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Influence of Tourism Industry Development on Environmental Pollution and Eco-Compensation Measures in Chongqing City, China

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ABSTRACT

Ecological environment is not only the basis for human survival and development but also the carrier of tourism industry development. However, such a basis for survival and development of the tourism industry is damaged given the excessive pursuit of economic benefits and neglect of ecological environmental protection in tourist attractions. Eco-compensation measures protect the tourism ecosystem and coordinate the contradiction between tourism industry development and ecological protection. Thus, the sustainable development of the tourism industry can be facilitated. In this study, research on environmental pollution caused by the tourism industry in Chongqing City, China, and relevant eco-compensation measures were first reviewed. Second, an empirical study on the relations of total tourism revenues with waste gas emission, wastewater discharge, and industrial solid waste emission in Chongqing City was conducted using a vector autoregression model. The study findings show that tourism industry development can influence environmental pollution slightly and that an eco-compensation mechanism coordinates the relationship between tourism and ecological environment. Tourism economic growth has long-term equilibrium relations and mutual Granger causality with waste gas emission, wastewater discharge, and industrial solid waste emissions. The conclusions provide a reference to understand the dynamic relations between tourism industry development and environmental pollution, construct a guarantee system for tourism eco-compensation mechanism, and achieve sustainable development of tourism industry and environmental protection.

INTRODUCTION

In recent years, China's tourism industry has achieved rapid development and has gradually intensified its influences on gross domestic product. With abundant tourism resources, the tourism industry plays a vital role in the country's economic development. Specifically, the continuous development of tourism industry has facilitated China's recent economic progress significantly. However, such development considerably focuses on economic benefits and neglects ecological environmental protection in tourism regions, thus causing severe damage to local geological landforms, hydrology, air, animals, and plants. Tourist attractions are suffering heavy ecological environmental pollution that further induces a vicious cycle. The ecological environment for tourism survival and development is damaged, thereby affecting the long-term and scientifically sound development of the tourism industry. Unreasonable tourism production activities and uncivilized tourism behaviours are the main causes of ecological environmental pollution or damage in tourism regions.

The total tourism revenues of Chongqing City, China, have been increasing at a high growth rate in recent years (Fig. 1). The total tourism revenues have increased from 91.785 billion yuan in 2010 to 434.415 billion yuan in 2018. This increase shows an annual growth rate that reaches 46%. However, ecological damage and environmental pollution are also gradually intensifying. The Chongqing municipal government has started to promote the economic development mode of low consumption, low pollution and high value added, and tourism activities. Furthermore, several economic activities surrounding tourist attractions have caused or will bring ecological environmental damage in local areas, thus further inducing a series of problems. Damage of ecosystem structures is mainly manifested by ecosystem dysfunction in tourist attractions. An example is the heavy atmospheric pollution. In comparison with the cyclic purification speed of the atmosphere, excessive discharge of toxic and harmful gases in tourist attractions leads to a significant reduction in air quality. Given excessive pollution, the purification capability of water declines, and the self-recovery of ecosystems is destroyed. Water-soil retention, wind prevention, and sand fixation, along with water source conservation and air purification of foreign elements are decreased or even lost due to overcut and damage. Ecological environmental pollution may decrease biodiversity and cause negative changes in animal and plant structures, population size, and growth mode. All of these influences may lead to final ecosystem degeneration. Tourism eco-compensation is the application of eco-compensation theory

in tourism, a lifestyle that claims high demands and consumption of natural resources. Tourism developed areas may face environmental problems if no compensation measures are adopted. The construction of an eco-compensation mechanism for the tourism industry can promote coordination between tourism industry development and environmental protection, change the blind industry development, and facilitate its sustainable development.

