

Improvement and Application for Environmental Conservation Value Assessment Map (ECVAM) of Nationwide Land in Korea

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Abstract : This study is aiming at improving the Environmental Conservation Value Assessment Map (ECVAM) of National Land in Korea. The ECVAM items are composed of legal and environmental/ecological assessments. A popular method applied to ECVAM is an overlay environmental/ecological assessment items. The purpose of this study is to offer complementary items of the ECVAM by examining assessment items. In this study we assessed the ECVAM by five methods. Method 1 is Grade 1 areas of each administrative district; Method 2 is comparing overlapped areas of each assessment items Grade 1, 2 and permission of each assessment items duplication; Method 3 is Grade 1, 2 areas by only singular assessment items; Method 4 is Grade 1 areas only of Method 2; and Method 5 is Grade 2 areas only of Method 2. Method 1 showed Seoul and other metropolitan cities revealed a large proportion of Grade I regions by the legal assessment items. Gang won-Do, showed a large proportion of Grade I regions by the environmental/ecological assessment item. Method 2 showed 93.4 % of diameter Grade II (standard for stability); forest diameter item accounted for 99.9 % by Method 3, Method 4 showed 95.7 % of forest diameter, and forest density accounted for 66.4 % by Method 5. This study contributes to reduce the complexity in the process of manufacturing ECVAM of National Land, and to raise the flexibility in the process of managing and updating this map.

Key Words : Environmental Conservation Value Assessment Map (ECVAM), environmental/ecological assessments, legal assessment items, GIS.

1. Introduction

National planning and utilization have progressed to focus on ways of supporting economic growth efficiently since the 1970s. Because of this social phenomenon, specific systems and policies for systematic and territorial environment management

were not prepared, and the difficulties of efficient territorial conservation and management bring about many social conflicts.

After Rio earth charter, seriousness of environmental issue is generalized. Idea of sustainable development is spreaded out for some time. So there is a need to evaluate environmental values efficiently through

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integrated environmental information, and on the basis of this evaluation, preventative and environmentally-friendly territorial environment management policy is required for unique land utilization and management (Lee, C.S, 2006).

This is the reason for creating Environmental Conservation Value Assessment Map (ECVAM) of National Land, with national integrated environment information and environmental value, evaluated objectively and able to be used by everyone. ECVA is a process of scientifically assessing physical and environmental features of land, and grading conservation suitability. This study is making steady progress from having formulated the concept of environmental assessment in 2001 and producing an ECVAM of Seoul metropolitan area in 2002, by constructing an ECVAM of National Land of South Korea till 2005. The map is built up through evaluation of 67 items, comprising 56 legal assessment items and 11 environmental/ecological assessment items.

An assessment method applied to ECVAM of National Land is basically an overlay method for legal assessment items and environmental/ecological assessment items. Legal assessment items are composed entirely of designated Environmental items for the Ministry of Environment, the Ministry of Construction and Transportation and the Korea Forest Service etc.

Environmental/ecological assessment items are the basis of existing composition map and make full use of all environmental GIS data now. However the existing data is scanty, possibility of similarity valuation items is duplicate assessment and renovating to fresh environmental GIS data.

Each using the thematic map of assessment items is difficult to apply ECVAM of National Land because these thematic maps are just only suitable for making data using construction organization. In the interest of higher confidence result, the construction

ECVAM of National Land has reviewed, and confirmation each assessment items at this time.

Domestic studies have been conducted on the environmental conservation value assessment and the map as next; the establishment of the ECVA standard of land, the examination of assessment items based on precedent theories and studies and the application of the ECVA on the Seoul metropolitan areas (Lee *et al*, 2004), and the selection of preservation areas within Gyeonggi- Do through the improvement of the ECVA. Also In addition there is a study to compute the environmental capacity, based on the ECVA of national land.

These existing studies are significant in the process of constructing and updating ECVAM of National Land. In this study, we provided the possibility of this map to be applied in diverse parts by improving the ECVA. In order to make these studies including our study meaningful hereafter, this map should be investigated and the improvement devise, which is capable of ensuring the reliance, should be provided.

The purpose of this study is to offer the device to complement items of the ECVAM by examining assessment items. For this, our study was preceded as follows;

First, we caught on to the overlapping degree among assessment items of the ECVAM of national land. For this, we grasped the grade distribution of the environmental conservation value assessment and analyzed the overlapping degree among assessment items to be applied to this map. On the concrete, we investigated the grade distribution on legal items and environmental/ecological items classified by each administrative district (Metropolitan, Do-province, Si-city, Gun-county, Gu-autonomous district), and scrutinized the propriety on environmental/ecological items to affect the assessment result more powerfully than legal items (Lee *et al*, 2005).

