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Spatial Differentiation of Rural Touristization and Its Determinants in China: A Geo-detector-based Case Study of Yesanpo Scenic Area

WANG Xinge[1,2], XI Jianchao[1*], YANG Dongyang[3], CHEN Tian[1]

1. Institute of Geographic Sciences and Natural Resources Research, Key Laboratory of Regional Sustainable Development Modeling, Chinese Academy of Sciences, Beijing 100101, China;
2. University of Chinese Academy of Sciences, Beijing 100049, China;
3. School of Geographic Sciences, East China normal university normal university, Shanghai 200062, China

Abstract: Tourism has emerged as a major driving force in the growth and expansion of rural settlements. After several studies revealed spatial differentiation of touristization among rural settlements, studies were conducted to explain this phenomenon. However, most of these studies explained spatial differentiation of rural touristization in a qualitative way. More robust and detailed quantitative results are needed to evaluate the relative roles of different factors. In this study, which takes Yesanpo tourism as a case study, the Geo-detector method was introduced to evaluate determining factors of rural touristization. Results show that "distance to core entry", "tourist number and sojourn time", and "distance to the nearest scenic area" have had a strong effect on the rural touristization in Yesanpo, whereas "distance to river", "elevation", "distance to main road", and "slope" have had a weak influence. The latter did, however, contribute a lot to touristization when interacting with "distance to core entry", "tourist number and sojourn time", and "distance to the nearest scenic", indicating the importance of these four factors. Higher rural touristization occurred in the zone near the core entry, with many tourists, long sojourn times, and proximity to the scenic area.

Key words: rural touristization; spatial differentiation; determinants; Geo-detector; Yesanpo scenic area

1 Introduction

Tourism has emerged as a major driving force in the growth and expansion of rural settlements. In the context of rural tourism development, many areas are experiencing a transition from agrarian- to service-based industries (Nepal, 2007; Xi *et al*, 2015a, 2015b). Young (1983) was the first to describe this phenomenon as "touristization," using the term in the sense of "industrialization" or "urbanization". Later, Chen (2007) further defined "rural touristization" as a process in which labor is transferred from agriculture (or fishing) to tourism. This development has a profound effect on the society, economy and culture of rural areas (Chen and Bao, 2007).

Previous studies have revealed spatial differentiation of touristization among rural settlements. Nepal (2007) found a spatially hierarchical structure of the development stage, size, and function of villages throughout the Annapurna region in Nepal. Xi *et al* (2015) showed that villages closer to a scenic spot in Yesanpo scenic area tend to have higher land-use intensities. Lee *et al* (2013) found that villages in rural settlements constitute main and sub-groups.

Several studies have been conducted to explain this phenomenon. The study in Nepal found that the historic migra-

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***Corresponding author:** XI Jianchao. E-mail: xijc@igsnrr.ac.cn

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tion of highland ethnic groups, regional hospitality traditions, the kinship and clan system, and the advent of service-based enterprises all influenced the progression and distribution of settlements. Xi (2015) indicated the different locations of villages determined their different development stages and paths. Lee *et al* (2013) evaluated the spatial indexes in terms of geographic accessibility and the characteristics of rural amenities to identify the centralities of villages. However, they explained these in a qualitative way. More robust and detailed quantitative results are needed to evaluate the relative roles of different factors.

In China, rural tourism has witnessed rapid growth during the past three decades. In March 2014, the Central Committee of the Communist Party of China (CPC) and the State Council jointly released a "National New-type Urbanization Plan (2014–2020)", which has created a great opportunity for rural tourism development (Qian *et al*., 2012). With a foreseeable influx of tourists and increasing demand for basic services, it is important for decision makers to identify reasonable ways for rural village to plan and develop sustainably. Thus, it is important to identify the determinant factors of rural touristization and present them in a detailed quantitative way. Therefore, in this study, a Geo-detector-based rural touristization determining factor is evaluated. We aim to answer: (1) What is the geographical domain of rural touristization at a specific rural tourism destination? (2) Which geographical factors are responsible for rural touristization? (3) What is the relative importance of each determining factor? (4) Do the dominant factors operate independently or are they interconnected?