PAST STUDIES

The relationship between tourism development and ecological environment has long been a hotspot in academic research. Developed countries have reported numerous associated studies. In the 1920s, relevant studies mainly concentrated in tourism environment capacity, evaluation indexes of tourism influences on the environment, tourism environmental protection measures, and coordinated development of tourism and environment. In terms of ecological environmental pollution caused by the tourism industry, Budowski (1976) supposed that tourism industry development is achieved at the expense of natural resources; moreover, the ecological principle of guiding the tourism industry to reduce resource use requires proper consideration to realize the maximum benefits of all parties. Assaf (2012) compared the ecological environmental efficiency of main tourism operators and hotels in several Asia-Pacific countries and discussed the investigation results. Gössling et al. (2002) used the ratio of CO_2 emission to tourism benefits as a measure of the ecological efficiency of tourism and evaluated the sustainable development of the tourism industry. Liu (2006) assumed that rural tourism development in Malaysia has caused heavy environmental pollution. Kytzia et al. (2011) evaluated the ecological efficiency of tourism in Davos, Alps, Sweden, based on an expanded regional input-output model. Katircioglu (2014) analysed the long-term equilibrium relations among tourism industry, energy consumption, and environmental degeneration in Turkey. This author concluded that energy consumption and climatic changes are increased significantly given tourism industry development. Saenz-De-Miera et al. (2014) studied the relationship between daily PM10 concentration and the number of tourists in Mallorca, Spain; this author determined that daily stock of tourists is an important index for predicting air pollution concentration. In terms of tourism eco-compensation measures, Poudyal et al. (2009) emphasized that the government, relevant administration departments, tourism enterprises, tourists, and NGOs are objects of tourism eco-compensation. This researcher considered that different compensations must be offered to these subjects. Lindberg et al. (2001) assumed that the tourism industry does not facilitate the actual welfare growth of community residents, and certain additional eco-compensation must be offered to local communities. Cranford et al. (2011) considered that implementing tourism eco-compensation can promote the sustainable development of the natural ecosystem. Wei et al. (2013) emphasized an eco-compensation mechanism for ecological resource values of tourism as a mechanism of adjusting stakeholders, protecting environmental benefits, and allocating economic benefits; these goals could only be realized by a series of systems and a

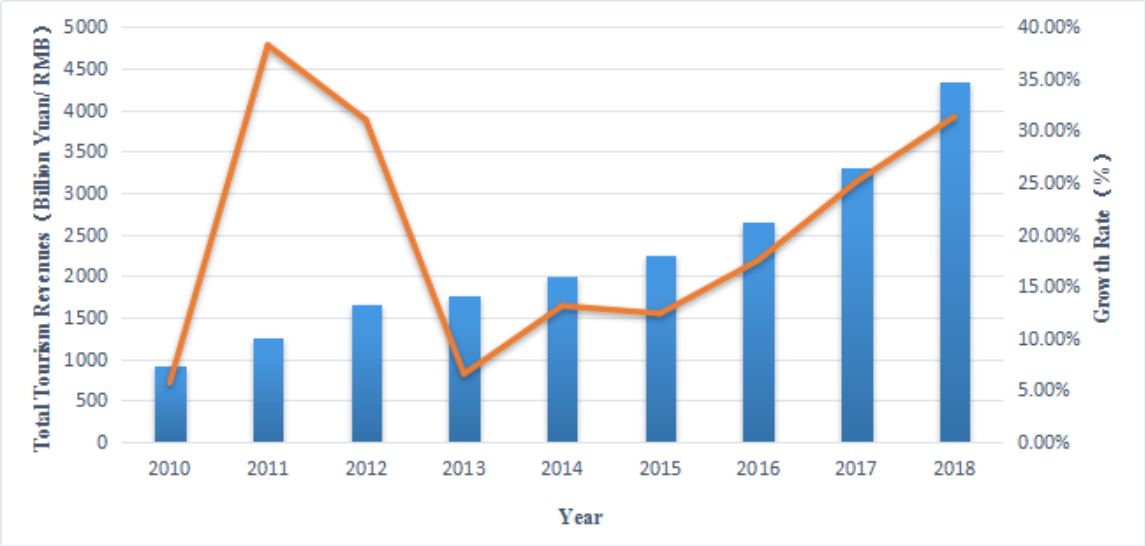

Fig. 1: Total tourism revenues in Chongqing City from 2010 to 2018
(Data source: Tourism statistical bulletin of Chongqing City)

perfect security guarantee that aims to ensure the implementation of tourism eco-compensation measures. Jiang (2014) highlighted that the spatial selection of eco-compensation objects is the core problem in establishing and perfecting the eco-compensation mechanism. A spatial selection model of tourism eco-compensation was constructed on the basis of an empirical study in Yulong County, China. The results demonstrated that different degrees of compensation to local residents can improve the enthusiasm of local residents to participate in environmental protection. Min (2015) advocated the study of eco-compensation equilibrium on schedule to protect the sustainable use of ecological tourism resources. This author determined that the value compensation mechanism of ecological tourism resources is an important component for constructing an eco-compensation mechanism for ecological tourism economic development. Adhikari et al. (2017) assumed that monetary rewards can stimulate local residents in tourism destinations to participate in eco-compensation; based on uncertainty method, this author suggested making decisions on economic compensation for local residents in and the surrounding areas of the Ba Be National Park in Vietnam. Based on the value evaluation method, Motta et al. (2018) investigated residents' willingness on forest eco-compensation in Paraiba, Brazil. This researcher concluded that peasants' willingness is determined by opportunity cost, environmental consciousness, and eco-compensation understanding. In accordance with existing studies, the tourism industry is extensively accepted as a "smoke-free industry" and can facilitate economic development significantly. However, this industry also brings serious ecological environmental pollution given the lack of foresight and ecological protection consciousness in development and management. Consequently, conflicts among tourism industry, resource environment, and community residents are increasingly highlighted. An equilibrium state between the tourism industry and the ecological environment can be realized by establishing the tourism eco-compensation system with considerations of stakeholder benefits. Thus, in the present study, influences of tourism development on the ecological environmental pollution in Chongqing City, China, were analysed, and relevant tourism eco-compensation measures were proposed. The present study aims to disclose the relationship between tourist activities and ecological environment in tourism destinations. The conclusions can provide policy suggestions for the ordered sound development of the tourism industry.