Second, we gripped results to be assessed by

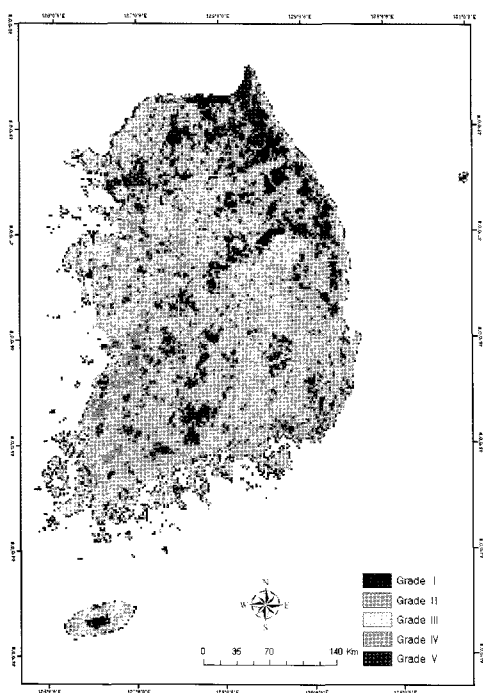


Fig. 1. Results of ECVAM.

various items, which were overlapped each other. In order to reflect each assessment item effectively to the environmental conservation value assessment map of national land, we analyzed the overlapping degree on environmental ecological items, and investigated the grade distribution by the field survey.

Based on the above examination, we presented the mediation plan within the range of having no effect on assessment results. From now on, this study will contribute to reduce the complexity in the process of manufacturing ECVAM of National Land, and to raise the pliability in the process of managing and updating this map.

2. Study Scope and Method

1) ECVAM Construction Present State

Environmental conservation value assessment map

(ECVAM) is used to assess nationwide environmental value. ECVAM was developed in three phases. During the initial phase, beginning in 2001, a foundation was laid through basic research, and in 2005 ECVAM was constructed from a blueprint of South Korea (1:25,000 scale 776 Map), and thereafter, from 2006, its resources have been continuously maintained, used for studies, and regularly updated. In total, 67 Environmental conservation value assessment (ECVA) items are to be evaluated, comprising 56 legal assessment items, such as conservation status, and 11 environmental/ecological assessment items which include the concept of natural resources Table 1. ECVAM arrives at a final assessment by totaling 67 assessment items, Graded 1-5, after applying the least indicator method (Lee *et al.*, 2005)

Overlapped analysis adopted the least indicator method, as shown in calculation (1). This is to evaluate a nation's environment when one of the environmental assessment items has a high value. The strength in this method is the production of relatively simplified results from a variety of environmental assessment factors, combined with a clear explanation of them. This study characterized the distribution trends in administrative sectors across the whole country, such as Si, Goon, and Gu, over ECVAM Grade I areas defined using the least indicator method, and reviewed overlapping areas of Grade I and II environmental/ecological assessment items.

$$I = \max \{ I_1, I_2, \dots, I_j, \dots, I_n \} \quad (1)$$

2) Study Area and Method

In order to grasp the distribution state of ECVAM administrative sectors, we executed an analysis of Si and Do areas of Grade I, where the preservation value is relatively high in ECVAM. Among ECVA factors,

Table 1. Assessment data of ECVAM.

Assessment Units		Assessment Data
Legal Assessment Criterion (56)	Natural Environment	Natural Environment Conservation Act (Ecology and landscape core conservation area, Buffer area), Conservation of Wetlands Act (Wetland protection area, Near wetland management area, Wetland improvement area), Protection of Wild Fauna and Flora Act (Wild animal and plant protection area), Soil Environment Conservation Act (Soil conservation countermeasure area), Special Act on the Preservation of Ecosystem in Island Areas including Dok-Island (Specific islands), Natural Parks Act (Natural conservation and Natural environmental district of natural parks)
	Water Quality Environment	Act on the Improvement of Water Quality and Support for Residents of the Riverhead of the Han River System (River watershed zone), Water Quality Conservation Act (Designated lakes and marshes, Water quality conservation area of lakes and marshes), River Act (River zone, Coastal zone), Small River Maintenance Act (Small river zone), Water Quality Conservation Act (Water quality degree I, II, III), Groundwater Act (Groundwater conservation area), Water Supply and Waterworks Installation Act (Water sources conservation area of metro water supply, Water sources conservation area of local waterworks, Expected water sources area)
	Others	National Land Planning And Utilization Act (Natural environment conservation area, Green area, Landscape district, Preservation district), Act On Special Measures For Designation And Management of Areas Of Restricted Development (Green belt), Act on Urban Parks and Greenbelts, etc. (Children's park, Neighborhood park, Urban natural park, Cemetery park, Sports park, Buffer green area, Landscape green area), Special Act on Jeju Free International City (Absolute conservation area, Relative conservation area, Management conservation area), Forestry Act (Preservation forest, Forest genetic resources), Protection of Cultural Properties Act (Natural monument district, Natural monument preservation zone), Farmland Act (Development right in agricultural land zone, Development right in agricultural protection zone, Abandoned agricultural fields), Rearrangement of Agricultural and Fishing Villages Act (Large scale land readjustment, Normal land readjustment, Simplicity land readjustment)
Environmental and Ecological Criterion (11)		Diversity (Species diversity), Naturalness (Forest map wood age, Green naturality map, Ecological map), Abundance (The number of species observed, Ecological change observation zone, Find point of endangered and rare species), Vulnerability (Distance from built-up areas and roads), Potential Value (Same areas for find point of endangered and rare species), Stability of Community (Diameter, Density)

