Path Research on the Coordinated Relationship between Rural Energy Consumption and the Development of Rural Tourism

Xia Yang

School of Land and Resources, China West Normal University, Nanchong 637002, China

Abstract

The coordinated relationship between energy consumption and the development of tourism in rural areas is an effective way to change the agricultural landscape and promote the economic growth in underdeveloped areas. However, it is not the case in rural areas of China today. In view of this, this paper, based on previous studies, constructs a spatial panel model to explore the relationship between rural energy consumption and rural tourism, as well as the coordinated development of the two. It finds that there is a significant spatial correlation between energy consumption and tourism in rural areas. The increase of former is not conducive to the development of the latter, and the former can exert greater impact on the latter than vice versa. To this end, to promote the tourist economy in a rural area, we must proactively optimize its energy consumption structure.

Keywords: Energy Consumption, Rural Tourism, Coordinated Development, Path Research.

1. INTRODUCTION

1.1 Literature Review

Currently, scholars at home and abroad have done considerable research on rural energy consumption and rural tourism, and formed a literature base of a certain scale. As far as rural energy consumption is concerned, L Chen and N Heerink et al. took 3 villages in Jiangxi Province as an example to analyze the main influencing factors of household energy consumption in rural areas. They found that the allocation of labor force and the selection of household energy could significantly impact energy consumption in rural areas (Chen et al., 2006). In their research, Yao and Chen et al. figured out that under current income level of rural residents and policies for rural areas, the emission of CO$_2$ had risen sharply, and that renewable energy could be used to generate electricity and modern biomass to replace coal to reduce energy consumption (Yao et al., 2012). In rural tourism development, P Dukbyeong and Y Yooshik studied the main causes of rural tourism in South Korea and found that family get-togethers, passive tourism, the pursuit of all kinds of tourism, knowledge and stimulation all had an impact on tourists’ intentions to travel in rural areas (Dukbyeong and Yooshik, 2009). IO Ezeuduji mainly looked at the key factors of rural tourism resources, capabilities and success in sub-Saharan African countries, indicating that unique rural tourist experience based on historical events was the future direction of tourism in this area (Ezeuduji, 2015). Starting from the individual case of Rongshui Miao Autonomous County, Wang Xiongjin et al. analyzed the coordinated development of new countryside construction and rural tourism in the vast ethnic minority areas in China, and puts forward specific promotion measures from such aspects as government support, brand building, innovative development mode and broadening financing channels (Wang and Chen, 2011).

Scholars at home and abroad tend to pay more attention to energy consumption and the development of tourism in rural areas than the relationship between the two, with SK Nepal as the only exception, who studied the dependence of rural tourism on fossil fuels in the Annapurna, Nepal (2008). Jian-Chao, Zhao et al. studied Liupanshan Tourism Poverty Alleviation Pilot Area for household energy consumption in rural tourism (Li-Panshan Tourism Poverty Alleviation Zone) (Jian-Chao et al., 2013).

1.2 Purpose of Research

This paper focuses on the reduction of energy consumption and thus promoting the level of rural tourism economy in rural areas. Rural energy is an important part of the national energy system and also a crucial material basis for the sustainable development of agriculture and rural economy. Therefore, controlling rural energy consumption can contribute greatly to rural ecological environment. For a long time, straw and fuel wood have been the main

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source to obtain energy, making biomass a dominant role in rural energy consumption. Given its abundant raw materials and low cost, this kind of energy consumption structure is hard to change and poses a great challenge to improving rural ecological environment (Xin et al., 2014). Moreover, the increasingly severe ecological environment it has caused, including deforestation and air pollution, will inevitably affect tourists’ willingness to travel in rural areas and as a result, restrict the sustainable development of rural tourism (Meng, 2009). In view of this, it is practical to study paths for coordinated relationship between energy consumption and tourism in rural areas, protecting the rural ecological environment and promoting the simultaneous development of agriculture and rural tourism while satisfying the living demand of rural residents.