BRIEF INTRODUCTIONS TO MODELS AND DATA SPECIFICATION

Vector autoregression (VAR) model: Sims (1980) proposed the VAR model, which has become a mainstream model worldwide and has been extensively used. The VAR model was adopted to predict and analyse dynamic impacts (degree, sign, and duration) of random system disturbances. This model was used to conduct an empirical analysis of tourism economic growth and environmental pollution indexes in Chongqing City.

The VAR model is defined as follows: If $Y_t = (y_{1t}, y_{2t}, \cdots, y_{nt})^T$ is the column vector of $N \times 1$ -order timing independent variable, then the p -order VAR model ($VAR(p)$) is

$$Y_t = \sum_{i=1}^{p} \Pi_i Y_{t-t} + U_t = \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \cdots + \Pi_p Y_{t-p} + U_t \quad ...(1)$$

In formula (1), Y_t is the k -dimensional endogenous variable, $\Pi_i (i = 1, 2, 3 \cdots, p)$ is the $N \times N$ -order matrix of the estimating parameter i, and $U_t = (U_{1t}, U_{2t}, \cdots U_{nt})^T$ is the column vector of $N \times 1$ -order random error. $Ut \sim IID(0, \Omega)$, where Ω is the covariance matrix of -order variance, and is the maximum number of hysteretic orders of the model.

Data specification: Total tourism revenues of Chongqing City is used as the index that describes tourism economic growth, whereas waste gas emission, wastewater discharge, and industrial solid waste emissions are used as indexes to describe environmental pollution. To obtain a stationary time series and eliminate possible heteroscedasticity, natural logarithms of total tourism revenues, waste gas emission, wastewater discharge, and industrial solid waste emissions of Chongqing City from 2001 to 2015 were calculated and expressed as Ln*inc*, Ln*gas*, Ln*wat*, and Ln*sol* and correspondingly. The selected study period was 2005-2016. Research data were collected from the Statistical Yearbook of Chongqing City and the Tourism Statistical Bulletin of China. EViews9 was applied as the quantitative analysis of data.

EMPIRICAL ANALYSIS

Unit root test: Generally, the classical linear model sequence is hypothesized as stationary to ensure consistency of OLS estimation and approximate the normal distribution of results. Many economic variables have no stationarity of time series. Therefore, in this study, a stationary test of variables must be performed to determine the number of integrated orders of different series. The unit root test (ADF) is a common method for examining the stationarity of time series. The ADF test results based on EViews9 are summarized in Table 1. The ADF statistical values of Ln*inc*, Ln*gas*, Ln*wat*, and Ln*sol* and on a 5% significance level are higher than their critical values. They have unit roots and unstable series. The ADF statistical value of the first-order differential statistics of the corresponding variables on 5% and 10%

Table 1: ADF Test.

Variables	The ADF statistics	The critical value	Conclusion
Ln*inc*	-2.684*	-3.741	Non-stationary
L*ngas*	-2.012*	-2.954	Non-stationary
L*nwat*	-0.987*	-2.541	Non-stationary
L*nsol*	-0.574*	-1.854	Non-stationary
ΔL*ninc*	-3.684*	-1.874	Stationary
Δ*Lngas*	-4.121*	-2.574	Stationary
Δ*Lnwat*	-5.854**	-4.241	Stationary
ΔΔ*Lnsol*	-4.785*	-2.541	Stationary

(Note: * and ** reflect significance at 5% and 10% levels, Δ represents the first-difference processing of the variable)

Table 2: Johansen cointegration test results.

