A Study on the Introduction of Total Natural Resources Management System Using the Environmental Conservation Value Assessment Map

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ABSTRACT:

The environmental impact assessment system and the environmental plan for the preservation of the land environment are carried out with the aim of preventing damage to the environment caused by human activities, improving the quality of life and creating a pleasant environment. However, despite these various systems, the natural resources have been continuously damaged, and the system to cope with them has been advanced, but there has been a limit to fully conserve natural resources from development. The total amount of natural resources is being promoted as a part of the purpose of supplementing the system, but the evaluation method of the total amount of natural resources suitable for domestic situation is not presented yet. Natural resources are diverse and complicated in their categories and elements, and their measurement units are also diverse, making it difficult to synthesize them into one unit. Therefore, in this study, we proposed a method to calculate the total amount by using the evaluation map of the Environmental Conservation Value Assessment Map(ECVAM) which derives the final achievement with 5 grades using 65 evaluation items. However, we consistently applied the weight twice as much as the grade and did not utilize any information other than the map of ECVAM. The results of this study can be applied to the Total Natural Resources Management System through follow-up study such as application of various environmental information and weighting method.

1. INTRODUCTION

Korea has been under development due to rapid economic growth. In the development of reclaimed land, the tidal flats lost their essential ecosystem functions, and the Baekdudaegan(a mountain range and watershed-crest-line which runs through most of the length of the Korean Peninsula, from Paektu Mountain in the north to Jirisan in the south) was cut off by mineral extraction and highway opening. In 1989, 92 species of endangered wild animals increased by about 3 times to 267 species in 2017. Tidal flats and forests disappeared by the development project were reports of biodiversity made over thousands of years. However, they have sold natural resources that cannot be measured by development logic.

The Environmental Impact Assessment(EIA) system and the Environmental Plan are carried out with the aim of preventing damage to the environment caused by human activities, improving the quality of life and creating a pleasant environment. However, despite the enforcement of these various schemes, the degradation of natural resources has continued. However, there is a limit to fully conserve natural resources from development.

There are three major necessities to introduce the Total Natural Resources Management System. First, the purpose of the introduction of Total Natural Resources Management System is to block the development of the whole country. Even if the natural resources such as Baekdudaegan, tidal flats and forests are wasted, and the ecosystem is destroyed, it is impossible to continue the policy of indulgence by paying 300 $ / ㎡ for ecosystem conservation cooperation.

Second, in the conservation of natural resources. Wild indigenous habitats were reduced by indiscriminate underdevelopment, and there were no top predators and populations increased. Some wild animals have been designated as harmful wild animals on the grounds of damaging crops or causing road kills and other threats to property and life of citizens. However, the fundamental cause of the damage was the undeveloped human development, and the damage can be prevented through conservation or restoration.

Third, in sustainable development. The Total Natural Resources Management System is a policy cornerstone for sustainable development as a minimal means of coordination to maintain the quantity and quality of natural resources that can be damaged by development.

In this paper, we propose a method to apply the Total Natural Resources Management System using Environment Conservation Value Assessment Map(ECVAM) in the sample site, Cheongju Oksan Industrial Complex.

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2. DEFINITION OF RELATED CONCEPTS

2.1 Environment Conservation Value Assessment Map(ECVAM)

The Environment Conservation Value Assessment Map(ECVAM) is divided into grids of 10m from the whole country, and it is evaluated as 57 legislative evaluation items and 8 environmental and ecological evaluation items. In other words, the result of evaluating the country as 65 evaluation indexes is classified into five grades. The evaluation method is the minimum indicator method, so that the highest grade among 65 evaluation items in the same grid can be classified as final grade. This method is evaluated and classified by simple overlapping, to contribute to the preservation of the country by complementing the situation where a high-valuation index can be omitted from the final evaluation. 65 evaluation indexes utilize information produced by various organizations such as Ministry of Environment, Ministry of Land, Infrastructure, and Transport, and Korea Forest Service.

