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Study on Introduction Carbon Management into Environmental Management of Tourist Destinations

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Abstract

Tourist destinations in China face pressure from the target that carbon emissions Per unit GDP dropping 40-45% from 2005 to 2020, as tourist activities almost happen in destinations and the carbon dioxide emissions generated by the tourism industry are mainly in destination. Carbon management is a new framework being built based on the ecosystem carbon cycle and environmental management and offers a new way to improve present management in destinations. How to introduce carbon management planning into tourist destination management to achieve low-cost carbon emission reduction targets has become a hot topic for research. While emissions are produced in travel to the destination, this study only examines in destination travel and looked destination as an integrated system to discuss future development by reconciling climate change, environmental management and tourism growth. Firstly, this article reviews past research about carbon management in China and abroad, followed by an analysis the key issues and the basis of carbon management at a tourist destination. Carbon management seeks to manage the carbon cycle system process, and the key problem to be solved is how to keep the carbon cycle in smooth operation, so that the tourism industry and the environment achieve coordinated sustainable development. Analysis of the operation, dynamic mechanism, and restraint mechanisms of carbon management in tourist destination, leads to the conclusion that the basic operating mechanism for carbon management involves carbon sinks. The forces driving change in this area are clean development and carbon trading. Stakeholder collaboration and responsibilities for carbon reduction are the main constraints.

Keywords: carbon management, environmental management, tourist destinations, tourist activity, carbon emission

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INTRODUCTION

Carbon dioxide is the most abundant greenhouse gas generated from human activities and is an important factor influencing global warming. Its emissions can serve as an important indicator of the impact of human activities on the ecological environment. As tourism has become the world's largest industry (World Travel and Tourism Council 1996), tourism related activities have become a major component of human endeavours. In 2010, tourism and associated activities accounted for approximately 10% of the total GDP worldwide. The tourism industry sectors which provide products and services to meet the tourism needs of the tourists, such as tourist transportation, accommodation, catering, entertainment, and excursions, is now producing 5−9% of global carbon dioxide emissions (Scott and Becken 2010).

China has become an important international tourist destination and source of tourists and comprises the world's largest domestic tourism market (Han et al. 2013). With the increase in the domestic income levels and the changes to employee leave system, China's tourism will continue to grow rapidly. This will cause the tourism sector to increase energy consumption and thereby increase carbon emissions (Zou 2011). In 2008, Chinese tourism produced 51.34 million metric tons of carbon dioxide, accounting for 0.86% of the total carbon dioxide emissions in the country (Shi and Wu 2011). As tourism becomes a new area of growth in China's social and economic development, development activities and tourism activities will grow rapidly. The tourism industry has become an important sector of energy consumption, and carbon dioxide emissions from tourism have become an important driving force in

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changing local environments and accelerating climate change (Shi et al. 2010).

In response to global climate change and to assume responsibility, in 2009 the Chinese government promised to the international community that by 2020 China's carbon emissions would be reduced by 40−45% compared to 2005 levels (Liu et al. 2008). The "Twelfth Five-Year" Plan clearly states the following sustainable development goals: energy conservation, a reduction in greenhouse gas emission intensity, development of a recycling economy, promotion of low-carbon technologies, and an active response to global climate change. Reducing carbon emissions, lessening the carbon footprint of human activities, and carrying out carbon management have become necessary in response to global changes under China's rapid economic growth. As China is an important force in the global tourism economy and one of the largest contributors to global warming (Ren et al. 2005), energy saving and emission reduction in China's tourism industry is of significant practical importance.

Tourist destinations are the main areas of carbon dioxide emissions in tourism industry. This is because they are not only the main areas where the tourism activities occur but are also the areas where service and facility centres are located to meet the needs of the tourists (Buhalis 2000, Leiper 1989, 1990). Excluding the carbon emissions from transportation between the tourist source locations and the destinations, the main components of carbon emissions in the tourism industry, such as carbon emissions from catering and accommodation, local transportation, and facilities, all occur in tourist destinations.

Carbon management has recently generated significant research interest and is a new direction for environmental management. Previous studies have focused on the potential threats caused by global changes to the landscape and natural resources in tourist destinations (Wall 1998). However, little attention has been paid to the use of fossil fuels in tourist destinations and the consequent increases in carbon dioxide levels, how tourism contributes to global climate change, and how it affects the environment (Becken 2004). Studies on carbon emission reduction and its management in tourist destinations are even more lacking, and the available environmental management investigations regarding carbon emission reduction are not sufficient to help with the practical requirements of energy saving and emission reduction in the tourism industry. Therefore, studies on carbon reduction in tourist destinations can fill the research gap, provide a scientific basis and data support for local governments or tourism administrations trying to craft policies targeted at carbon reduction, and aid sectors related to the tourism industry in implementing carbon reduction. Thus, such studies have important practical and theoretical value.