Null hypothesis	VAR1		
	Eigen value	Trace statistics	P-value
No cointegration relation	0.684	21.574	0.001*
At most one cointegration relation	0.521	5.241	0.064**
Null hypothesis	VAR2		
	Eigen value	Trace statistics	P-value
No cointegration relation	0.547	14.584	0.021*
At most one cointegration relation	0.145	0.632	0.241
Null hypothesis	VAR3		
	Eigen value	Trace statistics	P-value
No cointegration relation	0.645	28.456	0.002*
At most one cointegration relation	0.451	5.341	0.071**

(Note: * and ** reflect significance at 5% and 10% levels)

significance levels are lower than the critical values, and the series is stationary. Thus Ln*inc*, Ln*gas*, Ln*wat*, and Ln*sol* and were determined to be a first-order differential integrated series.

Cointegration test: If the series of different variables are non-stationary but several linear combinations of these variables may be stationary, then cointegration relations exist among these variables. In this study, the Johansen cointegration test was used to evaluate three VAR models (i.e., VAR1, VAR2, and VAR3) on the cointegration relations of tourism economic growth with waste gas emission, wastewater discharge, and industrial solid waste emissions. Table 2 displays that the logarithmic series of the three VAR models mentioned above has long-term cointegration relations and a unique standardized cointegrated vector. Moreover, all three VAR models deny the null hypothesis of no cointegration relation and accept the null hypothesis of at most one type of cointegration relation. This finding reflects the long-term equilibrium relations of tourism economic growth with waste gas emission, wastewater discharge, and industrial solid waste emissions.

Table 3 lists the cointegration regressions of VAR1, VAR2, and VAR3. Long-term equilibrium relations of tourism economic growth with waste gas emission, wastewater discharge, and industrial solid waste emissions in Chongqing City are all negative. This result reveals that increased emission of the three wastes may decrease tourism economic incomes in Chongqing City, but an increase in tourism economy may decrease, rather than increase, the emissions of three wastes. This finding may be due to the emission of environmental pollutants mainly comes from industries. Industrial pollutant emission is relatively small in a city with a relatively developed tourism industry. Therefore, facilitating the transformation of Chongqing City from a traditional industrial city to a service-oriented city is an important means of further enhancing tourism industry development, vitalizing urban resource inventory through industrial tourism, and optimizing urban settlement.

Granger causality test: The cointegration test can only determine whether a long-term equilibrium relation exists among variables. Whether such relation forms causality must be further verified through the Granger causality test. The

Table 3: Cointegration regression.

Variables	Cointegration Equation
Ln*inc*, Ln*gas*	$\Delta \text{Ln}inc = -1.541 \times \Delta \text{Ln}gas$ (0.117)
Ln*inc*, Ln*wat*	$\Delta \text{Ln}inc = -8.741 \times \Delta \text{Ln}wat$ (0.097)
Ln*inc*, Ln*sol*	$\Delta \text{Ln}inc = -0.924 \times \Delta \text{Ln}sol$ (0.102)

Granger causality test examines whether one variable causes changes in another variable. If one variable receives hysteretic influences of other variables, then Granger causality exists among such variables; otherwise, no Granger causality emerges. The test results are presented in Table 4.

At the 10% significance level, fluctuations in waste gas emission, wastewater discharge, and industrial solid waste emissions are the Granger causes of changes in tourism economic growth. Moreover, changes in tourism economic growth are the Granger causality in fluctuations of waste gas emission, wastewater discharge, and industrial solid waste emissions. The increase in such emissions deteriorates the environmental quality in Chongqing City, thus weakening the local tourism economic development. The rapid tourism economic growth can slightly regulate the local environment, including promoting local community consciousness, creating a favourable urban image, and reducing emissions of waste gas, wastewater, and industrial solid waste. These emissions can be reduced by sound development of ecological environment and can consequently benefit the sound tourism industry development in Chongqing. This development can not only increase environmental burdens but also strengthen people's consciousness of environmental protection. Therefore, tourism industry development in Chongqing City drives economic growth and provides guarantees for pollution prevention and environmental management.

TOURISM ECO-COMPENSATION MEASURES

Perfect legal system for tourism eco-compensation: Laws for tourism eco-compensation must be promulgated. A legal system is a basis for a smooth implementation of tourism eco-compensation, which cannot be implemented without coercive power support of the state. Thus, establishing a perfect legal system for tourism eco-compensation is necessary. Such legal system must be explicit, concrete, standardized, and overarching. Chongqing City must release local eco-compensation laws, regulations, and rules to adapt to most eco-compensation standards that consider not only direct value, potential value, opportunity cost, and development cost for tourism development based on ecological environment but also the amounts of compensation that the subject and object are willing to be paid and to receive. Traditional eco-compensation funds are generated from fiscal transfers of the central and regional governments and other regions. Special funds are basically derived from the fiscal allotment of the government. The responsible party of tourism eco-compensation must be determined, and a chain of responsibility mechanism for tourism eco-compensation is required to regulate responsibility, power, and obligations of the subject and objects of eco-compensation.

