



Emergy Analysis of Sustainable Development of Rural Tourism from the Perspective of Rural Revitalization

Jing Zhou*

College of Tourism, Northwest Normal University, Lanzhou, 730070, China

Corresponding author: zj_880129@nwnu.edu.cn

Abstract. In 2020, China's historic elimination of absolute poverty, China's "Three rural work focus from poverty alleviation to the full realization of rural revitalization, the effective link and organic combination of poverty alleviation and rural revitalization are the important strategic support for China to realize the "Two centenary goals". The sustainable development of rural tourism is the key to realize the ultimate goal of rural revitalization, which is to make agriculture strong, countryside beautiful and farmers rich. In view of this, this paper uses the emergy analysis method of eco-economics, taking the rural tourism complex system as the research object, constructs the energy analysis structure chart of rural tourism system and the Emergy Index System of sustainable development from the perspective of rural revitalization, through the analysis of the policy, material, environment, resources and other factors in the process of rural revitalization, the sustainable development level of rural tourism is comprehensively evaluated to provide a quantitative evaluation thinking for the effectiveness evaluation of rural revitalization, it is expected to provide reference for the selection of leading industries, the direction of government support, the consolidation of poverty alleviation, and the transformation and high-quality development of rural tourism.

Keywords: Rural Revitalization, Emergy Analysis, Sustainable Development, Rural Tourism

1 Introduction

At a time when the world is in a great change not seen in a century, China has fulfilled the task of eradicating poverty as scheduled, solved the problem of absolute poverty in a historic way, and entered a new journey of building a modern socialist country in an all-round way. The contradiction between the people's ever-growing needs for a better life and unbalanced and inadequate development has become the main contradiction in the new era of building socialism with Chinese characteristics. Solving the main contradiction in China has become an opportunity to seize the great changes in the world, the key to meeting the challenges of a changing world. At present, the problem of unbalanced and inadequate development in rural areas is particularly acute. Therefore, the state has proposed the implementation of the rural revitali-

zation strategy to solve the contradiction between the people's growing needs for a better life and unbalanced and inadequate development.

Compared with cities, the ecological, economic, social and cultural values of rural areas are completely irreplaceable, which requires that in the process of rural revitalization, rural areas can not be divided into homogeneous construction. At present, in the practice of rural revitalization in our country, there is a general wrong tendency to rejuvenate all the villages without considering the development trend of the villages in different types and regions, and without distinguishing between them, this led to the inefficient use and even waste of a large number of rural revitalization resources, resulting in "No development with growth, no return on investment". Therefore, in order to solve the problem of "Involution" and improve the utilization efficiency of rural revitalization resources, we must classify the villages, allocate the resources reasonably, abandon the villages that will inevitably disappear, and revitalize the villages with sustainable development. Which villages to give up, which villages to revitalize, how to revitalize need to build a set of evaluation index system to choose. Among the numerous rural development paths, it has become a common understanding that the tourism industry can promote the rural revitalization by integrating backward economy, fragile ecology and rich resources. On the basis of ensuring the production of agricultural products, we will realize the mutual penetration and deep integration of "Big agriculture" and "Big Tourism", accelerate the development of urban-rural integration, and rebuild the space of rural production, life, ecology and culture, to become a tourism-driven rural high-quality development and achieve the overall revitalization of an important path. Therefore, this paper uses emergy analysis of ecological economics to combine rural ecological environment, natural resources and social economic activities, the material flow, resource flow, talent flow and currency flow in the rural ecological-economic complex system are transformed into solar energy, and the systematic input-output analysis is carried out by constructing an evaluation index system, in order to evaluate the sustainable development level of rural areas, this method takes into account not only the input of human economic activities such as manpower, financial resources, material resources and policies, but also the input of natural environment resources, in order to avoid the appearance of "Dutch disease" in rural tourism, this paper evaluates the rural tourism system in a more comprehensive way, and provides a basis for the choice of giving up and revitalizing the rural areas and the high-quality development of rural tourism.