LITERATURE REVIEW

Studies on carbon management began in the twenty-first century. Draper and Becker (2000) proposed the concept of carbon management explicitly for the first time. Arakawa et al. (2001) analysed the pressures and challenges of global carbon emissions, and they pointed out the need to promote carbon management. Conrady and Buck (2010) pointed out that carbon management is essential to the success of the tourism industry, and the report suggested that tourism enterprises need to analyse the cost of carbon emission reduction and investigate how to achieve low-cost carbon reduction via carbon management.

In the theoretical research on carbon management, the implications, framework, and methods of carbon management have been discussed. Dilling et al. (2003) proposed that carbon management is the management of the future carbon cycle and should be expanded around specific targets. Carbon management should be based on scientific knowledge regarding carbon and should combine carbon emission measurement with goals for carbon sequestration and carbon cycling through a constantly revised system. The Global Carbon Plan (GCP) initiated the Urban and Regional Carbon Management (URCM) research plan in 2005 to provide a framework for the implementation of carbon management on three scales: global, regional, and municipal. Gössling (2011) published the book "Carbon management in tourism: mitigating the impacts on climate change." This book presents the impacts of climate change on the tourism industry as well as existing issues for the increasing carbon emissions in the tourism industry and for carbon reduction actions of stakeholders. A tourism carbon emission inspection framework suitable for different technological, social and cultural, political, economic, and trading backgrounds is also constructed. Di Giacomo et al. (2012) pointed out that carbon management efforts in the tourism industry should design measures and methods for carbon emission reduction based on carbon reduction targets. These methods should be continually validated and improved through practice. The goal of tourism carbon management is to achieve low carbon emission levels, and low-carbon tourism is one of the approaches to

achieve this goal. The essential issues of low-carbon tourism, such as carbon reduction, energy conservation, and sewage discharge reduction, are the same as that of carbon management. The difference is that carbon management concerns not only carbon reduction, but also the determination of carbon sources, carbon footprint monitoring, and producing carbon reports.

Regarding the applications of carbon management, studies on the relevant motivational behaviour, projects, process management, and performance have been carried out. Okereke (2007) proposed that the motive of corporate carbon management is profit maximisation, whereas pressure from public concerns will also drive enterprise carbon management. The main obstacle to enterprise carbon management is a lack of knowledge. De Young (2011) also pointed out that since humans are the main source of carbon emissions, human motives and behaviours must be taken into consideration in carbon management. The patterns of human thinking and behaviour, their focus on short-term benefits, and other factors may all distort actual carbon management from the expected results. Gössling (2011) conducted a case study on the carbon reduction technology, management, education, research, and policy from 33 first-tier tourist destinations in 17 countries. The report showed that tourism enterprises can reduce carbon emission by 10−20% within five years by merely changing certain behaviours (with low cost). They also showed that if the investment in a low-carbon technology can be returned within 10 years via carbon reduction, this technology is very likely to be promoted in the tourism industry. Pandey (2002) pointed to the need to be selective in choosing carbon management projects in order to optimise the supply chain efficiency. Cheng et al. (2010) proposed that comprehensive and authoritative carbon emissions testing is crucial. They also suggested that the first step of management and greenhouse gas emission reduction should be monitoring energy consumption and greenhouse gas emission via third-party verification and reports. Rush and Melville (2012) evaluated the carbon management performance of 200 listed companies and found that small enterprises can obtain a return more easily than large enterprises. They also found that enterprises with low carbon emission are more likely to obtain additional carbon management remuneration.

Studies on carbon management technologies and methods have mainly focused carbon reduction technologies, such as clean energy, carbon reduction, and carbon sequestration technologies. Carbon management technologies targeting different types of land have also been discussed. Huston and Marland (2003) proposed that incentives should have two aims – to replace fossil energy with clean energy and to replace energy-intensive products with bio-products – to promote the use of land toward the direction of increasing carbon sinks and reducing the carbon sources. They also specifically discussed the goals and implementation measures of carbon management. Research exploring carbon management technologies has mostly concentrated on the capture and storage of carbon dioxide. If carbon emissions produced by human activity cannot be reduced substantially in a short amount of time, continuously improving carbon storage technology is the optimal option (Edmonds et al. 2002). In addition to explorations on the theories, application, and technologies of carbon management, some scholars have also discussed how to combine carbon management and the construction of carbon sinks via land use. For example, it has been suggested that life cycle based carbon management should be applied to the design of forest carbon sinks to maximise carbon sequestration and improve the economic value of forests, e.g., their value in replacing fossil fuels (Birdsey et al. 2006, Law and Harmon 2011, Lippke et al. 2011, Pandey 2002). In terms of combining carbon management and soil carbon sequestration, studies suggest stabilizing the land types with a high degree of soil carbon sequestration to prevent the conversion of carbon sinks to carbon sources (Blair et al. 1997, Deurer et al. 2009). Suggestions for water body carbon management include designing policies to encourage carbon emissions to water sequestration, and to limit sewage discharge to natural water bodies (Wright and Hudson, 2012).

