http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 12 (21): 6229-6234, 2013
ISSN 1812-5638 / DOI: 10.3923/itj.2013.6229.6234

A Study on the Mechanism of Coupling Coordination Development of Tourism Carrying Capacity and Application Research

[1,2]Xiuping Yang and [1]Gangmin Weng
[1]College of Economy and Management, Yanshan Uinversity, Hebei, Qinhuangdao, 066004, China
[2]College of Economy and Management, Lanzhou University of Technology, Gansu, Lanzhou, 730050, China

Abstract: The objective of this study is to keep the sustainable carrying of tourism environment. Using the coupling theory, this study defines the connotation of tourism environment coupling system and analysis the formation mechanism and the module of the tourism environment coupling system. According to the research of the "structural coupling" and "stress coupling", it not only ensures the benign development of the tourism environment system, but also makes the different systems in the “interaction” under the action of the whole value added. This study takes the coupling of tourists and tourism environment system for and example to improve the reality explanation and guidance force and takes Jifa agricultural ecological sightseeing garden as an example.

Key words: Tourism environment coupling system, sustainable capacity, tourism environment capacity rate

INTRODUCTION

Tourist demand has increased rapidly in recent decades, widening the gap between tourist flow and tourism carrying capacity in tourist destinations. Intensified tourist flows at the global scale and the rising demand of tourists are vivid indicators that indicate the tourism industry is in the mass tourism. There is also increased pressure on the tourism environmental system. Especially in China, government in tourism destinations tend to regard tourist number as a critical generator of economic growth (e.g., Qinhuangdao, Sanya, Dali, etc.,). Therefore, some tourist destinations are facing the problem of carrying capacity. Carrying capacity theory has been investigated and applied with various tourist destinations by many foreign and domestic scholars.

Moreover, the establishment of mechanism of coupling coordination development between tourism carrying capacity of tourism flow has become the most urgent problem for the tourist destination. This study focuses on "structural coupling" and "stress coupling" of the tourism carrying capacity and takes the coupling of tourists and tourism environment system for and example to improve the reality explanation and guidance force taking Jifa agricultural ecological sightseeing garden as an example.

COUPLING MECHANISM OF TCC

Coupling, a conception derived from Physics, is a type of phenomenon of integration that is formed by the interaction of different systems or different modes of motion. The system coupling applies to analyze the relationship of coordination, feedback and development mechanisms. Coupling theory is an important tool to examine the law of tourism environment supply system and tourism environment demand system. (Kunz et al., 2013).From the tourism sustainability perspective, the balance of TCC and tourist flow is a critical player in sustainable carrying. As the expansion of the tourist number-particularly within the rapidly growing economies of China-it will become even more important.

Tourism environment coupling system has different features of the main adaptive, self diagnosis, self organization and high relevance between TES and relevant systems. TES includes Ecology environment (E), Economy environment (E) and Society environment (S) and it also couples with Tourist Number/Tourist Type (TN/TT), Tourism Area Life Cycle (TALC), Tourism Industry Ecology (TIE), Tourism Sustainable Development (TSD), Tourism Impact (TI), Tourism Destination Civilization (TDC) and Other Systems (OS), respectively. The coupling mains are nonlinear relationships, shown Eq. 1:

Corresponding Author: Xiuping Yang, College of Economy and Management, Yanshan Uinversity, Hebei, Qinhuangdao, 066004, China

$$TECS \sim \begin{cases} K_{stucture}(E,S,E) \\ K_{stress}(TN/TT,TDLC,TIE,TSD,TI,TDC,OS) \end{cases} \quad (1)$$

The structure coupling emphasizes the coupling relationship in the interior system. The stress coupling focuses on the TES with the other systems. These systems are constantly "learning"-"experience"-"knowledge" and can make use of the experience accumulated for changing the structure and behavior of their own way. It can promote the whole system development and evolution according to using environmental change and other subjects to coordinate. According to the theory of complex adaptive system, tourism environment coupling system has four characteristics (e.g., gathered; flow, nonlinear and diversity) and with mechanisms of identification, internal model and block.

The role of “Intermediate layer” is as far as possible to provide support and security related to tourism environment. “Tourism environment system base layer” is based on the sharing of resources of tourism environment coupling system in the natural environment, economic environment and social environment of tourism travel. They are physical or logical entity. Based on long-term monitoring, can construction of basic database. The role of this layer is implementation of the management and control for individual resources (databases) and monitors the resource status and statistics regarding resource use data. “Tourism environment convergence layer” emphasizes the principle or method to collect data and the indicators are obtained. Basic data is transformed in convergence layer and security of subsystems is implemented here. “Closely related layer” includes the relationships of tourism environment with TN/TT, TALC, TIE, TSD, TI, TDC, or OS. “Interaction layer” is the role of the interactive relationship of tourism environment system and other systems. It provides the theoretical foundation for the study of coupling degree. “Application layer” focus on the user’s application in the coupled system.