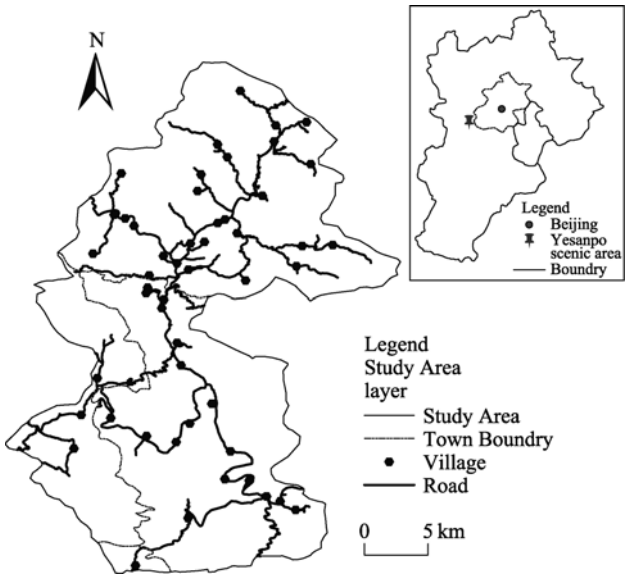

Fig.1 Location of the study area

2 Study area

The Yesanpo tourism area is a well-known rural tourism destination 100 km from Beijing and located at the meeting of the Taihang Mountains and Yanshan Mountains in northern China. Yesanpo has a total area of 520 km^2 with 6 independent tourism spots, 51 villages and a population of 12542. The area is rich in tourism resources, such as steep canyons, beautiful rivers, and thick forests, with vegetation coverage exceeding 90%. The climate here is continental with hot, wet summers and cold, dry winters, and an average annual temperature of 10.7℃. Since 1986, Yesanpo has gradually evolved into a well-known rural tourism destination in China, offering various tourism activities (Table 1). In 2014, it received about 2.24 million tourists, generating CNY 670 million in revenue. Moreover, Yesanpo was designated as a five-star (5A) tourism area by the China National Tourism Administration in 2011.

Table 1 Types of tourism activities in Yesanpo tourism area in 2014

Types of tourism activities	Tourism activities
Accommodation	Family inns and hotels
Catering	"Nongjiale" restaurants and independent restaurants, Barbecue
Shopping	Convenience stores and tourist supply stores
Entertainment	Photography, painting from life, horseback riding, rafting, donkey cart, karaoke, video games, billiards, fishing, folk performances, go kart racing, live CS (live-action shooting game), bonfire evenings, bungee jumping

3 Materials and methods

3.1 Data collection

The data used in this paper includes the rural touristization degree for the 51 villages and the spatial distribution of determining factors. Neither of the two types of data can be acquired directly. Therefore, we began by collecting basic data, including the number of households in each village, the number of households participating in the tourism industry, the administrative code boundaries at the village scale in the form of shapefile, high-resolution remote sensing (0.6 m), and the DEM. Most of the data were got from the local tourism administration department and the local government.

3.2 Statistical methods

(1) Rural touristization rate

In order to understand the observed spatial disparities of rural touristization, a touristization rate index with reference to the index of urbanization rate was constructed as follows:

$$T = h / H \quad (1)$$

where h denotes the number of tourism-involved household in a certain village and H denotes the total households in the village.

(2) Potential determinants of rural touristization

From a spatial perspective, the potential determinants of

Table 2 Potential determinants of rural touristization and the index

Potential determinants	Index	Abbreviation	Reference
Market factors	01Number of tourists	NT	(Naudé *et al*, 2005; He, 2006)
	02Sojourn time	ST	(Lew and McKercher, 2006)
Accessibility	03Distance to the main road	DMR	(Hannigan, 1994; Laga *et al*., 2014)
	04Distance to the nearest scenic area	DNSA	(Ying, 2008)
	05Distance to the core entry	DCE	(Williams and Shaw, 1991)
Landscape qualities	06Distance to the river	DR	(Reichel *et al*, 2000; Hall and Page, 2003)
	07Slope	S	(Sharpley, 2002)
	08Elavation	E	(Tosun, 2005)

rural touristization and the index were constructed based on the following considerations: Firstly, in rural tourism destinations, the demands for tourist services and amenities from an increasing number of tourists fuels development of the rural service industry that reshapes the rural landscape and land use in the village. To some extent, this affects the level of touristization, especially when the number of tourists increases and the sojourn time for tourists is prolonged (Nepal, 2007). Secondly, accessibility of the tourism destination determines how easy it is for tourists to access the desired destination (Morris *et al*., 1979). The more accessible a village is, the more tourists arrive, resulting in higher touristization of the village. Finally, the landscape of a village can use relevant natural features to provide an attractive and inviting setting for a variety of tourists (Zhang *et al*, 2012;). Thus, landscape qualities can have an important impact on touristization.