Carbon management research in China began in 2009, with the publication of the article “Progress in studies on urban carbon cycle and carbon management” by Zhao. This paper describes the scientific issues, opportunities, and challenges in urban carbon management and how to take targeted measures. Since then, Chinese research literature on carbon management has mainly focused on the carbon management of enterprise supply chains, exploring how to achieve carbon reductions by analyzing the carbon emissions and footprints at each link of the supply chain (Chen 2010, Li 2012, Zhu 2011). Some scholars have focused on only one element of carbon management – low-carbon management (Huang 2010). There has been no published paper that focuses on tourism carbon management in China, yet relevant research has been carried out. For example, the United Nations

Environment Programme – Tongji University of Environment for Sustainable Development Research Team (2012) proposed that tourism carbon management should be promoted with carbon source control, carbon sequestration, and carbon balance among other aspects. For example, reducing carbon emissions related to energy activities via industrial upgrading and restructuring, continuous emphasis on forestry carbon sequestration, improvements in the protection of wetland carbon sinks, and regular announcements of the results of carbon balance spatiotemporal evaluations. In addition, domestic carbon management research has included management of low-carbon scenic areas and low-carbon travel (Li and Yin 2012, Tan and Cheng 2010), and the evaluation system for low-carbon scenic areas has been discussed. While these studies provide an excellent basis for exploring low-carbon management in tourism destinations, they are limited to passive carbon reduction management via mandatory government directed energy saving and carbon reduction measures. There has been no broader conceptual framework for China's carbon management in tourist destinations. Mechanisms of carbon management in tourist destinations require further investigation.

KEY ISSUES IN CARBON MANAGEMENT IN TOURIST DESTINATIONS AND ITS FRAMEWORK

The Basic Content of Carbon Management

Generally speaking, carbon management is the management of future carbon cycling (Dilling et al. 2003). It requires the integrated combination of carbon emission measurement, carbon footprint assessment, setting carbon reduction targets, management of the process of carbon emission reduction, evaluation on the effect of carbon reduction, and continuous improvement in carbon reduction. Specifically, carbon management is aimed at the process of carbon emission reduction (Zhao et al. 2009) and is concerned with how to achieve carbon reduction targets at the lowest cost possible.

Thus, carbon management in the general sense covers a series of processes that include defining boundaries, carbon source inventories, carbon emissions statistics, carbon footprint assessments, determination of carbon reduction targets and factors, implementation of carbon reduction, effectiveness evaluations, and continuous improvement. It can be divided into three parts: design of carbon emissions inventory, carbon footprint assessment, and carbon reduction management. The specialised sense of carbon management only refers to carbon reduction management.

Key Issues and Elements of Carbon Management in Tourist Destinations

Tourist destinations are geographical locales where tourism activities occur. The activities of tourists change the original local industrial structure and environment. Tourists produce demand for destinations to provide facilities for food, housing, transportation, and shopping as well as various products and services. The development and construction of the tourism industry will impact the land use pattern of the tourist destination, promoting changes in local land use, and thereby indirectly affecting the local environment. In addition, the air, noise, waste, light pollution and other pollutions brought by tourism activities will have a direct impact on the ecological environment of the tourist destination. Carbon emissions, a major factor of the environmental impact of human activities, have also become an important factor driving ecological environmental change in tourist destinations. Therefore, carbon management in tourist destinations mainly addresses the following questions.

The first question is, what is the carbon cycle process in tourist destinations and what are the underlying mechanisms? Second, what types of impacts will tourism activities have on the carbon cycle in the tourist destination? Third, where are the carbon sources in the tourist destination? How do tourism activities promote energy consumption, waste generation, and construction? What is the condition of carbon sinks in the tourist destination, and does the change in land use caused by tourism development affect the carbon sinks? Fourth, what are the main driving factors for the carbon sinks in the tourist destination, and what is their relative importance? Fifth, what measures should the tourist destination take for management of carbon sources and carbon sinks? Sixth, what kind of management strategies, management systems, and management solutions are needed in the process of carbon reduction? Seventh, how should carbon reduction responsibilities be assigned to different parties so that the corresponding appropriate management method can be applied for each party?