ANALYSIS OF COUPLING MODULE

In order to analyze the relationship of Tourism Environment Coupling System (TECS), the tourism environment system coupling model (TECM) is built, as shown in Eq. 2:

$$TESCM \sim \begin{bmatrix} AB_{11} & AB_{12} & \cdots & AB_{1m} \\ AB_{21} & AB_{22} & \cdots & AB_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ AB_{n1} & AB_{n2} & AB_{n3} & AB_{nm} \end{bmatrix} \quad (2)$$

$$Ab_{ij} = (A_i B_j)\ (i = 1, 2, 3, \ldots, n;\ j = 1, 2, 3, \ldots, m)$$

Module should fully consider the related system standard and make the tourism environment module used and to meet the current needs of tourism environment standard as far as possible. Corresponding to different environment of tourism demand and tourism environment types, the types of coupling are different. The number of modules about tourism environment coupling system in reality is far less than the number of coupling module in theory. The reason is that tourism environment system and some systems can not be combined because of the limitations of tourism environment system, development deficiencies of related system, or restrictions on national policy. There is no ability to mix.

EXAMPLE

According to analyze the TALC, TT or TN keep a closely and dynamic relationship with the TCC. With the different phase of TALC, the increasing or declining of TN, the fluctuating of TCC, the tourism environment is affected. The degree of affected can be weighted by Tourism Carrying Rate (TCR), as shown in Eq. 3. The dynamic adjustment of TCC also impacts the brand of tourist destination tourism attraction and the development of tourist destinations. This article use the TCC, TCR, TN based on the TALC and describes the “Window-flower” model (Fig. 2a). In some period, the TCC keeps stable and invariable and tourist number is fluctuating up or down with factor of season. (Lafferty and Van Fossen, 2005).According to the TALC, limits are dynamic and changes will depend on how the destination adapt to the new situations, for example, increasing the carrying capacity from the sustainable development perspectives (Fig. 2c). With the increasing of tourism number, TES can be degradation or decline in some extent (Fig. 2b).

$$TCR = \frac{TQ}{TCC} \quad (3)$$

Tourist area contains numerous types of tourist attractions and different types of tourists can be attracted by different attractions, thus affecting the spatial displacement of tourists. For example, the diversity tourist attractions in one destination cause the change of tourist spatial displacement. Building the collections of modules-LM and NM. The collections of modules of LM for L-tourist is (AB_{31}, AB_{32}, AB_{23}, AB_{34}, AB_{82}, AB_{8n}, AB_{m2}). The collections of modules of NM for N-tourist is (AB_{11}, AB_{22}, AB_{24}, AB_{32}, AB_{43}, AB_{81}, Ab_{m2}). The LM and NM

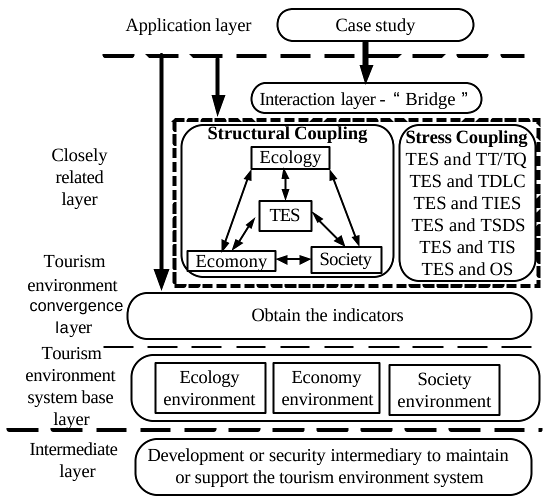

Fig. 1: Coupling mechanism of TCC

reflect the coupling relationship of TES and tourists, shown in Fig. 3.

AREA OF STUDY

Builds indicator system and evaluates method. (Aksoy and Ozturk, 2011). As dimensions in Fig. 1, the indicators of TCC include three dimensions: Including 2 natural, 8 economic and 3 social. It may not be necessary or possible to use all the indicators in all cases. It is important for a tourist destination to select a mostly appropriate dimensions and indicators to calculate. The hierarchical structure of the dimensions and indicators is shown in Table 1.

