Evaluation of forest functions for establishment of a sustainable forest land management system : focusing on Nakdong-jeongmaek of South Korea

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Abstract: This study aimed to evaluate forest function around the Nakdong-jeongmaek mountain range for sustainable conservation and sensible use of forestland. In terms of main function, the highest proportion of forest (42.2%) was found to have a natural conservation function, followed by timber production function (31.9%). The results of this forest function assessment will be useful as supporting data for efficient decision making processes in regional broad-scale forest management and planning.

Keywords: Forest Management, Ecological Network, GIS

1. Introduction

Increased attention to the need for sustainable forest management has necessitated the development of a new forest management system that can meet social, ecological, and economical demands, based on diversity of forest function. Outstanding forest resource management can establish a logical and scientific forest management system, contribute to smooth timber production and supply while increasing income, and also provide public benefits, such as ecosystem conservation, forest recreation, and land conservation. In order to achieve these goals, forest function needs to be scientifically evaluated by not only natural location, but also social, geographical, and economic factors. This should be used to prepare a forest use classification system, and thereafter establish a resource management system that displays diverse forest function in good balance.

Specifically, the forest resource management

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system should be established more carefully in regions with superior ecosystem characteristics. The Baekdu-daegan range and its branches (jeongmaek) make up the ecological axis of the Korean peninsula, but they have not been appropriately managed, despite possessing outstanding ecological resources. For Baekdu-daegan, following recognition of its ecological significance, the Baekdu-daegan Protection Act has been legislated. On the other hand, there has been a lack of legal or institutional protection for the jeongmaek, and so it is difficult to respond actively to development or damage. In addition, no guidelines are available for systemic forest use, which means that efficient utilization of natural resources by the local residents or users is also difficult. Therefore, evaluating function in jeongmaek regions to produce guidelines and evidence for the conservation and use of the jeongmaek is essential to sustainable forest resource management.

This study proposes a plan for sustainable conservation and sensible use of forests based on an assessment of forest function in Nakdong-jeongmaek.

2. Methods

2.1. Study Site

The mountain ranges of the Korean Peninsula consist of 1 daegan, 1 jeonggan, and 13 jeongmaek, and Baekdu-daegan and the jeongmaek have been considered its core ecological axis. In particular, Nakdong -jeongmaek is a branch of Baekdu-daegan located on the east side of the Nakdong River, forming a huge mountain range approximately 418 km in length. The conservation is required since it is closely connected with the other mountain ranges in the Yeongnam area, forming a major ecological axis, and it is also important in terms of utilization, providing the local residents with various services. Thus, we assessed forest function in the area within 2 km of the Nakdong-jeongmaek mountain range.

2.2. Classification and assessment of forest function

The forest function classification map prepared by the Korea Forest Service's National Forest Research Institute is a computerized map that divides forest function into 6 types for assessment: 'timber production function', 'water resources conservation function', 'forest disaster prevention function', 'forest recreation function', 'livelihood environmental conservation function', and 'natural environmental conservation function'. Timber production function refers to formation of timber resources to provide the stable supply of timber needed for national economic activity. Water resources conservation function is the function of supplying an ample and sustainable amount of clean water for domestic use, by allowing rainfall to permeate through the forest to underground and gradually leak out. Forest disaster prevention function is the ability to preserve land by preventing mountainous disasters, such as landslides and soil erosion, and devastation, such as surface erosion. Forest recreation function has a visitor oriented character, contributing to the improvement and maintenance of physical and mental health by providing a pleasant environment and a place to rest. Livelihood environmental conservation function has a resident oriented character, acting to maintain the scenic beauty of the city or neighborhood. Natural environmental conservation function refers to the conservation of nature with academic, cultural, or historical value.

Grades were assessed for each forest function based on function-specific evaluations and using an analytic hierarchy process (AHP) method to assign weights. Five functions, excluding natural environmental conservation function, were graded as low, medium, or high grade, while natural environmental conservation function was assessed positively when the area was legally designated as the conservation area.

Forest function were ordered by grade, with the highest grade corresponding to the main function, which shows the greatest potential. If the evaluation grade was identical, the order was determined as follows: water resource conservation function > timber production function > forest disaster prevention function > forest recreation function > livelihood environment conservation function. Natural environment conservation function took priority over other functions since it means that the area is legally protected (Kwon et al., 2008).

3. Results

When the forest area within 2 km from the middle mountain ridgeline of Nakdong-jeongmaek was evaluated for timber production function, the evaluation grades were as follows: 5.4% low, 0.7% medium, 51.7% high, and 42.2% legally protected area with no potential for timber production. For water resource conservation function, the evaluation grades were as follows: 0.0% low, 51.9% medium, and 5.9% high. For forest disaster prevention function, the evaluation grades were as follows: 26.8% low, 29.9% medium, and 1.2% high. For

forest recreation function, the evaluation grades were as following: 1.5% low, 46.1% medium, and 10.2% high. For livelihood environmental conservation function, the evaluation grades were as follows: 0.0% low, 53.4% medium, and 4.4% high. Legally protected area with a natural environmental conservation function constituted 42.2% of the total land, and the not applicable area was 57.8%.