The impacts of the tourism industry on the carbon cycle of tourist destinations are mainly manifested in two aspects.

The first aspect is that tourism industry directly drives changes in the carbon sources and carbon sinks

of the tourist destination. On the one hand, with the development of tourism, land use as well as the job opportunities and lifestyles of local residents are changed. These changes promote increases in the area of land developed for tourism, transportation, energy consumption, waste discharge, and carbon emissions. On the other hand, tourism development promotes the maintenance and repair of forest vegetation and encourages converting farmland to forestry, thereby increasing carbon sequestration.

The second aspect of tourism industry impacts on the carbon cycle of destinations is their potential effects on relevant factors in the carbon cycle. For example, tourism development increases the mobile population of the tourist destination, and this will inevitably increase carbon emissions. Tourism development promotes industrial and economic activities in the tourist destination, and these activities will also inevitably increase carbon emissions. Advances in carbon reduction technologies in the tourist destination will inhibit carbon emissions and promote carbon sinks, and the original ecological environment in the tourist destination (ecosystems, climate, land use, etc.) will also affect the status of carbon sinks. The local social cultural system may reinforce or hinder the pressure or motivation to carry out carbon emission reduction.

In short, carbon management in tourist destinations must start from the relationship between tourism, carbon cycle, and tourist destination; distinguish the regional differences in carbon cycle between different tourist destinations; and identify relevant factors such as tourists, tourism industry, land use, carbon technology, social cultural system of the tourist destination, stakeholder, as well their coupling relationships. Only in this way will the key issues in scientific carbon management be determined. Therefore, the key to carbon management is to start from the perspectives of carbon cycle mechanisms and socio-cultural motivations.

The purpose of environmental management in tourist destinations is to achieve coordination between the development of the tourism economy and the ecological environment, i.e., to ensure local ecological balance while developing the tourism economy. The ecological balance of the tourist destination can be monitored and analysed through its ecological carrying capacity and footprint, and its maximum capacity for tourist loads can be analysed through its environmental capacity and ecological carrying capacity. In this way, the ecology can be preserved by methods such as limiting the number of tourists. Ecological footprint analyses of the productive land area required by the tourist destination makes it possible to take corresponding measures to reduce the ecological footprint, such as limiting tourist flow, improving energy consumption structure, and strengthening the waste treatment, thereby reducing the adverse impact of tourism activities on the local environment.

Environmental management of tourist destinations can also learn from the mature theories and methods of management science to acquire insight and theoretical support for its development. For example, the introduction of the stakeholder theory can help tourist destinations to distribute responsibilities and benefits of carbon emission reduction. Carbon management needs to consider not only the activity of subjects within the organisational or regional boundaries, such as the tourists, the management staff, the tourism service staff, community residents, etc., but also business partners, parent departments, the external public, the media, and even future generations and natural environments that may be affected by activities in tourist destinations. The introduction of process reengineering theory is another aspect of management science that can help tourist destinations improve the existing environmental management mechanism as well as refine the current local system and policies to better solve environmental problems.

The Theoretical Framework for Carbon Management in Tourist Destinations

The novel theoretical framework for carbon management in tourist destinations is based on carbon cycling and environmental management in tourist destinations. The carbon cycle in tourist destinations is the core and main object of carbon management. Carbon management in tourist destinations needs to maintain the ecological balance of the tourist destination, so that the carbon emission caused by tourism activities is less than carbon sequestration. More importantly, via rational use of resources and reduction of environmental consumption, carbon management in tourist destinations needs to advocate green consumption, conservation-oriented development, clean production, and material recycling. This will promote tourism development and minimise the carbon emissions caused by tourism activities in the tourist destination, achieving low-carbon or even zero carbon consumption. In this way, true green tourism and construction of low-carbon scenic areas can be realised. Meanwhile, environmental management provides the theory and methodological support for