Secondly,Calculates the weight. This study advances a dynamic improving hierarchical process (ADIHP). In the X_i state, the weight of the indicators is (w_1, w_2, ..., w_{13}) and the total is 1. In the x_i state, the process of using the ADIHP can be divided into three steps. First, establish a hierarchical structure by recursively decomposing the decision problem. Second, construct the pairwise comparison matrix to indicate the relative importance of alternatives. As numerical rating including three rank scales is suggested, as shown in Table 2. Third, calculate the weights by the following three scale matrix, shown in Eq. 4.

$$C = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1n} \\ c_{21} & c_{22} & \cdots & c_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ c_{n1} & c_{n2} & \cdots & c_{nn} \end{bmatrix} = \left(c_{ij}\right)_{n \times n} \quad (4)$$

According to the matrix C above mentioned, calculate the importance index r_i. b_m is used to express the degree of

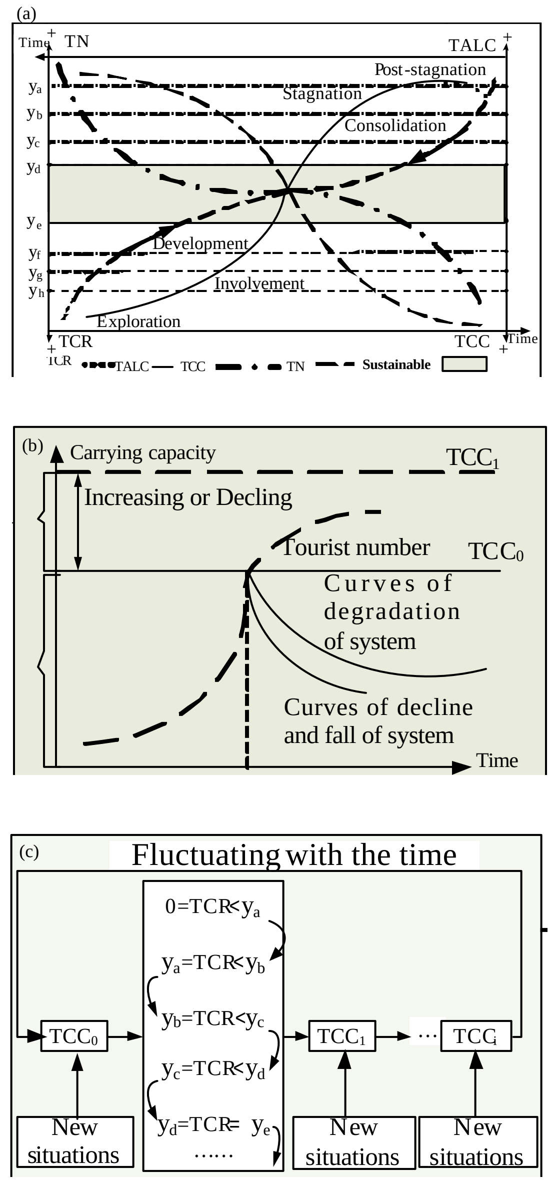

Fig. 2(a-b): (a) "Window-follower model" of TCC, TQ, TALC, TCR, (b) The state of tourism environment and (c) The fluctuating of TCR

importance of r_{max} and r_{min} corresponding to the index given according to some scale. The judgment matrix B is obtained by the indirect hierarchy analysis of matrix C. Then the calculation is followed by the process of AHP. Otherwise, the comparison matrix needs to be adjusted [4]. The process is shown in Eq. 5-9. The weight set is calculated in three conditions using the process above mentioned.

$$r_i = \sum_{j=1}^{n} c_{ij} \quad (5)$$

Table 1: Indicators of the TCC

F		
$TCC_{Ecology}$ (F_1)		x_1: Ecological Carrying Capacity
		x_2: Tourism Resources Carrying Capacity
$TCC_{Economy}$ (F_2)	F_{21} Infrastructure Carrying Capacity	x_3: Water Facilities Carrying Capacity
		x_4: Power Facilities Carrying Capacity
		x_5: Communication Carrying Capacity
		x_6: Transport Carrying Capacity
	F_{22} Tourism Service Facilities Carrying Capacity	x_7: Accommodation Carrying Capacity
		x_8: Dining Facilities Carrying Capacity
		x_9: Recreational Carrying Capacity
		x_{10}: Shopping Facilities Carrying Capacity
$TCC_{Society}$ (F_3)		x_{11}: Carrying Capacity of Management Level
		x_{12}: Carrying Capacity of Local Residents' Endurance Situation
		x_{13}: Carrying Capacity of Aesthetic Perception of Tourists