When the main function of Nakdong-jeongmaek was analyzed, the area with natural environmental conservation function was found to be highest (42.2%), followed by the area with timber production function (31.9%).

Table 1. Evaluation factors for each forest function

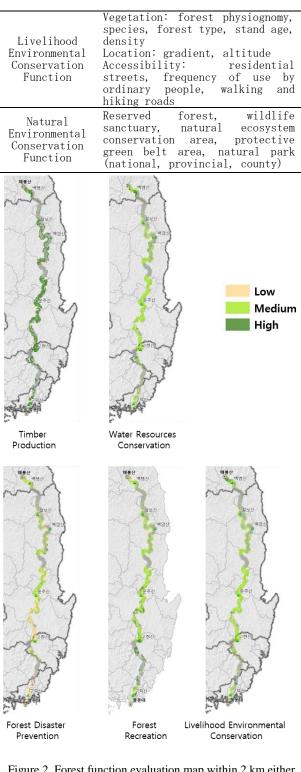| Function Classification	Evaluation Factors
Timber Production Function	Growth factors: forest growth state, rocks, topography, slope, altitude, bearing, soil depth, soil composition, slope shape, hardness, sedimentation mode, soil drainage, soil moisture Management factors: gradient, road accessibility, distance to market, population density
Water Resources Conservation Function	Vegetation: forest type, density, forest physiognomy, stand age, leaf area index, overstory cover, understory cover Location and climate: altitude, form of slope, gradient, rocks, soil depth, soil type, soil composition, density by soil depth, catchment area, rainfall
Forest Disaster Prevention Function	Vegetation: forest physiognomy, species, understory vegetation, age, diameter class Location and climate: ground, length of slope, location of slope, soil depth, gradient, altitude, soil type, soil composition, slope, disaster vulnerable areas (villages, roads, etc.), rainfall
Forest Recreation Function	Vegetation: forest physiognomy, species, stand age, species diversity, density Location: slope, altitude, water system (valley) Accessibility: road accessibility, market accessibility and size Significance: historical and cultural heritage, recreational facilities, walking and hiking roads, local specialties, rare animal habitat
Livelihood Environmental Conservation Function	Vegetation: forest physiognomy, species, forest type, stand age, density Location: gradient, altitude Accessibility: residential streets, frequency of use by ordinary people, walking and hiking roads
Natural Environmental Conservation Function	Reserved forest, wildlife sanctuary, natural ecosystem conservation area, protective green belt area, natural park (national, provincial, county)

Figure 2. Forest function evaluation map within 2 km either side of Nakdong-jeongmaek

4. Discussion and Conclusion

Forests bring a number of benefits to human by performing diverse functions. Classification of forest function helps to maximize the functional benefits of

forest land, by efficiently and quantitatively enabling evaluation of the social and environmental demands of forests (Führer, 2000). Therefore, classification of forest function can provide data to support the establishment of forest conservation policy and the sustainable use of forest resources through specialized forest management.
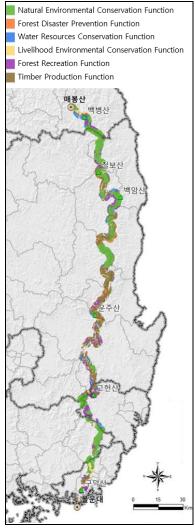

Figure 2. Distribution of forest function within 2 km either side of Nakdong-jeongmaek

Table 2. Analysis of main function within 2 km either side of Nakdong-jeongmaek

Main Function	Area (ha)	Proportion (%)
Natural conservation function	53,226.9	42.2
Timber production function	40,249.5	31.9
Forest recreation function	15,413.1	12.2
Water resource conservation function	9,391.7	7.4
Livelihood environmental conservation function	4,121.5	3.3
Forest disaster prevention function	3,721.4	3.0
Total	126,124.0	100.0

For Nakdong-jeongmaek, almost half of the whole area was designated as legally protected area, where conservation should be considered as the top priority over other uses. In addition to the legally protected area, it is thought that a buffering area will need to be designated to ensure continuity. Timber production function is an important function to increase the economic value of forest by production and supply of timber, in addition to increased income of local residents. Silviculture should be performed appropriately in these areas, and income should be maximized by planting species of trees with high value as timber.

The results of the forest function evaluation are expected to provide useful data to support efficient decision making in broad-scale forest management planning. In particular, it is now possible to objectively assess areas with high conservation value or with social, economic, and cultural value but lacking protective measures and detailed and efficient plans for use.

References

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