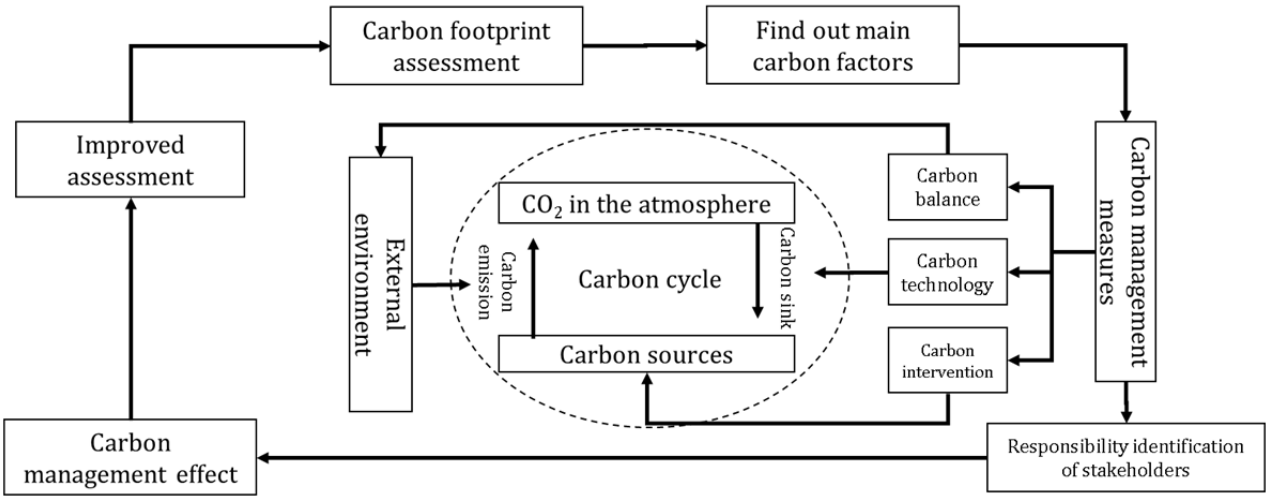

Fig. 1. Carbon management framework for tourist destinations

carbon management in tourist destinations. Carbon management based on comprehensive measurements of carbon emission in the tourist destinations involves the following: assessing carbon footprints, identifying main driving factors for carbon emissions and carbon emission reductions in tourist destinations, proposing carbon reduction measures, determining the distribution of rights and responsibilities in the carbon reduction process, evaluation of the effect of the carbon reduction, determining the subsequent improvement measures, and improving the carbon management mechanism to continuously optimise the effect of carbon management.

Here, a theoretical framework for carbon management in tourist destinations is proposed and is illustrated in **Fig. 1**. In this framework, carbon management is divided into two layers. The core layer is the management of the carbon cycle in tourist destinations. Specifically, it involves reduction of carbon emission and enhancement of carbon sequestration through carbon balance, carbon technologies, and carbon intervention measures. The second layer is the process flow of carbon management. The first step is to understand the development of human activities within the tourist destination and their carbon impacts to identify carbon sources (such as energy use, transport, and waste disposal) and determine the basic driving factors of carbon emissions. Predictions of future changes in carbon footprint and scenario analyses are then conducted. The second step is to analyse the carbon cycling in the tourist destination to evaluate the carbon balance of its ecosystem, and establish targeted carbon management measures. The third step is to analyse the economic gains of carbon sink management in the tourist destination and to encourage it to participate in carbon trading. The fourth step involves intervening at the sources of carbon emissions to find carbon management countermeasures, weighing the opportunities and obstacles facing the carbon management, and promoting the coordination between carbon management and other socio-economic conditions.

ANALYSIS ON THE MECHANISM OF CARBON MANAGEMENTS IN TOURIST DESTINATIONS

Carbon management is the management of the future carbon cycle. Its mechanism should be based on the scientific knowledge of carbon and a program that can be constantly revised for improvement. It should utilise the integrated combination of carbon emission measurements, carbon footprint assessments, carbon sequestration targets, and carbon cycling goals (Dilling et al. 2003). The principal components of regional carbon management are energy use and changes in land use at the regional level, and the primary goal is to support regional carbon management and sustainable development of the city (Grace 2004). To conduct rational regional carbon management, an integrated perspective that includes the city, the region, and the globe must be adopted to combine carbon management with the development of tourist destinations and local realities. , The determinants, development patterns, and management opportunities related to the carbon footprints of the tourist destination, the region, and the nation can be studied using comparative methods (Canan and Crawford 2006).