an environmental/ecological item makes a rather deep impact on the final results of the assessment since thematic map construction of a single item is implemented nationwide. There are eight items for analysis of characteristics: the rarity (a rarity discovery area), the variety (Species diversity), the naturality (the degree of green naturality, the degree of natural ecology, age), abundance (ecological change observation area), stability (diameter, density). We composed a thematic map from these eight and the legal assessment items, and then compared them with each environmental/ecological item. One of the frail among the environmental/ecological items involves an evaluation of grade for

the distance from roads and urban areas. Since it is a counter-application against the least indicator method and its character is different from other evaluation items, we excluded this item from our comparison list. We applied Overlapped analysis on the environmental/ecological assessment items in Grade I and II regions. In order to analyze environmental/ecological assessment items' data, we classified them by using GIS DB. GIS DB is already constructed. For details of the analysis method see Table 2 and Fig. 2.

We carried out field survey in the Grade I and II areas revealing highly Overlapped rates for age, diameter, and density of the Forest Map. We studied 45 areas of the 6 regions in the nation. Table 3 shows

Table 2. Analysis method.

Number	Analysis Method
Method 1.	- Grade 1 areas of each administrative district
Method 2.	- Comparing overlapping areas of each assessment items Grade 1, 2 - Permission of each assessment items' duplication
Method 3.	- Grade 1, 2 areas by only singular assessment items
Method 4.	- Only Grade 1 areas of Method 2.
Method 5.	- Only Grade 2 areas of Method 2.

Table 3. Field survey sites.

Administrative District	Land-use Types	Number of Sites
Wonju Si, Gangwon-Do	Forest	7
Yongin Si, Gyeonggi-Do	Built-up	5
Gwanak and Geumcheon Gu, Seoul	Built-up	5
Gimhae Si, Gyeongsangnam-Do	Forest, Agricultural Area	10
Seosan Si, Chungcheongnam-Do	Agricultural Area	9
Gochang Si, Jeonbuk-Do	Agricultural Area	9

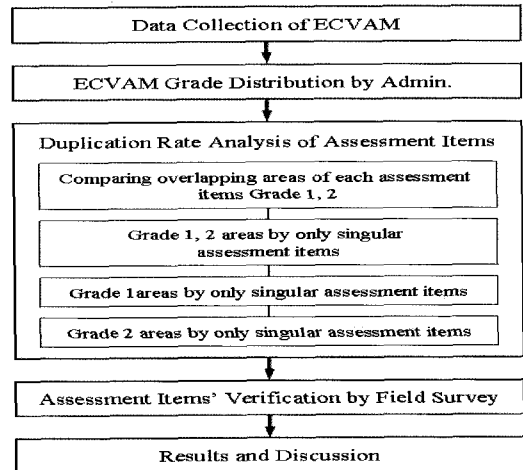
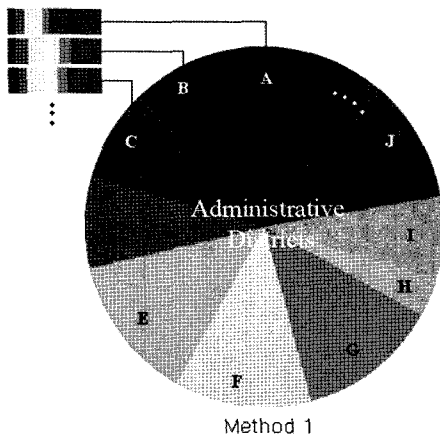


Fig. 2. Process adopted by this study.