The NT and ST was obtained from the Yesanpo Committee. NT refers to the average number of tourist entries (calculated by the number of tickets sold) to the six scenic area from 2008 to 2012. ST refers to the mean time elapsed between entering and exiting the scenic area on foot and walking at a steady pace.

The DMR, DNSA, DCE, DR were calculated by the GIS using buffer analysis.

The topographic elevation was obtained from a Digital Elevation Model (DEM). The DEM used in this study was derived from a geospatial data cloud established by the Computer Network Information Center, Chinese Academy of Sciences, in January, 2013. Slope is defined by a plane tangent to a topographic surface, as modeled by the DEM at a point. Slope presents the percent change in elevation over a certain distance. The output slope can be calculated as either the percent of slope or the degree of slope. In this study, degree of slope was chosen.

(3) Geographical Detector

The Geographical Detector, which can be downloaded free of charge at http://www.sssampling.org/.GeoDetector, was first proposed by Wang as a means of detecting and assessing the risk of disease (Hu *et al*., 2011; Wang *et al*., 2010). Over time it has developed into a technique used in research studies of society, the economy, nature, etc. to detect the causes and mechanisms of various factors (Huang *et al*., 2014; Zhu *et al*., 2015). The association between causes and various factors can be quantified by the Power of Determinant (PD) value.

$$PD = 1 - \frac{1}{n\sigma_H^2}\sum_{i=1}^{m} n_{D,i}\sigma_{H_{D,i}}^2 \quad (2)$$

where D denotes the influencing factor; H denotes the affected index; n is the number of the samples; and σ_H^2 is the variance of affected factor; m is the classification number of an index, and $n_{D,i}$ is the sample number of D of type i; $\sigma_{H_{D,i}}^2$ is the variance of the affected index of D of type i. Usually the value of PD lies between [0, 1]. The larger the value of PD, the greater the impact of the factor on the affected index.

The geographical detectors are composed of four detectors, including risk detector, factor detector, interaction detector and ecological detector. Risk detector aims to detect where the risk is higher. During the process, a t-value test was used to check whether the average risk in each subarea is statistically different when the study area is stratified by a potential determining factor. Factor detector aims to detect the environmental parameters responsible for rural touristization. Interaction detector is used in the research to detect whether the determining factors operate independently or are interconnected using GIS spatial analysis. Ecological detector is used to detect the relative importance of each determining factor based on an F-value test.

(4) Rural touristization and the potential determinant factors

Maps of rural touristization spatial disparities based on the rural touristization rate and the potential determinant factors were compiled using a Geographic Information System (GIS) environment (Fig.2).