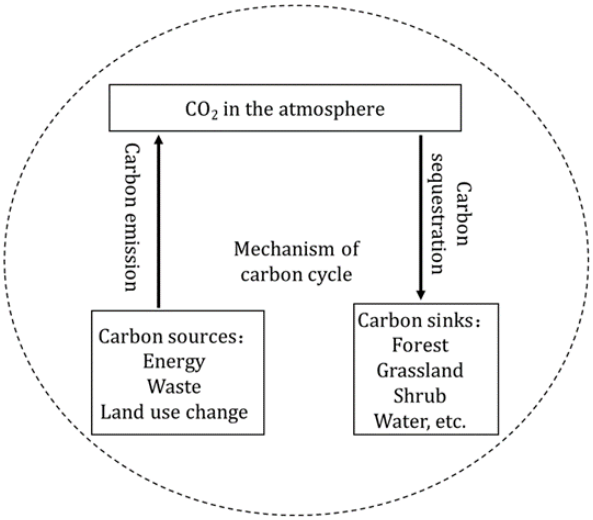

Fig. 2. Mechanisms of carbon sources and carbon sinks in tourist destinations

The Dynamic Mechanism of Carbon Sources and Carbon Sinks

The United Nations Framework Convention on Climate Change (UNFCCC) defines a carbon sink as a process, activity, or mechanism that removes carbon dioxide from the atmosphere, and it defines a carbon source as a process, activity, or mechanism that releases carbon dioxide to the atmosphere. The Intergovernmental Panel on Climate Change (IPCC 2007) divides greenhouse gas emission sources into five categories: energy activities, industrial processes and product use, agricultural activities, wastes, and changes in land use and forestry. Major sources of carbon emissions in tourist destinations include energy activities, wastes, as well as changes in land use and forestry (Yuan 2001). Forests, grasslands, woods, shrubs, and water bodies are all capable of carbon sequestration. Among these, forests are the largest carbon pool with a significant carbon sequestration function (Pan et al. 2011). In terms of tourist destinations, vegetation in mountainous tourist destinations have a significant effect on carbon sequestration, mainly manifested via the growth of biomass. This is also holds true of the carbon balance in Chinese regional forest ecosystems. In this context, forest ecosystems play a vital and decisive role in the carbon sequestration function of the entire tourist destination. The mechanisms of carbon sources and carbon sinks in tourist destinations are shown in **Fig. 2**.

In addition, the dynamic nature of carbon sources and sinks is constantly affected by a large number of complex driving factors influenced by climate variability, the internal dynamics of the land - ocean - atmosphere system, and anthropogenic effects. Therefore, to construct the mechanism of carbon management in tourist destinations, the mechanism of carbon sources and carbon sinks as well as the mechanism of carbon cycling in the tourist destinations must be fully understood.

The Mechanism of Stakeholder Participation

The stakeholders of an organisation include the owner (e.g., shareholder in the shared economy and acting national regulator in state-owned economy), managers, employees, governments, partners, and consumers. The stakeholders in carbon management include the subjects within the organisational or regional boundaries, such as the tourists, the management staff, the tourism service staff, and community residents as well as business partners, parent departments, the external public, the media, and even future generations and natural environments that may be affected by activities in tourist destinations.

Stakeholders that can have a significant impact on the environmental performance of the tourist destinations mainly include governmental authorities, management staff, local community residents, tourists, and environmentalist groups (Zhao et al. 2011). Under policies oriented towards GDP growth and environmental protection, the economic performance of carbon management in tourist destinations is the main motive stimulating stakeholder participation in the carbon management, and the effect of the remaining other factors is limited. Therefore, here we propose that several stakeholders, the higher authorities, tourists, community residents, and carbon trading partners of the tourist destination, are the main driving factors in carbon management in tourist destinations. The driving factors and response mechanisms are shown in **Fig. 3**.

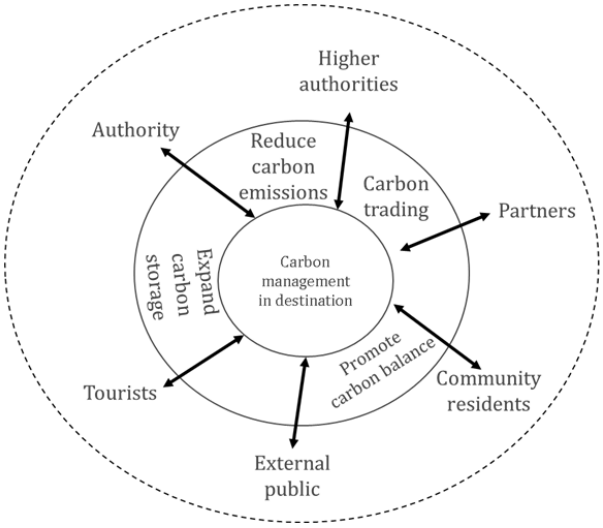

Fig. 3. Carbon management stakeholders in tourist destinations

Carbon Trading and Carbon Trading Mechanism

Carbon trading and carbon credit trading are both virtual trading mechanisms created based on the allocation of carbon dioxide emission targets specified by the UNFCCC and Kyoto Protocol. When developed countries, due to the large amount of greenhouse gas produced by industrial development, cannot reduce carbon emission to the standard as specified by the UNFCCC and Kyoto Protocol through technological innovation, they may solve this problem in two ways (Wang 2007). The first is to purchase the carbon emission quota from another country. This forms the market for carbon dioxide emission rights, referred to as "carbon trading." The second is to invest in reforestation in developing countries to increase carbon credit, thereby alleviating its total carbon emission targets. This represents the so-called "carbon credit trading." Carbon trading and carbon credit trading are both effective ways to achieve ecological value compensation via the market mechanism.