these areas. The field survey areas were selected by a standard of land usage presentation. We chose two from each of the urban, the agriculture and the forestry sites. The research method utilizes the basic resources for the researched areas. Examples of the basic resources are: 1:25,000 scale map, Land Cover Map and Forest Map (diameter, age, density, kinds of trees). We also checked the field survey location using GPS. Moreover, this study prepared a field survey note for each research location, recording

ECVAM Grades of each administrative district



Overlapped areas of each assessment items' Grades

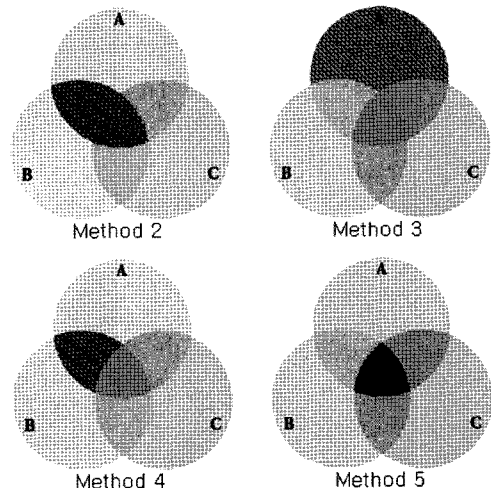


Fig 3. Concept of the analysis method.

every single tree's kind, number, location, height, wood age diameter moderate, and the crown, all within a 10×10m square, and then took a photo of the area's botanical composition and local condition. The research process is shown in Fig. 1.

3. Results

1) The Grade I Areas within Each Administrative Sector

The ECVAM Grade I region is 45,417.5 km², which covers 45.7% of the whole country. Of the Grade I areas within each administrative sector, Gangwon-Do's is the most extensive at 12,007.8 km², while North Gyonsangnun-Do's is second largest, covering a relatively wide 7,909.1 km². Metropolitan cities such as Seoul and Busan-Si have relatively small ECVAM Grade I regions in comparison with Do areas. Of the proportions of Grade I area within each administrative sector, Gangwon-Do shows the largest at 70.9 %, Daejeon-Si the second largest at 54.6 %, and Chungcheonnun-Do the third largest at 51.5 %. These proportions explain the different character between the environmental/ecological and the legal assessment items. We can see that 66.0 % of Kangwon-Do and 40.7 % of Chungcheonnun-Do are decided by environmental/ecological assessment items. Also, 49.1 % of Daejeon-Si and 44.9 % of Daegu-Si are decided by legal assessment items. We determined that 30.5 % of Daejeon-Si and 24.5 % of Busan-Si are appointed as Grade I areas in both the environmental/ecological and the legal assessment items.

Seoul and the other six metropolitan cities show a large proportion of legal assessment items evaluated as Grade I, due to, for example, the Development Restriction Zone. We can confirm that 'Do' regions,

such as Gangwon-Do, show a large proportion of environmental/ecological assessment items assessed as Grade I because of the high percentage of forest. Moreover, all of the metropolitan cities, except Incheon, have a large proportion of Grade I from the legal assessment items. All of Do, including Gangwon-Do, has a large proportion of Grade I by the environmental/ecological assessment items.

2) Overlapped analysis in environmental /ecological item

(1) Overlapped analysis in Grade I and II areas

Grade I occupies 45.73 % and Grade II occupies 23.47 % of the nation's landmass in the Environmental Conservation Value Assessment Map. These proportions reflect the defined areas in environmental/ecological and legal assessment item Grade I and II are the result of overlapping. The outcome of the overlapped analysis in each assessment Grade I and II areas are shown in Table 5.

Table 5 indicates the percentages of areas classified Grade I and II. It compares the degree of overlap by crossing each of the environmental/ecological assessment items. Through this, it confirms each item's degree of overlap by standardizing a single assessment item. Items with the highest degree of overlap in Grade I are as follows: 81.7 % overlap between Stability 1 (diameter) and Naturality 3 (age) areas; 63.8 % overlap between Diversity (Species diversity) and Rarity (a rarity discovery area) areas. Items with the highest degree of overlap in Grade II are as follows: 79.9 % overlap between Stability 2 (density) and Naturality 2 (ecological map); 74.3 % overlap between Naturality 3 (age) and Naturality 2 (ecological map). The proportion of cross overlapping in Grade I and Grade II areas are as follows: 91.0 % between Naturality 3 (age) and Stability 1 (diameter); 73.8 % between Stability 2 (forest density) and Naturality 2

Table 5. Results by Method 1 : Grade 1 areas of each administrative district.