4 Results

4.1 Risk detector

In Table 3 the "risk detector" in the Geo-detector model

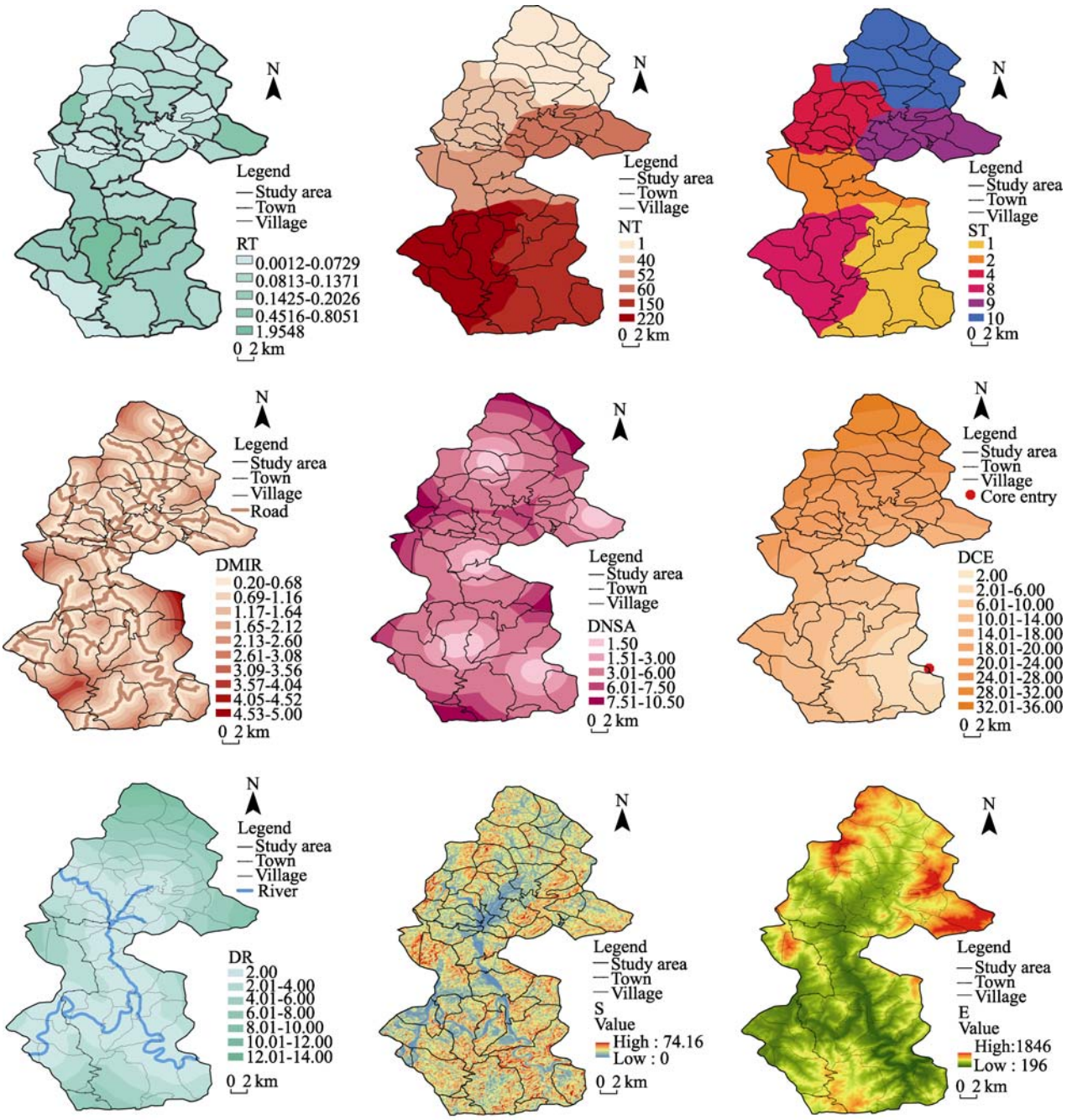

Fig.2 Maps of the potential determinant factors of rural touristization

shows the result that the average rural touristization indexes in every buffer of the nearest scenic area (1.5, 3, 4.5, 6, 7.5, 9, 10.5) are 52.73%, 37.39%, 20.39%, 14.31%, 13.67%, 14.40% and 0.12% respectively. These are statistically different (Table 3), indicating that higher rural touristization occurred mainly in the zone near the nearest scenic area. Similar analysis of other determining factors can be conducted using the same method.

4.2 Factor detector

The "factor detector" in the Geo-detector model ranks the influence of affecting factors on the rural touristization index by PD value as follows: DCE (0.19)> NT (0.18) >ST (0.16)>DNSA (0.10) > DR (0.05) > E (0.03) > DMR (0.01) > S (0.00).

4.3 Ecological detector

In Table 4 the "ecological detector" in the Geo-detector model shows the differences of *PD* between DCE, NT, ST, DNSA are not statistically significant and that differences between the rest of the factors are not statistically significant either. However, the differences between any one of the first

Table 3 Statistical significance of the geographical domain difference between each buffer around the entrance of the scenic area

Stat Sig Diff	1.5	3	4.5	6	7.5	9	10.5
1.5							
3	Y						
4.5	Y	Y					
6	Y	Y	Y				
7.5	Y	Y	Y	N			
9	Y	Y	Y	N	N		
10.5	Y	Y	Y	Y	Y	Y	

Note: The numbers stand for the codes of distances to the nearest scenic area (please refer to Fig.2), Y means the determinant difference between the two watersheds is significant with a confidence of 95%, and N means not.