Clean development mechanism (CDM)

CDM is a flexible mechanism in which developed and developing countries cooperate to reduce greenhouse gas emission which was established based on Article XII of the Kyoto Protocol. CDM allows investors from an industrialised country to carry out projects that can reduce greenhouse gas emissions or remove greenhouse gas from the atmosphere via carbon sequestration in the soils of developing countries, thereby reducing greenhouse gas emissions. Based on this, the investor can obtain "certified emission reductions (CER)" which can be used as credits for greenhouse gas emission in their own country. In this way, the developing country can fulfil the obligations for country emission limitations or reductions as specified in the Kyoto Protocol.

CDM includes potential projects in the following aspects: end-use energy efficiency improvement; supply side energy efficiency improvement; renewable energy; alternative fuels; agriculture (methane and nitrous oxide emission reduction projects); industrial processes (carbon dioxide emission reduction from cement production and other processes, hydrofluorocarbons emission reduction, sulfur hexafluoride and full carbon dioxide reduction); and carbon sequestration projects (only for afforestation and reforestation projects).

Although the international regulations provide general guidelines regarding the baseline and additionality, each developing country has the responsibility to determine their own criteria for project approval. The project host country and project investor also must prepare a project design document which must contain: a project description, a method for determining the baseline, a project schedule and the date of obtaining CER, monitoring methods and plans, calculations of greenhouse gas emissions by emission source, an environmental impact assessment, and opinions of the stakeholders of the project.

Voluntary Emission Reduction (VER)

With the development of the CDM projects following the Kyoto Protocol, VER markets were formed. VER markets first originated from the behaviour of some groups or individuals who purchase emission reduction credits voluntarily to cancel out their greenhouse gas emissions. The purpose, effect, applicable industries, and measurement standards of VER projects are the same as that of CDM projects. CERs are approved and issued by the United Nations Executive Board (EB), whereas VERs are issued by the Designated Operational Entity (DOE) of the United Nations EB. Compared to CDM projects, VER projects involve fewer approval steps and require less funds, time, and effort which improves the development success rate and lowers the risk of the development. Therefore, compared to CDM projects, VER projects are more flexible, they are easier to adapt to local conditions, and the requirements on the participants are lower. Hence, VER projects are worth promoting.

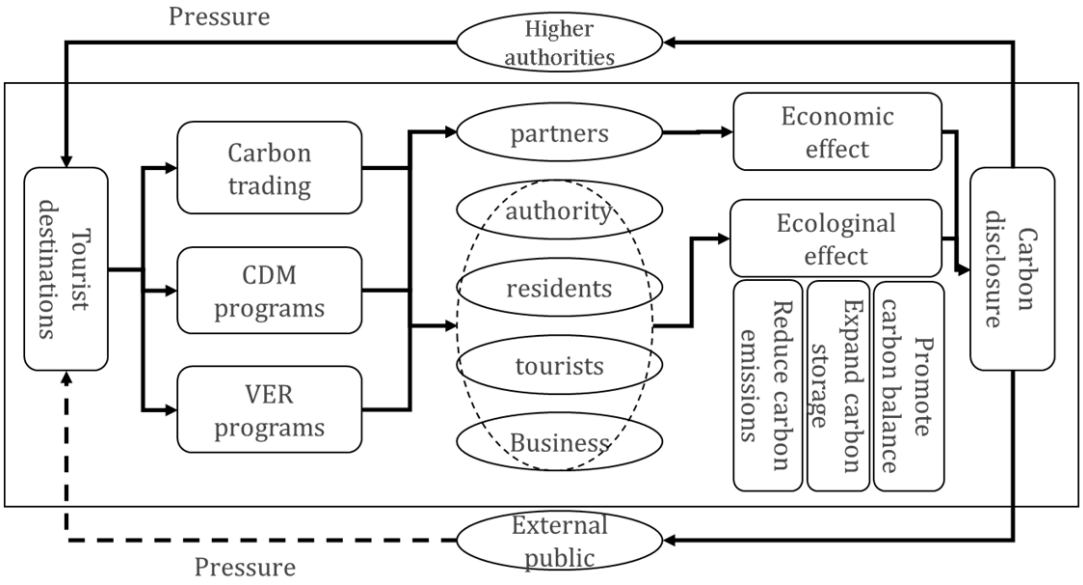

Fig.4. Construction of carbon management mechanism in tourist destinations

CONSTRUCTION OF THE MECHANISM OF CARBON MANAGEMENT IN TOURIST DESTINATIONS

The process of carbon management is the process of carbon emission reduction. Carbon management in tourist destinations is carried out via the emission reduction targets, emission reduction implementation measures, and emission reduction effect evaluations. Therefore, the core of carbon management mechanism is the carbon reduction mechanism.