Table 2: Numerical rating in the ADIHP

Scale	Meaning
2	Importance
1	Equal importance
0	Not importance

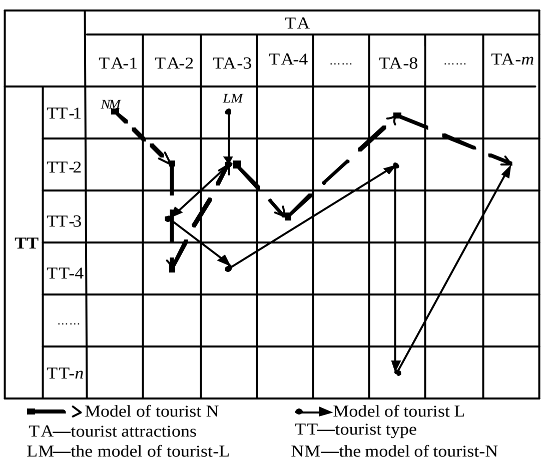

Fig. 3: Coupling of TES and TT

$$r_{max} = \max\{r_i\} \tag{6}$$

$$r_{min} = \min\{r_i\} \tag{7}$$

$$b_{ij} = \begin{cases} \dfrac{r_i - r_j}{r_{max} - r_{min}}(b_m - 1) + 1, & r_i > r_j \\ 1, & r_{max} = r_{min} \\ \left[\dfrac{r_j - r_i}{r_{max} - r_{min}}(b_m - 1) + 1\right]^{-1}, & r_i < r_j \end{cases} \tag{8}$$

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} \tag{9}$$

In the X_i state, the synthetically evaluation of TCC can be calculated after the calculated values of single index C_i and the weight w_i, as shown in Eq. 10:

$$TCC_{X_i} = \sum_{i=1}^{13} C_i \times w_i \tag{10}$$

Thirdly, determines gradations of TCR. This study uses the five-point scale, as shown in Fig 2a. Assume that evaluation indicators of TCR $X = \{x_1, x_2, \ldots\ldots, x_{13}\}$ range is $\{U_1, U_2, \ldots\ldots, U_{13}\}$, $U_i = [0,1]$, $i = 1, 2, \ldots, 13$, Y is the target variable of TCR which the domain is [0,1]. The level of deviation can be measured by the Angle between indicators and indicators of expectations. If denote the degree of deviation as Y_t which is the given indicator of $(y_a, y_b, \ldots, y_k)$, based on the definition of the degree of deviation. Value of Y_t is more close to that shows the current warning area Y_i is represented, as shown Eq. 11:

$$Y_t = \frac{X \cdot Y_i}{\|X\| \cdot \|Y_i\|} \tag{11}$$

Indicators $\{x_1, x_2, \ldots\ldots, x_{13}\}$ is denoted by $x_n(t)$, where $n \in [1, 13]$, t denotes the time, so select the value of the k-based indicators can constitute the $n \times k$ dimension feature state space:

$$\begin{bmatrix} x_1(1) & x_1(2) & \cdots & x_1(k) \\ x_2(1) & x_2(2) & \cdots & x_2(k) \\ \vdots & \vdots & \vdots & \vdots \\ x_n(1) & x_2(2) & \cdots & x_n(k) \end{bmatrix} \tag{12}$$

Predict the development by establishing the GM(1,1) gray model for all indicators in the evaluation system:

$$\frac{dx^{(1)}_i}{dt} + a_i x_i^{(1)} = u_i \tag{13}$$

Table 3: Graded levels of coupling

level	Bad	Poor	Medium	Good	Excellent
(Y_i)	$[0,y_a)$	$[y_a,y_b)$	$[y_b,y_c)$	$[y_c,y_d)$	$[y_d,y_e)$
	$[y_h,+8)$	$[y_g,y_h)$	$[y_f,y_g)$	$[y_e,y_f)$	
Value	[0,0.27)	[0.27,0.38)	[0.38,0.46)	[0.46,0.55)	[0.55,0.72)
	[0.89,1)	[0.80,0.89)	[0.80,0.85)	[0.72,0.80)	