Figure 1. Environment Conservation Value Assessment Map(ECVAM)

2.2 Total amount of natural resources

The total amount of natural resources is like nature, ecosystem and environment and has different concepts and includes the economic concept of resources. Also, the total amount has the characteristic to integrate the categories and elements of resources that use different units. Conceptual definitions of ecosystems, nature, and the environment share each other in terms of categories, elements, and resources, but they refer to distinctive characteristics and objects. To distinguish the definition of natural resources, which are the subject of this study, from the other concepts, we define the natural resources as "Elements of the ecosystem to be conserved and responding to environmental characteristics". By organizing the categories and elements of natural resources according to these characteristics, various elements such as vegetation, wild animals, geological features and landscapes can be included, and these factors can be changed according to the situation of the times, scientific development, civic consciousness. There are various categories of recognizable natural resources and abundant situations in economically inadequate situations and various categories of perceived environmental characteristics of individual citizens. The subject of the natural resource to be preserved can also be changed according to the situation and the recognition of the time, and it can be changed according to the level of the scientific method and technology development that can express such natural resources.

The total amount of natural resources is the sum of the categories and components according to the concept of natural resources. The components are limited by the unit of measurement for each element, the natural resources will include the valuation, so that the total amount of natural resources can be regarded as the sum of the values of conservation of natural resources. Conservation value can be a specific object (endangered species, landscape, etc.), but it can be expressed as a spatial distribution of natural resources value because it requires space to conserve natural resources.

In this study, the total amount of natural resources is defined as "the total sum of spatial values in which ecosystem components to be preserved are distributed". According to the definition of concept, natural resources should be expressed as spatial information, value evaluation should be preceded, and the total amount can be regarded as the sum of natural resource value distribution.

2.3 Total Natural Resources Management System

The total volume of natural resources refers to the amount of natural resources to be protected from being damaged by the plan or the target construction. There are five methods to manage the total amount of natural resources; Avoidance(Vermeidung), Minimization(Minimierung), Balance(Ausgleich), Replacement (Ersatz) and Compensation(Kompensation). The pre- amount of natural resources is the total amount of natural resources before the development project or administrative plan, and the post-amount of natural resources can be defined as the total amount of natural resources changed in accordance with the plan and setting of the project.
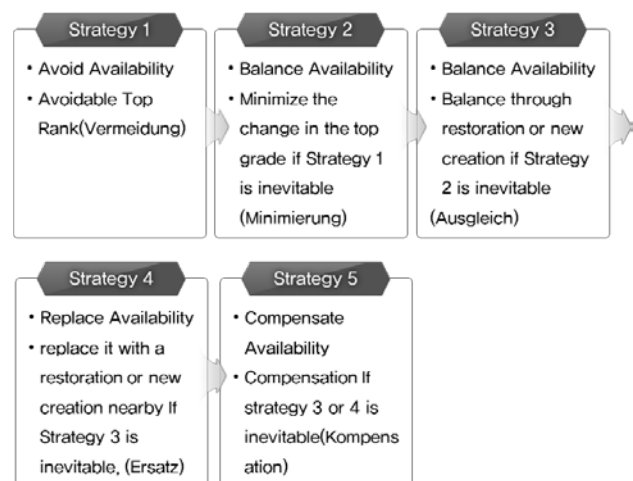

Figure 2. Step of Total Natural Resources Management System

The total volume of natural resources is a policy measure to minimize human damage due to ecosystem damage and to prevent biodiversity infringement. It is a lossless principle (No Net) that makes the quantitative and qualitative reduction of ecosystem that can occur due to development equal to pre-, the

principle of prevention, principles of precautionary, principle of polluter burden, sustainable development, compensation by the same type or value are applied based on the Loss Principle.

3. MAIN BODY OF TEXT

3.1 Selection of Natural Resources Indicator

There are many factors that can be called natural resources. Thus, the index of the total amount of natural resources was selected through four steps.