Administrative Districts	Grade 1		Environment and Ecological Items (%)	Legal Items(%)	Duplicate Area (%)
	Area (km ²)	Percentage(%)			
Seoul	132.1	21.7	10.2	21.4	9.9
Gwangju n	181.1	36.4	9.3	38.5	11.4
Daegu	429.5	48.7	26.2	44.9	22.4
Daejeon	294.9	54.6	36.0	49.1	30.5
Pusan	313.4	41.5	28.8	37.1	24.5
Ulsan	521.2	48.8	29.1	39.2	19.5
Incheon	180.7	21.3	18.6	6.2	3.5
Gangwon Do	12,007.8	70.9	66.0	22.4	17.4
Gyeonggi Do	4,122.6	40.5	31.8	18.5	9.8
GyeongsangnamDo	4,394.8	42.1	30.6	22.9	11.4
Gyeongbuk Do	7,909.1	41.5	31.5	19.5	9.5
Jeollanam Do	4,213.6	36.2	28.1	15.9	7.8
Jeonbuk Do	3,442.3	43.4	35.2	20.5	12.3
Jeju Do	595.4	31.8	23.4	22.1	13.7
Chungnam Do	2,845.8	33.2	28.5	10.4	5.8
Chungcheongnam Do	3,833.0	51.5	40.7	25.0	14.2
Total	45,417.5	45.7	37.1	20.3	11.6

Table 6. Results by Method 2 : Comparing overlapping areas of each assessment items Grade 1, 2

Assessment Units (%)	A		B		C		D		E		F		G		H		I	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	A	100	-	2.1	0.7	10.9	0.7	26.2	39.7	6.6	2.0	15.5	20.7	1.2	14.5	32.9	24.1	31.2
	-	100	0.1	0.2	24.7	0.5	23.4	43.4	5.5	1.2	13.9	22.0	0.9	13.2	35.1	24.5	27.9	35.0
B	63.8	2.8	100	-	2.2	0.4	2.2	27.2	23.9	3.0	1.0	21.1	0.1	22.0	2.6	23.8	58.4	24.6
	11.5	4.7	-	100	2.9	0.1	2.7	5.6	29.7	9.4	1.8	3.8	0.2	1.7	5.8	5.0	16.0	20.4
C	4.9	18.0	0.0	0.1	100	-	17.8	39.0	1.8	0.8	11.0	35.2	0.4	28.8	47.9	31.3	38.1	33.8
	15.7	18.6	0.3	0.1	-	100	34.7	36.4	6.4	3.0	15.7	19.9	0.4	16.3	35.7	27.0	28.2	25.5
D	12.3	17.7	0.0	0.1	18.5	0.7	100	-	0.6	0.9	4.9	39.2	2.0	36.0	47.9	33.1	40.5	32.9
	4.7	8.3	0.1	0.0	10.3	0.2	-	100	2.5	0.4	4.4	31.8	0.2	4.9	44.8	38.8	22.4	52.2
E	11.9	16.2	1.4	3.3	7.2	0.5	2.3	38.0	100	-	1.1	22.5	0.4	12.8	29.2	18.9	30.3	34.7
	12.7	12.3	0.6	3.5	10.8	0.8	11.4	18.7	-	100	6.1	10.2	0.2	6.3	16.0	10.3	26.4	18.8
F	12.4	18.0	0.0	0.1	19.7	0.5	8.4	30.1	0.5	0.8	100	-	4.5	91.0	43.2	43.6	42.3	28.7
	5.8	9.8	0.2	0.1	21.7	0.2	23.3	74.3	3.4	0.5	-	100	0.0	2.1	63.8	34.0	29.0	50.8
G	17.3	21.5	0.0	0.1	11.9	0.2	61.7	20.8	2.9	0.5	81.7	0.2	100	-	57.4	25.8	63.7	14.8
	11.9	17.6	0.6	0.1	52.8	0.6	63.6	34.2	5.8	0.8	93.4	6.2	-	100	53.9	43.4	39.5	29.0
H	6.4	11.1	0.0	0.1	20.7	0.3	20.0	73.8	3.1	0.5	10.5	44.8	0.8	12.7	100	-	29.4	48.9
	5.9	9.6	0.2	0.1	16.9	0.3	17.3	79.9	2.5	0.4	13.2	29.9	0.4	12.8	-	100	24.9	51.3
I	7.5	10.9	0.5	0.2	20.4	0.3	20.9	45.5	4.0	1.0	12.7	25.1	1.1	11.5	36.3	24.6	100	-
	4.4	7.9	0.1	0.2	10.5	0.2	9.8	61.3	2.7	0.4	5.0	25.5	0.1	4.9	34.9	29.3	-	100

A : Rarity discovery area, B : Species diversity, C : Degree of Green Naturality, D : Ecological Map (Vegetation), E : Ecological Change Observation Area, F : Forest Map - Wood Age, G : Forest Map - Wood Diameter, H : Forest Map ? Density, I : Legal Assessment Items

(ecological map).