Table 4 Statistical significance of the determinant between each factor

	NT	DNSA	DR	ST	S	DMR	E	DCE
NT								
DNSA	Y							
DR	Y	Y						
ST	N	N	Y					
S	Y	Y	N	Y				
DMR	Y	Y	N	Y	N			
E	Y	Y	N	Y	N	N		
DCE	N	N	Y	N	Y	Y	Y	

Note: Y means the determinant difference between the two watersheds is significant with the confidence of 95%, and N means not.

Table 5 Interaction between pairs of determining factors in introducing rural touristization

Interaction of two determents	Comparison between the interaction value and the sum value	Conclusion (C denotes the interaction value and A and B are two determinants
DCE∩NT	=0.32<0.37=DCE (0.19) + NT (0.18)	C<A+B
DCE∩ST	=0.32>0.26=DCE (0.10) + ST (0.16)	C>A+B
DCE∩DNSA	=0.51>0.29=DCE (0.19) +DNSA (0.10)	C>A+B
DCE∩DR	=0.38>0.24=DCE (0.19) +DR (0.05)	C>A+B
DCE∩E	=0.34>0.22= DCE (0.19) + E (0.03)	C>A+B
DCE∩DMR	=0.31>0.20=DCE (0.19) +DMR (0.01)	C>A+B
DCE∩S	=0.21>0.19=DCE (0.19) +S (0.00)	C>A+B
NT∩ST	=0.15<0.34=NT (0.18) + ST (0.16)	C<A+B
NT∩DNSA	=0.50>0.28=NT (0.18) + DCE (0.10)	C>A+B
NT∩DR	=0.28>0.23=NT (0.18) + DR (0.05)	C>A+B
NT∩E	=0.23>0.21= NT (0.18) +E (0.03)	C>A+B
NT∩DMR	=0.25>0.19=NT (0.18) + DMR (0.01)	C>A+B
NT∩S	=0.20>0.18=NT (0.18) + S (0.00)	C>A+B
ST∩DNSA	=0.50>0.26=ST (0.16) + DNSA (0.10)	C>A+B
ST∩DR	=0.28>0.21=ST (0.16) + DR (0.05)	C>A+B
ST∩E	=0.22>0.19= ST (0.16) + E (0.03)	C>A+B
ST∩DMR	=0.25>0.17=ST (0.16) + DMR (0.01)	C>A+B
ST∩S	=0.20>0.16=ST (0.16) +S (0.00)	C>A+B
DNSA∩DR	=0.16>0.15= DNSA (0.10) + DR (0.05)	C>A+B
DNSA∩E	=0.16>0.13= DNSA (0.10) + E (0.03)	C>A+B
DNSA∩DMR	=0.21>0.11= DNSA (0.10) + DMR (0.01)	C>A+B
DNSA∩S	=0.11>0.10= DNSA (0.10) + S (0.00)	C>A+B
DR∩E	=0.08=0.08= DR (0.05) + E (0.03)	C=A+B
DR∩DMR	=0.09>0.06=DR (0.05) +DMR (0.01)	C>A+B
DR ∩S	=0.06>0.05= DR (0.05) + S (0.00)	C>A+B
E∩DMR	=0.14>0.04=E (0.03) +DMR (0.01)	C>A+B
E∩S	=0.06>0.03=E (0.03) +S (0.00)	C>A+B
DMR∩S	=0.05>0.01= DMR (0.01) + S (0.00)	C>A+B

Note: The conclusion identifies whether two health determinants A and B when taken together weaken or enhance one another, or whether they are independent in inducing rural touristization and can be interpreted as followings: Enhance, if C>A or B; Enhance; bivariate: if C>A and B; Enhance; nonlinear, if C>A+B; Weaken, if C<A+B; Weaken; univariate, if C<A or B.

four factors and any one of the rest of the factors are statistically significant. With the factor detector and the ecological detector, we find that DCE, NT and ST, DNSA have a strong effect on rural touristization, whereas the remaining factors have a weak effect.

