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Evaluating spatial centrality for integrated tourism management in rural areas using GIS and network analysis

Sang-Hyun Lee [a], Jin-Yong Choi [a,b,*], Seung-Hwan Yoo [a], Yun-Gyeong Oh [a]

[a] Department of Rural Systems Engineering, Seoul National University, Seoul, Republic of Korea
[b] Research Institute for Agriculture & Life Sciences, Seoul National University, Seoul, Republic of Korea

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ABSTRACT

The aim of this study is to identify and classify villages according to their spatial centralities, considering rural amenity resources, for integrated tourism management. Rural tourism is an important means of regional economic development because it permits new infrastructure to be developed and helps retain existing amenities. This study took place in Korea, where little attention has been given to an integrated rural tourism planning perspective, thereby undermining current initiatives. In this study, 43 villages in Jangheung-gun and Jeollanam-do were assessed and the centralities were measured using geographic information systems (GIS) and network analysis. The results show that Okdang-ri is the spatial core village supported by Yongjeon-ri and Bangchon-ri, thereby permitting a more effective provision of services. In addition, Inam-ri and Unheung-ri were identified as the sub-core villages of the two sub-groups, while Deogam-ri served as the connection node between these groups. This study demonstrates the applicability of centrality indices for evaluating spatial characteristics such as role, accessibility, and influence on surrounding villages for integrated tourism management.

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1. Introduction

Tourism is increasingly regarded as a savior of rural areas, with many governments recognizing the industry's potential in fostering regional economic development (Jackson & Murphy, 2006). However, the enormous infrastructure and resource demands of tourism can have severe impacts upon local communities and their surrounding environment if not properly managed. Therefore, an appropriate tourism development management approach is required for the maintenance of rural amenity resources and the preservation of rural environments, including natural and traditional resources in rural areas.

In Korea, various efforts have been made to develop rural areas by taking into account the available rural amenity resources (Kim, 2004; Kim & Choi, 2007; Kwon & Hong, 2003). Since 2002, the Korean government has been promoting farm-stays, traditional themed villages, information network villages and fishing villages in response to the heightened interest and demand for the discovery and creation of rural amenities (Oh, Choi, & Bae, 2008). Moreover, various organizations have been created for the purpose of developing various amenity resources and invigorating rural tourism by the citizens themselves, such as the Research Society for the Amenities of Rural-Mountain-Fishing Villages. The Rural Development Administration (RDA) in Korea is conducting a nation-wide rural amenity resources survey project to construct databases of rural amenity distribution. In addition, various studies have been conducted with the aim of improving rural tourism in other countries (Erkuş-Öztürk & Eraydin, 2010; Novelli, Schmitz, & Spencer, 2006; Shih, 2006). However, overlapping investments in uniform tourism projects, such as farm-stays or sightseeing tours, have already been executed in most of the rural areas in Korea, even though the individual villages have retained the characteristic amenity resources. In addition, without connection to neighboring villages, the effective management of rural amenity resources would be difficult within the context of small-scale tourism projects because small-scale amenity resources are scattered throughout rural areas.

Accordingly, several studies have been conducted to examine integrated tourism in Korea. Sim (2002) established the standard for defining specialized tourism zones according to characteristic tourism resources and divided Jeollabuk-do into five zones. Park and Song (2004) constructed a culture-tourism area for integrated development and analyzed the strategy of an individual area. However, these studies only classify major cities or rural areas with respect to tourism resources or administrative districts without

* Corresponding author. Department of Rural Systems Engineering, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, Republic of Korea. Tel.: +82 28804583; fax: +82 28732087.
E-mail address: iamchoi@snu.ac.kr (J.-Y. Choi).

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considering their relationships with neighboring villages in terms of both rural amenity resources and geographic location. An integrated tourism strategy should be implemented for the effective management of scattered amenity resources and the tourism plan connecting to neighboring villages. In addition, in the case of rural tourism development within many villages, it is important to identify which villages perform the main role for integrated rural tourism and how the main and sub-groups are constituted within several villages. In this study, a spatial index that considers geographic accessibility and the characteristics of rural amenities is evaluated with the application of centrality theory to promote an integrated tourism strategy. The idea of centrality is one of the earliest to be pursued by network analysts (Scott, 2000). Freeman (1979) gave a discussion of actor centrality and network centrality. Wasserman and Faust (1994) presented various centrality measures and referenced the literature on centrality. Numerous measures have been developed, including flow betweenness, the rush index, influence measures and various centralities (e.g., degree, closeness, betweenness, eigenvector, and information centralities) (Borgatti, 2005; Hoede, unpublished manuscript; Hubbell, 1965; Katz, 1953; Taylor, 1969). As centrality implies nodes in a network structure, a centrality that considers both rural amenity resources and the geographic positions of the villages could represent the degree, accessibility, and influence on the other surrounding villages. Accordingly, integrated tourism management that is based on spatial centralities could result in the effective management of scattered amenity resources and the development of connections between neighboring villages.