The proportion of cross overlapping in Grade II and Grade I areas are as follows: 93.4 % between Stability 1 (forest diameter) and Naturality 3 (forest age); 63.6 % between Stability 1 (forest diameter) and Naturality 2 (ecological map).

(2) Overlapped analysis in a single assessment item

The results in Table 5 evaluate the Overlap between two assessment items. For this reason, we cannot confirm the Grade I and II areas from a single item. So we carried out the analyses, shown in Table 6, Table 7 and Table 8, in order to assure the defined

areas as Grade I and II, and the grades were decided, respectively, by a single item, overlapping two items, and three or more items.

Table 6 indicates the degree of overlap of integrated Grade I and II areas. It shows the proportion of the Grade I and II areas in each of one, two, and three items. An individual item of Grade I and II is 24.2 % of the abundance (ecological change observation area) Grade I and II areas. 19.9 % of Diversity (Species diversity) and 17.8 % of Rarity (a rarity discovery area) Grade I and II show overlap. Two items of Grade I and II regions are 19.2 % of Diversity (Species diversity) and Abundance (ecological change observation area), 6.8 % of

Table 7. Results by Method 3 : Grade 1, 2 areas by only singular assessment items.

Assessment Units (%)	A	B	C	D	E	F	G	H	I	J	K
A	17.8	0.1	0.5	2.9	1.1	0.0	0.0	0.4	10.5	15.4	66.8
B	1.8	19.9	0.0	-	19.2	0.0	-	0.6	11.6	33.2	46.9
D	0.6	0.0	2.0	1.8	0.1	0.0	-	0.1	2.3	4.9	93.1
D	0.7	-	0.4	5.6	0.1	0.1	0.0	6.8	5.4	13.5	80.9
E	3.9	2.5	0.2	1.2	24.2	0.0	-	0.1	10.4	18.3	57.4
F	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.8	0.0	1.1	98.9
G	0.0	-	-	0.0	-	0.0	0.0	0.0	0.0	0.1	99.9
H	0.1	0.0	0.0	7.8	0.0	0.4	0.0	0.7	0.5	8.8	90.4
I	2.4	0.1	0.4	5.0	0.6	0.0	0.0	0.4	25.5	9.0	65.5

A : Rarity discovery area, B : Species diversity, C : Degree of Green Naturality, D : Ecological Map (Vegetation), E : Ecological Change Observation Area, F : Forest Map - Wood Age, G : Forest Map - Wood Diameter, H : Forest Map ? Density, I : Legal Assessment Items, J : Duplicated Area of 2 items, K : Duplicated Area over 3 items

Table 8. Results by Method 4 : Only Grade 1 areas of Method 2.

Assessment Units (%)	A	B	C	D	E	F	G	H	I	J	K
A	35.9	0.2	3.0	1.9	1.6	0.7	-	9.5	9.5	26.5	37.6
B	7.5	4.4	0.1	0.1	5.6	0.0	-	0.7	4.0	18.0	77.6
C	1.3	0.0	13.8	5.5	0.5	1.4	0.0	12.8	3.9	25.5	60.6
D	0.9	0.0	5.7	10.0	0.3	3.3	0.0	9.8	3.9	23.9	66.1
E	2.9	0.3	1.9	1.0	38.7	0.4	-	10.2	8.3	25.1	36.2
F	0.5	0.0	2.5	5.7	0.2	8.5	0.2	6.8	2.7	18.7	72.7
G	-	-	0.0	0.0	-	4.2	0.0	0.1	0.0	4.2	95.7
H	1.9	0.0	5.6	4.1	1.1	1.6	0.0	45.4	14.3	28.6	26.0
I	2.3	0.0	2.1	2.0	1.1	0.8	0.0	17.7	47.8	26.0	26.3

Table 9. Results by Method 5 : Only Grade 2 areas of Method 2.