4.4 Interaction detector

In Table 4 the "interaction detector" in the Geo-detector model shows that joint impacts of two factors are measured by PD value and can be compared with their separate impacts. The interactive effects between distance to core entry and sojourn time (0.32), distance to core entry and distance to nearest scenic area (0.51), distance to core entry and distance to river (0.38), distance to core entry and elevation (0.34), distance to core entry and distance to main road (0.31), distance to core entry and slope (0.21) are stronger than the effect of distance to core entry (0.19), which has the strongest main effect on rural touristization, whereas the interactions between distance to core entry and tourist number (0.32) weaken the effect of distance to core entry. Similarly, interactions between tourist number and other factors fluctuate compared to the main effect of tourist number. Elevation neither enhances nor weakens the effect of distance to river (=0.08=0.08=E (0.03) +DR (0.05)). Distance to river, elevation, distance to main road and slope were found to have weak effect on rural touristization; however, they contributed considerably to touristization when interacting with distance to core entry, tourist number and sojourn time, distance to the nearest scenic. This finding indicates the importance of these four factors.

5 Discussion and conclusions

5.1 Discussion

As many as 75% of the world's poor people live in the rural areas. In China, there are 674.15 million people living in rural areas, accounting for 50.32% of the total population, among which 70.17 million are poverty-stricken rural people according to the rural poverty alleviation line (CNY 2300 per year for each resident at 2010 constant prices) set by the Chinese government. With this as a backdrop, as a development strategy, rural tourism has been identified as a development strategy that provides a tool for rural revitalization that can create great prospects for the development of poor households in many developing countries. Rural tourism is a determining factor in rural development and a driving force in some cases for the development of a region (Baležentis *et al*., 2012; Haven and Jones, 2012). In China, tourism-driven urbanization is also seen as an important part of the new-type urbanization, creating new land use patterns and local employment structures (Mullins, 1999).

5.1.1 Spatial differentiation of rural touristization

With the objective of developing rural tourism efficiently, touristization has aroused wide public concern as great changes have taken place in rural tourism settlements. Some villages have expanded both horizontally and vertically, as land functions have changed from meeting the living needs of villagers to satisfying the demands of tourists. However, we should note that this is not suitable for all the villages when considered at a local scale. A previous study showed the spatial polarization of Gougezhuang village and Jiaojiekou village, even though the two villages are located within 8 km of each other in the Yesanpo tourist area. Moreover, when all of the villages were taken into account, rural touristization of the villages was spatially different. This study took this phenomenon as a starting point and then analyzed and explained it by constructing a "rural touristization index" describing employment in the tourism industries in the context of rural tourism development.

5.1.2 Geographical detector

In this study, we use a geographical detector method for assessing associations between rural touristization and potential determinants. The theory is based on spatial variance analysis (SVA) of the spatial consistency of rural touristization distribution with potential geographical strata. The basic purpose of SVA is to measure the degree to which the spatial distribution of rural touristization is consistent with that of potential determining factors (e.g. distance to core entry, tourist number, sojourn time, etc.). The validation of the results is evaluated by a statistical significance test. We assume that the rural touristization will exhibit a spatial distribution similar to that of a determining factor if the determining factor contributes to rural touristization. The mechanism is quantified by power values, the same as Wang Jinfeng's case.

5.1.3 Determinants of rural touristization

Of more concern is the question of which factor has the greatest role in rural touristization. Use of the four detectors we selected found that distance to core entry, tourist number, sojourn time, and distance to the nearest scenic area were mainly responsible for rural touristization. As core entry became closer, tourist numbers greater, sojourn times longer and distance to the nearest scenic area shorter, rural touristization became heavier. Moreover, the combined effects of distance to core entry and sojourn time, distance to core entry and distance to the nearest scenic area, and tourist numbers and distance to the nearest scenic area are stronger than the individual effects of these factors. However, the combination of distance to core entry and tourist number, and tourist number and sojourn time are weaker than the individual effects of these factors. Distance to river, elevation, distance to main road and slope were found to have weak effect on rural touristization; however, they contributed a lot to rural touristization when interacting with distance to core entry, tourist number, sojourn time and distance to the nearest scenic area, indicating the importance of the latter four factors.

An explanation for distance to core entry, tourist number and distance to the nearest scenic area being identified as key contributors to rural touristization could be that they can all bring opportunities for tourism development to rural villages. Since 1986, Laishui has been a national-level poverty-stricken county. In 2014, there were still 88 poor villages according the State Council Leading Group Office of Poverty Alleviation and Development and, among these, 31 villages were within the vicinity of Yesanpo scenic area. Therefore, as the only development tool available, touristization occurred in the villages which had the greatest opportunities.