2 Review of research

As for the research on the combination of rural tourism and rural revitalization, before the strategy of rural revitalization was put forward, there were many relevant studies regarding rural tourism and rural revitalization as a main body, however, the relative research on rural tourism in rural revitalization and rural construction is relatively lacking. Since the 19th National Congress of the Communist Party of China put forward the strategy of rural revitalization, various areas have carried out various practical explorations. The academic circle has also carried out a large number of high-

quality and efficient studies on the Hot Topic of rural tourism boosting rural revitalization from various perspectives, and have produced fruitful research results. The current relevant research focuses on the mode, mechanism, path, countermeasures and effects of tourism to promote the overall revitalization of rural areas. There is no fixed model in the process of rural tourism promoting rural revitalization and development, and different development models should be adopted according to different types, different regions and different development bases. Research on the mechanism of tourism promoting rural revitalization in poverty-stricken areas focuses on the interaction between rural tourism and rural revitalization, scholars have analyzed the mechanism by which rural tourism promotes rural revitalization, taking into account the particularity of most rural areas in poor areas, it is necessary to study not only the mechanism of promoting rural revitalization by tourism, but also the mechanism of realizing the precision poverty alleviation by tourism, especially the coupling and linking mechanism between the precision poverty alleviation and the rural revitalization driven by tourism. In terms of the ways to realize the overall revitalization of rural areas. Scholars generally recognize that there is a natural coupling between the targeted poverty reduction strategy of tourism and the rural revitalization strategy, and strengthen the effective institutional link between the targeted poverty reduction strategy and the rural revitalization, it is of great significance to speed up the precise poverty eradication in the poor areas and even realize the overall revitalization of the countryside. The research on the measures of rural tourism promoting rural revitalization is quite targeted, Scholars put forward many measures from different angles. To sum up, the study of tourism boosting rural revitalization is still dominated by qualitative research, case studies and inductive methods have become the mainstream of research, and relatively speaking, mathematical statistics methods are not perfect, systematic, quantitative and standardized theoretical research and quantitative research results are relatively scarce.

For the rural areas rich in tourism resources, the connotation of the sustainable development of tourism is the same as the general goal of “Industry prosperity, ecological livability, rural civilization, effective governance and well-off life” and “Agriculture strong, farmers rich, rural beauty” put forward by the rural revitalization strategy. Therefore, based on the perspective of rural revitalization, a set of scientific evaluation index system that is logical, reasonable and applicable to a wide range of tourism to promote rural revitalization is constructed, this paper analyzes the environmental, ecological, economic and social factors of the tourism-assisted rural revitalization, and analyzes the key factors and support direction of the tourism-assisted rural revitalization, it provides a new way of thinking for grasping the difference of the countryside and the future development trend, highlighting the focal points, classifying the measures and understanding the role of tourism in the revitalization of the countryside.

3 Research methodology

3.1 An overview of emergy analysis theory

The theory and method of emergy analysis is an important method in ecological economics. In 1987, the famous American ecologist H.T. Odum ^[1] put forward the theory of emergy concept for the first time after long-term research and published the first emergy monograph in 1996. Emergy analysis is based on energy as a unified unit of measurement, an integrated method to analyze, convert and evaluate the flow of energy flow, material flow, information flow and money flow in environmental economic system by energy conversion rate. This method provides scientific basis for the formulation of sustainable development strategy by correctly analyzing the interaction and relationship between human activities and nature, environment, society and economic value. Therefore, the theory and method of emergy analysis have attracted the attention of ecologists, economists and systematists.

In the 1980s, the United States took the lead in developing a wealth of basic theories and case studies on emergy analysis, which contributed greatly to the improvement and development of this method. Subsequently, many developed countries such as Italy, Sweden, Australia, Switzerland and other countries also began to study. Emergy theory and methods were introduced into China in 1990s through the book on contemporary ecology. Shengfang Lan ^[2] and other scholars first carried out the applied research of emergy theory and analysis methods, the method is applied to analyze the sustainable development level of agricultural system. Since then, Chinese scholars have carried out a large number of basic theories and case studies of emergy theory. Based on the existing research, scholars apply emergy theory and analysis method to analyze different scale and different types of eco-system and eco-economic system.