2. ANALYSIS OF THE CORRELATION BETWEEN ENERGY CONSUMPTION AND TOURISM DEVELOPMENT IN RURAL AREAS

2.1 Construction of Spatial Panel Model

Spatial correlation test is the key to economic analysis of space econometrics. There are mainly three ways, namely, LMerr, LMsar, Walds, and the correlation index, Moran’I. Use the hypothesis HO: $\rho=0$ or $\lambda=0$, and block diagonal matrix $C = I_T \times W$ to replace Moran’I and other statistics to calculate the spatial weight matrix, so these tests will be extended to the panel data for analysis. Given the gradual increase of rural energy consumption and rural tourism economy slowdown, this paper examines the relevance of the two. The following formulas (1), (2) and (3) are respectively established on the above three statistics:

$$\text{Moran' I} = \frac{e'Wye}{e'e}$$  \hspace{1cm} (1)

$$\text{LMerr} = \frac{e'Wel(e'el/N)}{tr(W^2 + W'W)}$$  \hspace{1cm} (2)

$$\text{LMsar} = \frac{e'Wyel(e'el/N)}{WX\beta'[I - X(X'X)^{-1}/\sigma^2] + tr(W^2 + W'W)}$$  \hspace{1cm} (3)

Where: $C = I_T \times W$; the definition of variable parameters is show in Table 1:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Number of rural tourism areas (N = 60)</td>
</tr>
<tr>
<td>T</td>
<td>Length of time (T = 10)</td>
</tr>
<tr>
<td>I_T</td>
<td>T dimension time matrix</td>
</tr>
<tr>
<td>e</td>
<td>Residual vector estimation of ordinary least squares (OLS)</td>
</tr>
<tr>
<td>tr</td>
<td>Trace of the matrix</td>
</tr>
</tbody>
</table>

Among them, statistics such as LMerr and LMsar can test the spatial correlation and provide conditions for the model setting, so that the space error model and the autoregressive model are optimized and selected. It proves a good choice for the correlation of rural energy consumption and rural tourism (Long and Zhang, 2016). If the statistics of the former is better than the latter, then select SAR model; otherwise, select SEM model. Errors in the collection of economic variables sample data of different regions, or the economic disparity of adjacent reasons may prove such phenomenon that the tourism grows slowly in rural areas of low energy efficiency and increased energy consumption. The two basic models of spatial econometrics are SEM and SAR that respectively examine the differences between the variables in different rural areas and the observed variables. The correlation between rural energy consumption and rural tourism economy can be analyzed with SEM (4) and SAR (5) models:

$$\text{SEM: } y = X\beta + \mu, \quad \mu = \lambda(I_T * W_N) + \varepsilon$$  \hspace{1cm} (4)
In addition, the economic spatial weight matrix (W), the weight matrix of rural energy consumption (W) and the total rural tourism revenue (TR) are represented as below:

\[
W = w^* \text{diag}\left(\frac{y_1}{\sum_{i=1}^{n} y_i}, \frac{y_2}{\sum_{i=1}^{n} y_i}, ..., \frac{y_n}{\sum_{i=1}^{n} y_i}\right)
\]

Among them, \(t\) is the period of study, \(N\) is the number of rural areas, \(y\) is the total tourism revenue (TR) in areas studied. Since the setting of different spatial weight matrix will greatly affect the result of model estimation, this paper applies this method for spatial panel data analysis of energy consumption and tourism in rural areas.

### 2.2 Variable Selection and Data Source

The total tourism revenue in 60 rural areas is adopted as the explained variable and tourism economic growth in China is represented as \(TR\). The tourism energy consumption in rural areas is adopted as the explanatory variable, and tourism energy consumption is represented as \(TE\). In the “China Statistical Yearbook”, industries associated with tourism are mainly transportation, wholesale, retail trade, accommodation, and catering, which is basically consistent with the industrial classification in the national economy accounting. Therefore, the author selects the total energy consumption of the above industries to represent tourism industry energy consumption, with 30 provinces, autonomous regions and municipalities directly under the central government in 2000-2015 in China (some data such as Tibet, Hong Kong, Macao and other regions are missing and no longer included in the data) as object of research. The total tourism revenue data come from “The Yearbook of China Tourism Statistics (2000-2015)”, and the data of rural tourism energy consumption, “China Energy Statistical Yearbook (2000-2015)”. To reduce the heteroscedasticity of the original data and to ensure the stable change among the original variables, all data are logarithmically processed.