The reason why sojourn time was an important contributor to rural touristization could be that the tourists' sojourn time in a scenic spot determines the level of tourists' consumption. Villages with increased demand for accommodations, catering, shopping, entertainment will experience higher levels of touristization. For Yesanpo, sojourn time in Bailixia could be 10 hours and during that time tourists become tired, thirsty, and hungry. To take advantage of this, Gougezhuang village can build lodges and rest areas to cater the needs of tourist. In Yugudong where the sojourn time is only 1 hour, most tourists do not need any tourism-related services and, therefore, villages in the area have low level of touristization.

5.2 Conclusions

In this study, a geographical detector method was used to assess the association between rural touristization and determining factors. Firstly, the results showed this method to be novel in that it extracts the interrelationships between tourism development and dominant factors by identifying the correspondence of their spatial distributions. Moreover, it is easy to implement. Secondly, the study found that distance to core entry, tourist number and sojourn time, and distance to the nearest scenic area have a strong effect on rural touristization, whereas the remaining factors have a weak effect. However, the weak factors contributed a lot to touristization when interacting with distance to core entry, tourist number and sojourn times and distance to the nearest scenic area, indicating the importance of the latter four factors. Higher rural touristization occurred in the zones near the core entry, with many tourists, long sojourn times, and near scenic areas.

Furthermore, research on the effect of geographical factors on rural destinations has important policy implications for the sustainable development of the rural tourism. Firstly, planning for tourist attractions must take into consideration the need to protect the traditional rural settlements so as to attract tourists, increase tourist capacity and gradually take advantage of the sources of rural tourism. Secondly, priority should be given to spatial arrangements and itinerary designs so that tourism development of rural villages will be stimulated by the spatial agglomeration of tourists. Finally, infrastructure construction to support rural tourism should be accelerated, especially the construction of transportation facilities between rural villages and scenic spots, and between villages and the rural road grid to improve accessibility and eliminate tourism bottlenecks.

The key limitation of geographical detectors is that they are statistical and do not detect causality, but they can identify factors of rural touristization that are suspect, awaiting in-depth field surveys or theoretical analysis for confirmation. The limited impact on rural tourism development of some social and economic factors such as operator skill and management services levels should be given consideration. Another limitation is that some rural touristization cases do not exhibit spatial patterns, perhaps because the study domain is too small to display a geographical stratum. Therefore, our approach is not appropriate to detect all risks. Field sampling surveys for suspect factors are necessary to identify touristization cases that have weak spatial patterns.

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基于地理探测器的乡村旅游化空间分异及其影响因素研究：以野三坡旅游区为例

王新歌[1,2]，席建超[1]，杨东阳[3]，陈田[1]

1. 中国科学院地理科学与资源研究所，中国科学院区域可持续发展分析与模拟院重点实验室, 北京 100101；
2. 中国科学院大学, 北京 100049；
3. 华东师范大学地理科学学院, 上海 200062

摘　要：乡村旅游化是旅游景区周边乡村聚落功能向旅游服务转变的过程。受同一景区带动，景区周边不同乡村聚落旅游化程度存在空间差异。不少学者已经对此类村落的演变过程、空间分布特征进行了研究，并采用定性分析方法对空间差异影响要素进行了初步分析。然而，目前定量分析方法较少，不能有力说明影响要素与空间差异现象之间的关系。基于此，本文以野三坡旅游区周边 56 个乡村聚落为例，结合实地考察、GIS 分析及地理探测器模型，对乡村旅游化空间分异及影响因素进行了研究。结果表明，距离区域主要入口的远近，景区游客规模及游客逗留时长，距离核心景区的远近是影响村落旅游化程度差异的主要因素；距离河流的远近，高程，距离主要道路的远近以及坡度对村落旅游化程度差异的解释力较弱，但是当他们与其他因素交互时，可以增强其他因素所起的作用；距离区域主入口越近，村落的旅游化程度越高；同样地，村落所处景区游客规模越大、游客逗留时间越长、距离核心景区越近，村落的旅游化程度越高。该研究对于有序引导旅游地乡村聚落的发展，实现旅游地可持续具有重要作用。

关键词：乡村旅游化；空间分异；影响因素；地理探测器；野三坡旅游区