Research on sustainable development of tourism as a hot spot of tourism research, scholars see the tourism system as a multi factor coupled, open, dissipative structure, with frequent material and energy flow and circulation inside and outside the system, said dynamical system, a professor of tourism at the University of California, San Diego, the application of emergy analysis in tourism system provides a quantitative research idea for sustainable development and high-quality development of tourism. In the applied research, the research objects selected by the scholars include tourism system, tourism ecosystem, tourism industry ecosystem, and tourism eco-economic system, etc., they include the natural, environmental, economic, social and tourism elements of a particular region involved in tourism activities, so the names of these systems can be used interchangeably. Reviewing the existing literature, the emergy analysis of tourism system has made great progress in the improvement of basic theory, the construction of index system and case study. Theoretical elaboration and improvement, including system boundary definition and emergy flow chart drawing, Emergy benchmark selection, emergy conversion calculation and method integration, for example, Odum ^[1], Brown ^[3], Abel ^[4], shengfang Lan ^[2] etc. Because the tourism eco-economic system covers a variety of system types, when selecting the elements, we need to judge the degree of interrelation between the natural, human environment

and tourism system to screen the elements, such as Doherty [5], Abel etc. In the index system construction, Odum initially constructed a series of emergy indexes to analyze the sustainable development level of the system, and then many other scholars constructed new indexes according to the characteristics and differences of different types of systems, improve the Odum index system.

3.2 Energy structure map of rural tourism system

Rural revitalization includes industrial revitalization, talent revitalization, cultural revitalization, ecological revitalization, and organizational revitalization. Therefore, the rural tourism system in the perspective of rural revitalization is a special type of man-land relationship regional system. The system includes many elements of “People, land, money, industry and technology” In rural revitalization, and is a compound dynamical system of “Nature, economy, society and Tourism” centered on agricultural production and tourism activities. Through literature review, on-the-spot investigation and research, carding the energy flow, material flow, information flow and currency flow of system input and output, the energy analysis structure chart of rural tourism system is constructed (Figure 1).

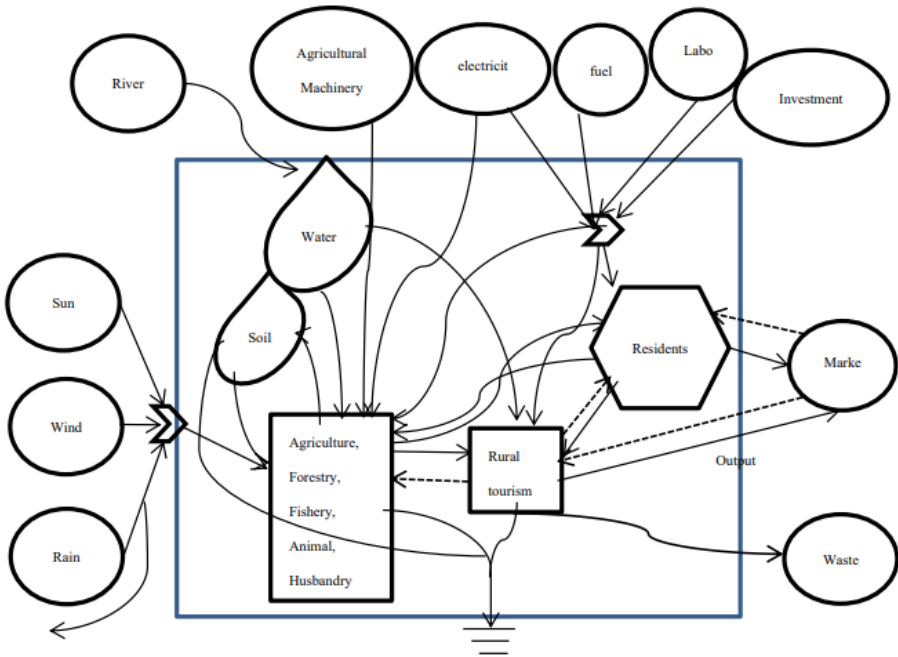


Fig. 1. Energy structure map of rural tourism system (Photo credit: Original)

4 Establishment of an indicator system

In this paper, the energy analysis method is used to establish an objective energy analysis index system of rural tourism system from the perspective of rural revitalization based on the energy structure chart of rural tourism system (Table 1), the index system covers not only the impact of human agricultural production and tourism activities on the rural ecological environment, but also the comparable relationships among energy flow, material flow, information flow and money flow, at the same time, taking into account the contribution of the free natural environmental resources in rural areas to the rural economy, highlighting the importance of the natural ecological environment to the development of the rural economy, and providing quantitative evaluation ideas for the sustainable development of rural tourism, it is expected to provide a new perspective for the selection of rural leading industries, the direction of government support, the consolidation of poverty alleviation, and the transformation and high-quality development of rural tourism.