### 2.3 Relevance Analysis of Energy Consumption and Tourism Development in Rural Areas

Based on Moran’I, L Merr, LMsar, and with geo-dichotomous weight matrix and economic weight matrix, spatial correlation test is done on energy consumption and tourism development in China’s rural areas. The three spatial correlation test results \((P = 0.0000)\) show high significance, indicating that there is a significant spatial correlation between the two. Besides, the positive values of the statistic test reveal that rural energy consumption increases and rural tourism is relatively slow in economic growth. As the statistical value of LMsar is larger than that of L Merr, under the two special weight matrixes, both should choose SAR model for estimation. The spatial panel estimation of rural tourism energy consumption and tourism economic growth, as well as the correlation between the two, is further explored with geographical weight and economic weight. Given the different effects of space and time, the space econometric models are divided into three types, namely, non-fixed effect (nonF), spacial fixed effect (sf) and spacial and temporal fixed effect, and their statistical test indicators are compared, with results shown in Table 2:

<table>
<thead>
<tr>
<th></th>
<th>sF</th>
<th>sTF</th>
<th>nonF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural energy consumption</td>
<td></td>
<td></td>
<td>1.5274 (3.2527)*</td>
</tr>
<tr>
<td>constant</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(\beta)</td>
<td>1.1541</td>
<td>1.6841*</td>
<td>0.4279(3.1548)</td>
</tr>
<tr>
<td>(\rho)</td>
<td>-1.5741</td>
<td>88.2547</td>
<td>-135.247</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.5874</td>
<td>0.9852</td>
<td>0.8821</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>sF</th>
<th>sTF</th>
<th>nonF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural tourism development</td>
<td></td>
<td></td>
<td>1.2516 (1.5827)*</td>
</tr>
<tr>
<td>constant</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(\beta)</td>
<td>1.2478</td>
<td>0.4712*</td>
<td>1.4711(2.5841)*</td>
</tr>
<tr>
<td>(\rho)</td>
<td>2.8412</td>
<td>-1.5741</td>
<td>0.9841</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.8814</td>
<td>0.9147</td>
<td>0.7751</td>
</tr>
</tbody>
</table>
2.4 Results Analysis and Discussion

From the results of Table 2, we can see that first, in SAR, the significance test value passes the regression coefficient ($\beta$) and the spatial autoregressive system ($\rho$) under the two kinds of spatial weights, indicating that there is a significant spatial correlation between rural tourism energy consumption and tourism economic growth, and that the increase of rural energy consumption is unfavorable to the rapid development of rural tourism economy. Second, under the two spatial weights, the goodness-of-fit (R$^2$) of $sF$ is significantly larger than the corresponding values of the model, showing that in the interaction between the two, the increase in energy consumption can exert greater influence than economic disparity.

3. COORDINATED DEVELOPMENT OF ENERGY CONSUMPTION AND TOURISM IN RURAL AREAS

3.1 Policies and Regulations for Rural Tourism Management

To promote the coordinated development, it is essential to reduce rural energy consumption and improve efficiency. Relevant government departments should formulate management norms to control rural energy consumption. For example, it can specify a reasonable control range of rural energy consumption, including the amount of straw, firewood, traditional coal and diesel used for burning, and the greenhouse gas emissions such as carbon dioxide, and strictly implement it.

3.2 Enhance Rural Tourism Project Construction and Increase the Support to the Introduction of New Energy Sources

The government should full play its role and increase incentives and support for the construction of rural tourism projects and the introduction of new clean energy. It can increase job opportunities by encouraging the construction of rural tourism projects, so as to increase the non-agricultural income of rural residents and increase their consumption level and capacity. Reduce their electricity and other cost of living through low-cost measures of new energy companies, so that they can gradually abandon the traditional ways of consuming biomass energy, thus structure change of rural energy consumption and ultimately the coordinated development of energy consumption and tourism development in rural areas.

3.3 Guide the Planning and Construction of Rural Tourism Projects According to Local Conditions

Local tourism departments and governments should analysis of the status of local tourist market and resources, and determine whether to develop rural tourism according to the actual local conditions, like whether it is of aesthetic, historical or cultural value, so as to ensure the reasonable development of rural resources and energy. For the construction of rural tourism projects in underdeveloped rural areas, relevant departments should send professional teams for planning and highlighting the differences and characteristics of regional environment and atmosphere, so as to create brands of strong regional features and competitiveness, boost tourist leisure and fun in the wild, and boost rural economy.

4. CONCLUSION

In summary, the current energy consumption in rural areas of China still relies on biomass energy, which has caused great damage to ecological environment and hindered the development of tourism and economy in rural areas. In view of this, this paper, based on previous studies, constructs a spatial panel model to explore the relationship between rural energy consumption and rural tourism, and conducts empirical research on the relevance of the two. It finds that there is a significant spatial correlation between energy consumption and tourism in rural areas. The increase of former is not conducive to the development of the latter, and the former can exert greater impact on the latter than vice versa. It is recommended that empirical analysis of the evaluation system of rural energy consumption, and the specific influencing factors be launched, based on cases on these two aspects, to further explore their relationship.

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