restaurants in Hui culture tourism area should be strengthened, such as the installation of "air conditioning terminal temperature control device" in hotels; In addition, it is also an important measure to reduce carbon emissions and extend the life cycle by advocating the concept of green consumption of tourists.

5. Conclusion
Based on the analysis of life cycle assessment framework, this paper constructs a carbon emission life cycle assessment model of Hui cultural tourism destination, which consists of four parts: defining objectives and determining scope; inventory analysis, impact assessment and improvement assessment. The inventory analysis is composed of accommodation, traffic, catering, and visiting. The impact assessment consists of environmental pollution and ecological damage. According this model, it is necessary to increase the activities of scenic spots, strengthen the carbon emission management of enterprises related to scenic spots, and publicize the concept of green consumption of tourists. By reducing carbon emissions, improving the sustainable development of tourism activities and ecological environment in Hui cultural tourism destination.

Acknowledgments
This work was financially supported by Anhui Humanities research project (SKHS2019B03) fund and Huangshan University’s Hui-culture research project (2019xwhh002) fund.

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