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Tourism sustainability in Tibet – Forward planning using a systems approach



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ABSTRACT

The purpose of this study is to employ a nonlinear dynamic evaluation method to assess the tourism sustainability of Tibet Autonomous Region (TAR), China, a new emerging tourism destination. The methodology draws on system dynamics and Back Propagation (BP) neural network. According to 7 setting principles, this study identifies 13 tourism sustainability indicators including conventional tourism income, tourism resources stock, pollution stock, etc., as well as specific residents' tourism cognition, seasonal difference, accessibility, etc. Then a system dynamics model including the 13 indicators (variables) and other relevant auxiliary variables is established. Based on the numerical simulation, using a three layers BP neural network optimized by genetic algorithm and particle swarm algorithm, this study evaluates the future sustainability dynamically and compares the sustainability evolution from 2014 to 2050 under different development strategies. The research results not only provide information useful for the dynamic control and scientific management of the future sustainable tourism development, but also provide a systems approach to evaluate regional tourism sustainability.

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1. Introduction

Since the appearance of the Sustainable Development as an environmental management thought, sustainable development strategies have been gradually formed and widely accepted by the public. In this context, the World Tourism Organization (UNWTO) proposed the concept of Sustainable Tourism Development (STD) in 1993, and then United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP) and UNWTO jointly adopted “Sustainable Tourism Development Charter” and “Sustainable Tourism Development Action Plan” at the World Tourism Sustainable Development Conference held in Spain. Consequently, “sustainable tourism development” and “sustainable tourism” have become high frequency key words in research publications on tourism. Thereinto, the assessment of tourism sustainability has become the focus of the literature on sustainable tourism and its hot topic (Lu and Nepal, 2009).

Sustainable development was defined as development that meets the needs of the present without compromising the ability of future generations to meet their own need, due to the fact that STD is based on the sustainable development (UNWTO, 1998), the assessment of the STD is developed on the regional sustainable

development evaluation. Accordingly, the UNWTO defines STD as follows: sustainable tourism development meets the needs of present tourists and host regions while protecting and enhancing opportunities for the future. Generally, a sustainable development evaluation index system includes three domains: economy growth, society development, and environment protection (Li et al., 2009; Yu and Wen, 2010; Tso et al., 2011; Hak et al., 2012). Similar to the evaluation of sustainable development, the evaluation of STD is also based on economic, social and environmental elements, supplemented by other related indicators such as population, resources, etc. (Tsaour et al., 2006; Choi and Sirakaya, 2006; Sharpley, 2009; Castellani and Sala, 2010; Blancas et al., 2011; Wan and Li, 2013; Pérez et al., 2013).

Yet, although considerable and sustained research efforts have contributed to the assessment of tourism sustainability, there has been intense debate about how sustainability should be assessed (reductionist vs. systems approach; Ko, 2005). The dominant research paradigm currently is mainly based on linear methods (reductionist approach) measuring different level indicators such as Analytic Hierarchy Process (AHP) (Tsaour and Wang, 2007; Lee et al., 2010; Park and Yoon, 2011; Crouch, 2011), Touristic Ecological Footprint Model (Gössling et al., 2002; Yang and Li, 2005; Li and Hou, 2011; Castellani and Sala, 2012) and Data Envelopment Analysis (DEA) (Cracolici et al., 2009; Pérez et al., 2013). Unfortunately, the correlation of the impact factors of STD, subjectivity of determining weights, difficulty of calculating quantitative indicators and

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appearance of noise in indicators data, as well as some other factors, lead to that the traditional research paradigm is often difficult for making scientific description of the sustainability. So the reductionist approach is limited. Thus, some improved methods such as the integration of the Delphi technique and network analysis (Melón et al., 2012), genetic algorithms (Huang et al., 2009) and spatial agent-based model (Balbi et al., 2013) demonstrate the applicability of nonlinear evaluation methods in general. In addition, there is still a critical and significant but long-neglected issue: how to assess the tourism sustainability at different development stages and scenarios. Despite the dynamic assessment in some areas such as water scarcity risk (Gain and Giupponi, 2015) and climate change (Giupponi et al., 2013), in the existing literature on evaluation of STD, more attention is paid to the static analysis, and dynamic extensions have long been neglected. Only dynamic evaluation of STD can contribute to the scientific control and management of regional tourism systems (Buhalis and Costa, 2006; Tyrrell and Johnston, 2008). Hence, Zhang et al. (2013) argues that a combination of quantitative and qualitative indexes, nonlinear and linear methods, and static and dynamic evaluations is the future of the sustainable tourism evaluation method.