Table 1. Energy index system of rural tourism system from the perspective of rural revitalization

Thematic layer	Sub-theme layer	Index layer	Calculation formula	Interpretation of indicator
Energy index	Input energy	Renewable resources	R	System's own energy
		Non-renewable resources	N	System's own energy
		System's own total energy	$M=R+N$	System's own total energy
		Purchase renewable resources	FR	Economic and social input energy
		Purchase non-renewable resources	FN	Economic and social input energy
		Total purchase input energy	$F=FR+FN$	Economic and social input total energy
		Agricultural input energy	FA	Agricultural investment wealth
		Tourism input energy	FT	Tourism investment wealth
		Government input energy	FG	Government investment wealth
		Non-government input energy	FC	Non-government investment wealth
		Total system input energy	$U=R+N+FR+FN$	Total energy in the system
	Output energy	Agricultural Products Output energy	A	Output the energy value of agricultural products
		Tourism output energy	T	Output the energy value of tourism

		Ecosystem output energy	S	The functional value of system ecological services
		Total Waste emissions energy	W	The energy contained in the discharged waste
		Total system output energy	$Y=A+T+S$	Output resources and commodity wealth
Rural Revitalization Index	Strong agriculture	Energy yield rate (EYR)	$EYR=Y/F$	Evaluate the economic benefits of the industry
		Tourism energy yield rate (TEYR)	$TEYR=T/F$	Evaluate the economic benefits of rural tourism
		Agriculture energy yield rate (AEYR)	$AEYR=A/F$	Evaluate the economic benefits of agriculture
		Energy exchange rate (EER)	$EER=U/Y$	Evaluation of the gains and losses of exchange
		Tourism investment energy ratio (TIER)	$TIER=FT/U$	Reflect the development level of rural tourism
		Government investment energy ratio (GIER)	$GIER=FG/U$	Reflect the dependence of the village on government investment
		Non-government investment energy ratio (NGIER)	$NGIER=FC/U$	Reflect the dependence of villages on non-government investment
	Peasant rich	GDP per capita	GDP/P	Evaluate people's economic income level
		Per capita energy	U/P	Evaluate people's living standards and quality of life
		Energy density	U/acreage	Evaluate energy intensity and utilization intensity
		Tourism energy per capita	T/P	Evaluate the improvement of people's living standards and quality of life by rural tourism
	Rural beauty	Energy investment ratio (EIR)	$EIR=F/M$	Evaluate nature's tolerance for economic activities
		Energy self-support ratio (ESR)	$ESR=R/U$	Evaluate the potential of rural natural environment to contribute to the system
		Environmental loading ratio (ELR)	$ELR=(U-R)/R$	Evaluate the pressure on the rural natural environment
		Waste output ratio (WOR)	$WOR=W/U$	Analyze waste output ratio

		Energy waste ratio (EPR)	$EPR=W/R$	Evaluate the pressure of waste discharge on the natural environment
Comprehensive index		Energy sustainable indices (ESI)	$ESI=EYR/ELR$	Evaluation system sustainable development level
		Energy indices of Sustainable Development (EISD)	$EISD=(EYR \times EER)/ELR$	New system sustainability performance indicators
		Rural revitalization ratio (RRR)	$RRR=\sum_{i=1}^n a_i X_i$	Comprehensive indicators for evaluating rural revitalization

Note: The calculation formula in the table is part of reference [1], part is constructed by this paper. R: renewable resources include solar energy, wind energy, rainwater energy, river energy and so on. N: non-renewable resources include surface soil loss energy and soil loss energy, p: total rural population (in the total rural population, the number of tourists in the corresponding proportion of the calculation of this part) U: system input total energy value; Y: total system output energy; N: number of important impact factors; XI: important impact factors; AI: weight of important impact factors.

The rural revitalization strategy emphasizes the concept of multi-function of rural areas, making the functions of rural areas from single to diversified, and taking "Agricultural multi-function" as an important goal of rural development, the coordinated and sustainable development of rural and agricultural resources, social economy and ecological environment is emphasized, and the all-round development of rural areas is required. Therefore, the sustainable development of rural tourism from the perspective of rural revitalization means abandoning agriculture, grain production and natural resource exploitation, and performing the function of rural landscape in addition to the original function, on the basis of ensuring the development of modern agriculture and food security, the rural community's functions of production, consumption and protection have broadened the path of rural development, making rural tourism a new growth point and catering to modern demands, so that the countryside to achieve "strong agriculture, rich peasants, and beautiful rural areas". the goal of full revitalization.