In this study, a geographic information system (GIS) and network analysis were employed to evaluate spatial centralities and classify villages based on their centralities to develop an integrated tourism strategy that considers rural amenity resources. Herein, we illustrate the methodology for spatial network construction and present an evaluation of the degree, betweenness and eigenvector centralities of individual villages, respectively. Furthermore, the core and sub-core villages are identified for integrated tourism using these results. Additionally, the main and sub-group villages are categorized by their eigenvector and degree centrality, and the connecting villages that perform the role of linkage between these groups are evaluated by betweenness centrality.

2. Materials and methods

In this study, a spatial network structure applying network flow as a weight for the links was constructed to analyze the spatial centrality of rural villages. The spatial network structure was constructed as an adjacency matrix using the shortest paths among villages using GIS. The network flow was estimated using the spatial tourism interaction model, including various factors such as green tourism potential, human resources, and the shortest distances among villages. The green tourism potential is measured using the tourism amenity index and the weight of the rural amenity (Oh et al., 2008). The amenity resources, such as plants and reservoirs, are regarded as more important factors in green tourism, and most tourism plans in Korea include the application of amenity resources. The population also performs a significant role in integrated tourism strategy. Even if the rural amenity resources are plentiful and an integrated tourism plan is established in a rural area, it is difficult to maintain rural tourism and amenity resources without abundant manpower. The distances among villages are also a main factor in promoting integrated tourism. Therefore, in this study, the rural amenity resources, population and distances among villages were used as the main factors in creating a spatial tourism interaction. The spatial centralities (degree, betweenness, and eigenvector centrality) were then calculated in the spatial network structure by applying spatial tourism interaction as the network flow using network analysis. From these results, the core, sub-core and connection villages are identified, and the main group centering the core village is ascertained for application to the integrated tourism strategy. The core villages are identified by a high degree centrality and an eigenvector centrality, and the connection villages are indicated by a betweenness centrality. In addition, the main and sub-groups are evaluated by an eigenvector centrality in the integrated rural tourism. A flowchart of procedures for the spatial centrality analysis is shown in Fig. 1.

2.1. Spatial tourism interaction among rural villages

2.1.1. Spatial network structure by shortest path

Network analysis, which is derived from graph theory, attempts to describe the structure of relationships between given entities and applies a quantitative technique to produce relevant indicators and results for the study of characteristics of an entire network, and the position of individual entities within the network structure (Shih, 2006). In network structure, two nodes joined by a link are referred to as adjacent or neighboring and it is often useful to consider an adjacency (or connectivity) matrix. The adjacency matrix focuses on unweighted networks that are binary in nature, which means that the links between nodes are either present or not, and the diagonal of the adjacency matrix contains zeros and is thus a symmetric matrix (Boccaletti, Latora, Moreno, Chavez, & Hwang, 2006). In this study, an adjacency matrix was analyzed by the shortest paths among villages using GIS. However, along with a complex topological structure, many real networks display the intensity of the connections. Therefore, we considered spatial tourism interaction to be positive and the symmetric weight of the links in the adjacency matrix. In other words, the weighted network, which took into account the adjacency matrix and the weight of the link, was obtained using the weight distribution from the spatial tourism interaction among the given links.

2.1.2. Spatial tourism interaction as the weight of links in the spatial network

Spatial interactions cover a wide variety of movements, such as trips to work, migrations, tourism, public facility usage, the transmission of information or capital, retail marketing activities, international trade and freight distribution (Rodrigue, Comtois, & Slack, 2009). The basic assumption behind many spatial interaction

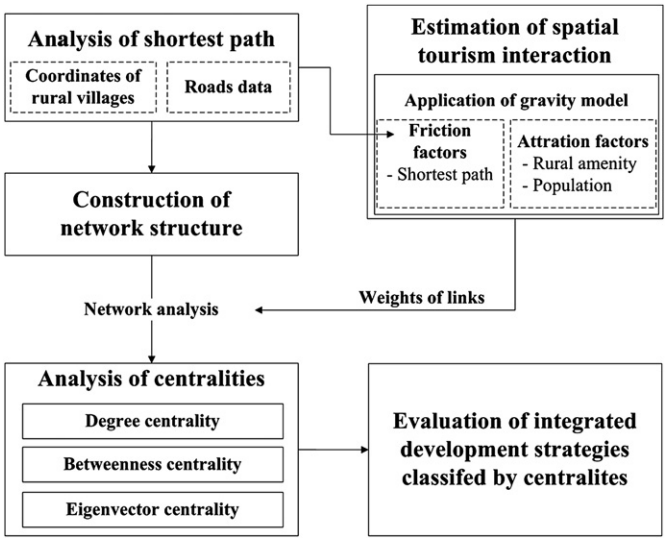

Fig. 1. Flow of procedures for spatial centralities analysis.

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