Assessment Units (%)	A	B	C	D	E	F	G	H	I	J	K
A	27.4	0.1	0.1	8.4	0.6	4.1	5.0	1.2	7.9	27.5	45.1
B	2.4	61.8	0.0	1.4	7.6	1.0	0.5	1.2	14.4	28.6	9.6
C	4.7	0.0	22.5	9.1	0.8	4.1	3.5	2.0	7.7	32.0	45.5
D	1.6	0.0	0.0	18.9	0.1	8.0	1.1	10.2	17.1	38.2	42.9
E	6.2	2.9	0.2	4.6	51.8	1.9	2.0	0.6	8.2	26.5	21.7
F	1.8	0.0	0.0	18.4	0.1	9.0	0.2	3.8	5.9	30.3	60.7
G	6.7	0.0	0.1	7.3	0.3	0.7	22.5	15.4	6.6	37.1	40.4
H	0.5	0.0	0.0	20.5	0.0	3.4	4.6	2.9	1.7	30.7	66.4
I	1.8	0.1	0.0	19.7	0.2	2.9	1.1	1.0	28.0	26.9	45.1

Naturality 2 (ecological map) and Stability 2 (density). These percentages are the highest among the items. Three items of the Grade I and Grade II regions are 99.9 % of Stability 1 (diameter), 98.9 % of Stability 1 (age), and 93.1 % of Naturality 1 (the degree of green Naturality).

Table 7 indicates the degree of overlap in the Grade I area. The highest proportion and items in Grade I (defined by a single item) are as follows: 45.4 % of Stability 2 (density), 38.7 % of Abundance (ecological change observation area), and 35.9 % of Rarity (a rarity discovery area). 12.8 % of Naturality 1 (the degree of green Naturality) overlapped with Stability 2 (density) in the Grade I area (defined by two items), as did 10.2 % of Abundance (ecological change observation area) and Stability 2 (density).

With more than three items of the Grade I region, 95.7 % is assessed as Grade I for Stability 1 (diameter), 77.6 % for Diversity (Species diversity) and 72.7 % for Naturality 3 (age).

Table 8 indicates the degree of overlap in the Grade II area. Grade II which is identified by a single item shows a high percentage as follows: 51.8 % of Abundance (ecological change observation area) and 27.4 % of Rarity (a rarity discovery area). Also, defined as the Grade I area within two items are as follows: 20.5 % of Stability 2 (density) overlapped

with Naturality 2 (ecological map), and 18.4 % of Naturality 3 (age) overlapped with Naturality 2 (ecological map) in Grade 2 region.

The Grade 2 region of three items or more is 66.4 % of Stability 2 (density), 60.7 % of Naturality 3 (age), and 45.5 % of Naturality 1 (the degree of green Naturality) all in Grade II.

(3) The field survey

The target areas of the field survey confirmed the accuracy of the degree of forest map. The 34 forest areas which are defined as forest density Grade I met the standard of a crown-occupying area, which is, as the result of the field research, over 71 %. Also, two out of eleven areas turned out to be density Grade I. These were identified as density Grade II areas before we implemented the field survey.

The cause may be the interval between the density research period and the present time as well as the different seasons. After we carried out the field research, we confirmed the forest's diameter and age were Grade II and III in the large proportion of the density Grade I and II regions. It explains the tree composition of the density Grade I and II areas, and we can see it is difficult to decide the forest's stability through the density item itself.

In the density Grade I region, it is more significant

Table 10. Field survey results.