Construct an organization to ensure the implementation of tourism eco-compensation: To ensure the smooth implementation of tourism eco-compensation in Chongqing City, sub-mechanisms, such as constraints, rewards and punishments, cooperation, integrity, and communication, must be protected. The construction of a special eco-compensation management organization in Chongqing City is recommended. Other entities at all levels must establish their corresponding eco-compensation organizations that can organize, coordinate, and determine a series of problems in eco-compensation. Moreover, competent departments must be identified for the organization, coordination, guidance, and supervision of implementing tourism eco-compensation.

Determine responsibility of tourism eco-compensation: Explicit responsibilities of eco-compensation constrain individuals or groups to assume legal consequences for violating eco-compensation laws and regulations and environmental damage. Administrative legal responsibilities of tourism eco-compensation include administrative punishments and sanctions. The involved subjects are enterprise and public institutions, individuals, direct person in charge or managers in tourism destinations, and local governments that have not committed crimes. In accordance with their experiences in a lifelong accountability system of security production, a unified competent department must be established to guide the lifelong accountability system for severe ecological pollution events. Moreover, imposing punishments must be strengthened to force local governments to implement ecological supervision policies positively.

Construct a coordinated supervision mechanism of tourism eco-compensation: The supervision function of the government must be strengthened to protect the tourism eco-compensation mechanism and its implementation from a disturbance of external factors. Supervision must focus on the specific implementation of tourism eco-compensation measures and the use and management of compensation funds to coordinate benefits among stakeholders. Furthermore, illegal behaviours must be punished to retain the sound development of the ecological environment. Subject and

Table 4: Granger causality test results.

Null hypothesis	F value	P value	Conclusion
L*ninc* is not the Granger cause of L*ngas*	5.741	0.014	Denied
L*ngas* is not the Granger cause of L*ninc*	6.351	0.078	Denied
L*ninc* is not the Granger cause of L*nwat*	8.541	0.011	Denied
L*nwat* is not the Granger cause of L*ninc*	45.121	0.657	Denied
L*ninc* is not the Granger cause of L*nsol*	9.684	0.081	Denied
L*nsol* is not the Granger cause of L*ninc*	12.357	0.068	Denied

(Note: * and ** reflect significance at 5% and 10% levels)

object of tourism eco-compensation must also be supervised and controlled to ensure the full development of the eco-compensation mechanism. An independent third party organization can be established to evaluate whether a tourism eco-compensation mechanism for national parks is reasonable and if the implementation of eco-compensation measures is efficient.

Protect sustainable development of tourism eco-compensation: Proposals for innovative uses of tourism eco-compensation funds in Chongqing City are necessary. Considerable efforts are also required to promote inclusive finance construction. The poverty relief mechanism of Chongqing City must be combined with ecological finance. Tourism eco-compensation funds are applied to establish a special fund for poverty relief in Chongqing City to support the construction of ecological tourism, green forestry, and ecological agricultural construction. In addition, new uses of tourism eco-compensation funds must be explored. In addition, the city can benefit from suggestions on integrating tourism development and massive health industry, changing a sightseeing-oriented tourism industry development mode into an entertainment development mode, and creating diversified ecological tourism products. Moreover, the benefits include promoting the deep integration of ecological tourism with local education, culture, and massive health industry, developing ecological tourism experiences, advocating low-carbon wisdom tourism, and promoting local industrial development.

CONCLUSIONS

Environmental resource development is the premise on which tourism industry development depends on. A favourable ecological environment is therefore the precondition to realize the sustainable development of the tourism industry. However, constructing ecological tourism attractions may frequently cause damage to the ecological environment, which may bring further severe damage to local residents. In this study, the VAR model was conducted on the relations of total tourism revenues with waste gas emission, wastewater discharge, and industrial solid waste emissions in Chongqing City, China. Eco-compensation measures of the tourism industry were proposed. The results demonstrate that Tourism economic growth has long-term equilibrium relations and mutual Granger causality with waste gas emission, wastewater discharge, and industrial solid waste emissions. Some policy suggestions for tourism eco-compensation, including perfecting the legal system, establishing an organization to protect its implementation, determining the chain of responsibility, constructing a coordinated supervisory mechanism, and ensuring its sustainable development, are proposed. Moreover, this study suggests that, in the future, deeper analysis on similar influencing mechanisms of tourism industrial agglomeration on environmental pollution, legal system construction for tourism eco-compensation in different regions, and implementation of tourism eco-compensation from stakeholder perspectives should be conducted.

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