In summary, taking into account the characteristics and differences of villages in different regions, the characteristics of traceability and updating of data, the comparability of villages in different regions, and combining with the research results of other scholars, taking solar energy value as a unified standard of measurement, this paper constructs an index system of rural tourism system from the perspective of rural revitalization, which is suitable for universal evaluation. The evaluation index system is composed of three major parts: Concrete Evaluation Index, index calculation formula and index interpretation. The concrete evaluation index is that the evaluation of rural tourism system must consider concrete index, index calculation formula is the concrete calculation explanation of each index evaluation, and the index interpretation is the interpretation of the evaluation index.

In order to make the index system clearer, this article divides the index system into two thematic levels, namely the emergy index part and the rural revitalization evaluation part. The first part is the emergy index part, which is used to calculate the emergy input and output of the system. Including emergy input and output two sub-theme layer and specific indicator layer, where the input includes 11 indicators, and the output includes 5 indicators. The second part is the indicator part of rural revitalization. Based on the emergy indicator of the first part, the general goal of rural revitalization is "strong agriculture, rich peasants, and beautiful rural areas" is taken as three sub-theme levels and corresponding evaluation indicators are constructed. For tourism-driven rural areas, agriculture and rural tourism are two important industries. Therefore, this point is highlighted in the indicator construction. In addition, in the process of rural revitalization, in addition to the endogenous development of the village, exogenous factors are also very important. Therefore, government and non-government investment are also included in the indicator system, and the contributions of these two factors are comprehensively considered to increase the rate of return on investment to avoid duplicated investment and invalid investment. Finally, three comprehensive evaluation indicators are constructed. Emergy sustainability indicator, sustainable development emergy indicator and rural revitalization rate indicator were used to measure the comprehensive level of rural revitalization.

5 Conclusion

Based on the emergy evaluation principle and method established by Odum, this paper studies the sustainable development of rural tourism and the realization of the goal of rural revitalization. The results show that the application of emergy theory to the sustainable development and comprehensive benefit evaluation of rural tourism system can not only provide quantitative basis for economic development and ecological environment protection. Moreover, it can objectively and comprehensively reflect the role and contribution of different resources and industries to the rural revitalization in the rural areas where tourism resources are abundant. This can guide people to target, maintain the rural revitalization between the various elements of the dynamic equilibrium, and make it good, stable and sustainable development direction, in order to evaluate the rural areas to achieve the rural revitalization goal of "strong agriculture, rich peasants, and beautiful rural areas".

The marginal contribution of this paper is embodied in the application of emergy analysis theory of eco-economics to the study of rural revitalization, by analyzing all kinds of energy flow, material flow, information flow and money flow in the rural tourism system into a unified solar energy index, the ecological, economic and social aspects of the system are integrated organically, this paper constructs the Evaluation Index System of rural tourism sustainable development from the perspective of rural revitalization, which provides theoretical support for the sustainable development of rural tourism and a new perspective for the study of rural revitalization.

This paper only makes a general analysis of the sustainable development of rural tourism, which is rich in tourism resources. The following research can consider a

targeted analysis of different regions and different types of villages, it provides a more scientific and accurate reference for the evaluation of sustainable development of rural tourism and the promotion of rural revitalization.

Acknowledgements

This paper is the phased research results of the 2021 Gansu Province philosophy and social science project (2021QN010).

References

1. Odum H T. Environmental Accounting: Emergy and Environmental Decision Making. New York: John Wiley&Sons,1996.
2. Lan Shengfang, Qin Pei. Emergy analysis of eco-system. Chinese Journal of Applied Ecology, 2001, 12(1):129-131
3. Brown M T, Ulgiati S. Emergy-based indices and ratios to evaluate sustainability: monitoring economies and technology toward environmentally sound innovation. Ecological Energy, 1997,9(1/2):51-69
4. Abel T. Ecosystems, Sociocultural Systems and Ecological-Economics for Understanding Development: The Case of Ecotourism on the Island of Bonaire. Florida: University of Florida, Gainesville, Florida,2000:8-11
5. Doherty S J, Brown M T, Murphy R C, Odum H T, Smith G A. Emergy Synthesis Perspectives, Sustainable Development and Public Policy Options for Papua New Guinea. Florida: Center for Wetlands & Water Resources University of Florida,1993:5-9.
6. Wang J J, Zhang J H, Wang Q, Huang J F. Progress of emergy research on tourism systems. Acta Ecologica Sinica,2015,35(2):584-593.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