Table 4: Statistics of Jifa agricultural ecological sightseeing garden

Years	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	Deviation
							Y_2							
2006	0.475	0.524	0.485	0.461	0.427	0.617	0.517	0.659	0.518	0.634	0.612	0.423	0.624	0.9892
2007	0.517	0.540	0.545	0.489	0.455	0.636	0.556	0.638	0.543	0.661	0.645	0.524	0.658	0.9932
2008	0.532	0.575	0.605	0.537	0.478	0.667	0.636	0.667	0.564	0.682	0.636	0.611	0.675	0.9984
2009	0.556	0.627	0.644	0.568	0.491	0.687	0.679	0.694	0.587	0.710	0.667	0.572	0.694	0.9946
2010	0.573	0.667	0.669	0.581	0.546	0.695	0.735	0.711	0.613	0.708	0.691	0.586	0.717	0.9871
2011	0.587	0.713	0.695	0.621	0.576	0.716	0.764	0.733	0.672	0.724	0.693	0.615	0.729	0.9927
							Y_3							
2012	0.630	0.728	0.712	0.642	0.612	0.736	0.793	0.758	0.708	0.748	0.706	0.641	0.736	0.9888
2013_{pre}	0.624	0.736	0.725	0.639	0.604	0.742	0.781	0.762	0.712	0.753	0.716	0.652	0.747	0.9867
2013_{error}	0.627	0.731	0.726	0.636	0.596	0.748	0.790	0.768	0.709	0.749	0.717	0.650	0.750	0.9917
2013_{actul}	0.588	0.732	0.734	0.639	0.599	0.753	0.801	0.771	0.713	0.752	0.721	0.661	0.754	0.9948
2014_{pre}	0.632	0.735	0.739	0.655	0.614	0.761	0.811	0.776	0.715	0.756	0.731	0.667	0.756	0.9876

Finally obtain the prediction results:

$$x_i^{(1)}(k+1) = \left[x_i^{(0)}(1) - \frac{u_i}{a_i}\right]e^{-a_i k} + \frac{u_i}{a_i} \quad (14)$$

$$\hat{x}_i^{(0)}(k+1) = x_i^{(1)}(k+1) - x_i^{(1)}(k) \quad (15)$$

Posteriori estimation is used to test the prediction accuracy, assuming $\epsilon_i^{(0)}(k+1)$ is the residual error for predictive value and the true value of the, then obtain:

$$\varepsilon_i^{(0)}(k+1) = x_i^{(0)}(k+1) - \hat{x}_i^{(0)}(k+1) \quad (16)$$

As the prediction error exists, BP neural network is used to amend the GM (1,1) model prediction residual. The neural network training processes see Reference.

Gradient descent method is adopted to adjust BP neural network weights, obtain the predictive value $\hat{\varepsilon}_i^{(0)}(k+1)$ based on the indicators residuals$\epsilon_i^{(0)}(k+1)$. The ultimate predictive value is shown in Eq. 10:

$$x_i^{(0)}(k+1) = \hat{x}_i^{(0)}(k+1) + \hat{\varepsilon}_i^{(0)}(k+1) \quad (17)$$

This study takes Jifa agricultural ecological sightseeing garden for an example. It is located in the north-eastern Hebei province, China, approximately 12 km from Qinhuangdao. Qinhuangdao is a beautiful seaside city famous for its ice-free port. It is one of the 14 coastal cities opening to the outside world; class 4A tourist city in China and also known as the country's "Summer Capital" and "China Top Tourist City". These conditions have contributed to making the tourism industry a significant alternative, especially considering the advantage of climate. More recently, the Jifa agricultural ecological sightseeing garden was assigned the title of "4-A scenic area". This expansive growth of Jifa agricultural ecological sightseeing garden has been the main factor causing the change of carrying capacity. According to statistics of Jifa agricultural ecological sightseeing garden in Table 2, calculate the deviation degree of alarm value for July 2006-July 2013. Coupling degree between tourism carrying capacity and tourists is divided10 points, as shown in Table 3. The data are collected through personal in-depth interviews and the main ways are questionnaire surveys and secondary data sources.

Use the gray prediction model, base indicators of July 2014 are calculated, we can find the value is 0.787. The coupling level is good, as shown in Table 4.

ACKNOWLEDGMENTS

The study is subsidized by the general project of the Ministry of Education, Humanities and Social Sciences (Western and Frontier Areas Projects) (11XJC630016), the National Social Science Fund (09BJY087) and (10CGL046), Hebei Province Social Science Fund Project (HB12YJ075) and Hongliu Plan of Lanzhou University of Technology (Q201213).

REFERENCES

Aksoy, A. and N. Ozturk, 2011. Supplier selection and performance evaluation in just-in-time production environments. Expert Syst. Applic., 38: 6351-6359.

Kunz, N.C., C.J. Moran and T. Kastelle, 2013. Conceptualising coupling for sustainability implementation in the industrial sector: A review of the field and projection of future research opportunities. J. Cleaner Prod., 53: 69-80.

Lafferty, G. and A. Van Fossen, 2005. The role of clusters in preventing tourism decline: A conceptual and empirical examination. Int. J. Services Technol. Manage., 6: 142-152.