According to the Kyoto Protocol, there are three types of carbon reduction mechanisms: emissions trading (ET), joint implementation (JI), and CDM. JI and ET are emission reduction cooperation projects or emission reduction credit trading between developed countries, and China does not participate in the implementation of these two mechanisms. In CDM, the developed country provides funds and technologies, cooperates with developing countries, and the certified emission reduction credits can be applied through the project to the developed country to complete the obligations of the Kyoto Protocol. As of 7 May 2013, the number of registered CDM projects between China and developed countries published on the CDM Executive Board (EB) official website has reached 3563, accounting for approximately 53% of all CDM projects worldwide.

Construction of the mechanism of carbon management in tourist destinations requires an understanding of the system structure, internal connections, and function of the carbon management as well as knowledge regarding the key factors determining the efficacy of carbon management. For carbon management in tourist destinations, the basic operational mechanism is the driving mechanisms for carbon sources and carbon sinks, the dynamic mechanisms are CDM and carbon trading, and the rights and responsibility constraints on main participants of carbon management as well as the social supervision mechanism are established based on stakeholder theory (**Fig. 4**).

Carbon management is the process of managing the carbon cycle system in the tourist destinations. Its relevant activities are centred on the goal of reducing carbon sources, increasing carbon sinks, and promoting carbon balance. Therefore, the operational mechanism of carbon management is based on the driving mechanism of carbon sources and carbon sinks.

CDM and carbon trading serve as the dynamic mechanisms of carbon management in tourist destinations. First, carbon trading can promote the transformation of carbon sinks in the tourist destinations into real economic gains and drive carbon management from the perspective of economic gains. Secondly, CDM is government-led and promoted by government regulations. Third, public carbon consciousness promotes VER projects, enhancing the social value of carbon management. CDM is the core of the dynamic mechanism of carbon management and the basis for carbon trading. CDM projects are the pilot projects for VER projects.

The constraint mechanism of carbon management in tourist destinations is the stakeholder mechanism.

Feedback from the main participants and stakeholders of the carbon management can constrain and modify the behaviour of the carbon management system. In the past, stakeholders have not received sufficient attention in environmental management because their impacts were not initially clear. However, with population growth and the growth in consumption level, the influence of the behaviour of the stakeholders will account for an increasingly large portion of all environmental problems. Hence, their role in responsibility sharing should also grow.

CONCLUSION

Carbon management requires directing the carbon cycle system in tourist destinations. Its relevant activities are centred on the objectives of reducing carbon sources, increasing carbon sinks, and promoting carbon balance. The key issue that carbon management in tourist destinations needs to address is how to maintain a smooth operation of the carbon cycle by means of intervention in order to coordinate the development of the tourism industry and the ecological environment. The impacts of tourist destinations on the carbon cycle are mainly manifested in two aspects: (1) directly driving the changes in the carbon sources and carbon sinks in the tourist destination and (2) indirectly driving relevant factors in the carbon cycle of the tourist destination.

The theoretical framework for carbon management in tourist destinations is a new framework based on carbon cycle and environmental management in these locations. On the one hand, carbon cycling in tourist destinations is the core and main objective of carbon management. On the other hand, environmental management provides the management theory and methodological support for carbon management in tourist destinations. Based on comprehensive measurement of carbon emission, carbon management in tourist destinations involves the following: assessing carbon footprints, identifying the main driving factors for carbon emissions and carbon emission reductions in tourist destinations, proposing carbon reduction measures, determining the distribution of rights and responsibilities in the carbon reduction process, evaluating the effect of the carbon reduction, determining the subsequent improvement measures, and improving the carbon management mechanism to continuously optimise the effect of carbon management.

Construction of the mechanism of carbon management in tourist destinations involves an understanding of the system structure, internal connections and function of the carbon management, as well as the key factors determining the efficacy of carbon management. For carbon management in tourist destinations, the basic operational mechanism is the driving mechanism for carbon sources and carbon sinks, the dynamic mechanisms are CDM and carbon trading, and the constraints on the rights and responsibilities of the main participants of the carbon management and social supervision mechanism are formed based on stakeholder theory.

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