Land Cover Type	Administrative District		Wood Density*		Wood Diameter*		Wood Age*	Major Wood Species		Survey Date	
	Admin.	No.	Forest Map	Field Survey	Forest Map	Field Survey	Forest Map	Forest Map	Field Survey		
Forest	Wonju Si, Gangwon Do	1	1	1	3	2	3	Mixed Species Stand	Pinus densiflora Stand	2006. 6. 13	
		2	1	1	3	2	3	Mixed Species Stand	Pinus rigida Stand		
		3	1	1	3	2	3	Pinus densiflora Stand	Quercus serrata Stand		
		4	1	1	3	3	3	Pinus densiflora Stand	Pinus rigida Stand		
		5	1	1	3	2	3	Mixed Species Stand	Larix kaempferi Stand		
		6	1	1	3	3	3	Pinus densiflora Stand	Robinia pseudoacacia Stand		
		7	1	1	3	2	3	Pinus densiflora Stand	Quercus serrata Stand		
	Gimhae Si Gyeongsangnam Do	1	1	1	3	1	2	Pinus densiflora Stand	Pinus densiflora Stand	2006. 7. 6 ~ 7. 7	
		2	1	1	2	2	1	Mixed Species Stand	Quercus serrata Stand		
		3	1	1	3	2	2	Mixed Species Stand	Pinus densiflora Stand		
		4	1	1	3	2	2	Mixed Species Stand	Quercus serrata Stand		
		5	1	1	3	2	2	Pinus densiflora Stand	Quercus variabilis Stand		
		6	2	2	2	2	2	Pinus densiflora Stand	Pinus densiflora Stand		
		7	2	2	3	3	3	Pinus densiflora Stand	Quercus variabilis Stand		
		8	2	2	3	3	2	Pinus densiflora Stand	Quercus variabilis Stand		
		9	2	1	3	3	3	Pinus densiflora Stand	Koelreuteria paniculata Stand		
		10	2	2	3	3	2	Pinus densiflora Stand	Quercus serrata Stand		
	Built-up	Yongin Si Gyeonggi Do	1	1	1	3	3	2	Deciduous Stand	Quercus serrata Stand	2006. 6. 14
			2	1	1	3	2	3	Castanea crenata Stand	Quercus serrata Stand	
3			1	1	3	2	3	Mixed Species Stand	Pinus rigida Stand		
4			1	1	3	2	3	Deciduous Fores	Quercus serrata Stand		
5			1	1	3	2	3	Pinus rigida Stand	Pinus rigida Stand		
Gwanak and Geumcheon Gu, Seoul		1	1	1	3	2	2	Deciduous Stand	Robinia pseudoacacia Stand	2006. 6. 15	
		2	1	1	3	2	2	Deciduous Stand	Quercus variabilis Stand		
		3	1	1	3	1	2	Deciduous Stand	Robinia pseudoacacia Stand		
		4	1	1	3	2	2	Deciduous Stand	Robinia pseudoacacia Stand		
		5	1	1	3	2	2	Deciduous Stand	Robinia pseudoacacia Stand		
Agricultural Area	Seosan Si, Chungcheongnam Do	1	1	1	3	2	3	Mixed Species Stand	Quercus variabilis, Pinus densiflora Stand	2006. 7. 18	
		2	2	1	3	2	3	Pinus densiflora Stand	Pinus densiflora Stand		
		3	1	1	3	3	2	Pinus densiflora Stand	Pinus densiflora Stand		
		4	2	1	3	2	2	Pinus densiflora Stand	Pinus densiflora Stand		
		5	1	1	3	2	3	Pinus densiflora Stand	Quercus variabilis, Pinus densiflora Stand		
		6	2	1	3	3	3	Pinus densiflora Stand	Pinus densiflora Stand		
		7	1	1	3	2	2	Pinus densiflora Stand	Quercus variabilis, Pinus densiflora Stand		
		8	1	1	3	2	3	Pinus densiflora Stand	Pinus densiflora Stand		
		9	1	1	3	2	2	Pinus rigida Stand	Pinus rigida Stand		
	Gochang Gun Jeonbuk Do	1	1	1	2	2	1	Pinus rigida Stand	Pinus densiflora Stand	2006. 7. 19	

when we consider the forest age and diameter together. We should also take into account the many kinds of trees in the forest.

4. Discussion and Conclusion

In this study, we reviewed other distribution state in each administrative region of ECVAM and the suitability of the environmental/ecological assessment items. Seoul and other metropolitan cities reveal a large proportion of Grade I regions which are affected by the legal assessment items. The 'Do' regions, such as Gangwon-Do, show a large proportion of Grade I regions which are affected by the environmental/ecological assessment item. We could confirm that ECVAM results differ according to administrative regions.

Environmental/ecological assessment item's overlapping reviews are as follows: Through Method 2, 93.4 % of diameter Grade II (standard for stability) and age Grade I (standard for naturality), 63.7 % of forest diameter (standard for stability) and the legal assessment item; and through Method 3, among three items, 99.9 % of forest diameter, 98.9 % of forest age and 90.4 % of forest density. These items all represent stability. Method 4: 95.7 % of forest diameter and 72.7 % of forest age show overlap. Method 5: 66.4% of forest density and 60.7 % of forest age show their repetitive character. As above, this study enables us to realize the relationship between ECVAM and environmental/ecological assessment through the repetitive analysis in Grade I and II regions of each assessment item. As a result of field research for the degree of forest items, the accuracy of its general construction is high. However, we found a different condition of the age and diameter's distribution in the density. In fact, we verified the Grade I density region and then we were

able to find that there are thickness of forest's areas of Grade II and III for diameter and age. The density item of the degree of forest map reveals a large proportion of overlap. Therefore, applying this item onto ECVAM requires a further study.

The utilization of ECVAM is growing throughout the nation. It has become the basic data for efficient consultation and management in development plans. In order to maintain and renew information in ECVAM, it is necessary to maintain the consistency of assessment items. Also, for the management of more objective assessment items, it is urgent that we adjust overlapped criteria by reviewing the suitability of this study which suggested an evaluation standard.

However, the purpose of ECVAM is a clear indication of sustainable Grade through the objective environmental evaluation of the national land, and for this reason has chosen broad resources and ways of analysis. Therefore it is not appropriate to discuss the suitability of simple items' duality.

This study analyzed data by using GIS and carried out field research. Follow-up studies are required to select items which could more accurately reflect the environment's value.

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