Given this background, this study employs a systems approach to assess the tourism sustainability and compare the sustainability in different scenarios. Its aim is to resolve the lack of dynamic and comparative assessment of tourism sustainability. The proposed methodological framework will be a basis on which the tourism sustainability can be assessed in various destinations at different development stages and under different scenarios. The methodology presented in this paper draws on system dynamics and BP neural network. The system dynamics is a suitable approach, used to predict dynamic results of interactions in complex systems and analyze policies in different scenarios (Bald et al., 2006; Arquitt and Johnstone, 2008). BP neural network has great advantages in evaluation research with the excellent property of massively parallel distributed processing, great adaptability, self-learning, robustness and fault tolerance (Papale and Valentini, 2003; Yu et al., 2008). So the method combining system dynamics with BP neural network is right competent for this study.

This study is divided into 6 sections. In the next section we describe the case and why we choose it. In Section 3 we explain how the indicators and data were obtained to measure tourism sustainability. In Section 4 we carry out a system dynamics simulation. The results and discussions are presented in Section 5 using BP neural network and the conclusions in the final section.

2. Study area

This study takes the Tibet Autonomous Region (TAR) in China as a case study. TAR is an emerging tourism destination in China with a lot of world-famous historical sites, magnificent plateau landscapes related to Tibetan Buddhism. Since the 21st century, the central and local government have adopted policies to improve the Tibetan tourism industry strategically. In 2000, the TAR government explicitly prioritized the industry to develop tourism. At the “2005 EU-China Tourism Forum” held in Switzerland, Lhasa, the capital of TAR, was rated as the “European tourists favorite tourist city” and Potala Palace as the “European tourists favorite tourist attractions”. Besides Potala Palace, Mount Qomolangma, Drepung Monastery, Tashilhunpo Monastery, Yarlung Zangbo Grand Canyon, Mount Namchabarwa, Mount Kangrinboqe, Namtso, Lake Manasarovar, etc. are also very fascinating tourism attractions. In 2010, The Fifth Tibet Work Forum of The CPC Central Committee proposed to build TAR into an important world tourism destination and put Tibetan tourism under the national development strategy. Consequently, in 2013, TAR was visited by 12.91 million tourists (23 times

the number in 2000), and the tourism income amounted for RMB 16.52 billion (26 times the number in 2000) (National Tourism Administration of PRC (NTAPRC), 2014). As a result of this rapid development, some research efforts to Tibetan sustainable tourism have been made (Zhang, 2011, 2013; Zhang et al., 2011), nonetheless, few studies contributed to Tibetan tourism sustainability. There are still some critical issues remained: Does the rapid tourism development accord with the sustainable development? What are the key indicators affecting the tourism sustainability? What are the current and future tourism sustainability? What countermeasures should be adopted to improve the tourism sustainability?

Taking this into account, we take TAR as our case study to dynamically evaluate its tourism sustainability and provide important information regarding the sustainable development.

3. Sustainability indicators and data collection

3.1. Setting principles and indicators

Based on the tourism development goals presented in “Tibet Autonomous Region Tourism Development Master Plan (2005–2020)” and “Tibet Autonomous Region Twelfth Five-Year Development Plan”, this study focuses on indicators with important decision-making reference values following the fundamental principles of comprehensibility, measurability and availability (Manning, 1999; Miller, 2001; Medina, 2005; Schianetz and Kavanagh, 2008), as well as special principles of independence, dynamics, boundedness and specificity.

- (1) **Comprehensibility.** On the basis of the foregoing analysis, the STD system includes economy, society, environment, population and environment elements, and the essence of STD is to promote the coordinated development of them (Bramwell and Lane, 2013; Edgell, 2013; Liu, 2003; Zhang, 2011). Thus the evaluation indicators of STD is a comprehensive system comprising 5 subsystems: the economy subsystem, population subsystem, society subsystem, resource subsystem and environment subsystem. There will be one or more indicators in every subsystem.
- (2) **Measurability.** The indicators should be quantitative, or qualitative ones that could be converted into quantitative indicators using quantitative methods. For instance, the local culture is a destination's most valuable asset and play an important role in achieving sustainability (George and Reid, 2005), nevertheless, culture change is difficult to be measured quantitatively in STD, hence cultural indicators are excluded in this study.
- (3) **Availability.** It is difficult to obtain some indicators' data due to the existing statistical system in TAR, therefore, considering the tourism development, the evaluation indicators should be available through related literature analysis or field research or some technical methods. Despite the fact that crises have a major impact on STD in TAR (e.g. “SARS” in 2003, “3.14” Lhasa Riots” in 2008), it is impossible to forecast when they will happen, so crises indicator is unavailable.
- (4) **Independence.** Though completely independent indicators in sustainable development are nonexistent (Hak et al., 2012), there should be weak correlation between selected indicators. In traditional evaluation model (especially the linear model), there was strong correlation between indicators very often, which affects the evaluation accuracy.
- (5) **Dynamics.** Indicators should be sensitive to the changes of the socio-economic environment, otherwise it is difficult to reflect the dynamic changes of the tourism sustainability. Some indicators such as tourism area (Pérez et al., 2013), although it may also constrain the tourism sustainability, it does not work in the

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