First, conceptual indicators were selected. The indicators that can be derived according to the concept and definition of the total amount of natural resources were selected. These include abstract, qualitative indicators and indicators that require further investigation and construction. As a result, 434 elements of 12 categories were extracted. The 12 sections are as follows. Landscape, Climate, Culture, Microbes, Ecosystem, Wetlands, Plants, Vegetation, Wildlife, Terrain, Land use, etc.

Second, collectable indicators were selected. It should be information that has been established and surveyed by a reliable organization. We selected indicators that could be formally collected or examined through information or information. As a result, 338 elements were selected in 12 categories.

Third, spatializable index was selected. Based on the collected indicators, we selected indicators that can be converted into spatial information form. As a result, 235 elements were selected in 12 categories.

In this way, starting from the conceptual index, the possibility of collectability and the possibility of spatialization were examined and the final total natural resource volume index was calculated. However, natural resources have diverse and complex categories and elements, and the measurement units are also diverse, making it difficult to synthesize them as a single unit. Therefore, we plan to apply environmental conservation value assessment map to calculate the total amount of natural resources.

The environmental conservation value assessment map contains 57 legal evaluation items and 8 environmental and ecological items and is suitable for calculating the total amount of natural resources in quantitative form. Because it utilizes various evaluation items, it is suitable to the concept of the natural resource total amount system, and it is easy to construct by applying map of urban ecological situation, ecological nature map, national natural environment survey data, etc. Also, in addition, if there is a limit to the information that is constructed, it can be utilized for newly constructed information by utilizing research guidelines and construction guidelines and is suitable for convergent utilization.

3.2 Estimation of total natural resources

The calculation of the total amount of natural resources is roughly divided into four stages.

First, it is the total amount matrix calculation step before and after the construction. The total amount of natural resources before the project is evaluated by using ECVAM and the biotope map, ecological nature map, and direct survey data. The total amount after the project predicts the total amount of natural resources predicted according to the development plan.

Second, the total amount of natural resources is calculated. The total amount of the prefecture will be calculated based on the pre-project status and the total amount of the natural resources will be calculated according to the projected post-project evaluation.

Third, the total amount of compensation is derived. The existing and surveyed natural environment information is evaluated by diversity, naturalness, abundance, and rareness, and the total amount is calculated and the total amount to be changed is predicted according to the development plan to derive the total amount of compensation.

Finally, a compensation plan is proposed. We seek a countermeasure against the total amount of compensation and seek offsetting and alternative measures when avoidance is inevitable. If the total amount of compensations is zero, the business is promoted. If the total amount of compensations is less than 0, the project is reviewed. If the total amount of compensations is less than 0, Pay compensation for the part, and make the total amount of compensation zero and promote the business.

3.3 Study Subject

Construction of industrial complexes causes loss of natural resources. As the target of this study, the Oksan industrial complex of Cheongju city, Chungbuk province, which is an environmental impact assessment project site, was selected. The construction of Oksan Industrial Complex was completed as of 2017 after the 2010 environmental impact assessment. The construction scale is 1,324,889 ㎡.

Figure 3. Cheongju Oksan Industrial Complex

3.4 Status of Total Natural Resources - Before the Project

The natural resources of the target areas before the construction referenced in the environmental impact assessment report are as follows.

Before Construction	○ Land flora (field survey) - Vegetation: shrubs 29.76%, oak-shark trees 22.46%, regina pine trees 13.10% - Green land Natural level 7 grade 33.05%, 6th grade 31.96%, 5th grade 29.76% - No ecological nature degree 1st grade area - Specified by the Ministry of the Environment Endangered Wild Plant Not distributed ○ Land animal fauna (field survey) - Mammals: 10 genera, 13 species - Birds: 18 genera, 33 species - Amphibians and reptiles: 8 genera, 15 species - Land insects: 67 genera, 194 species - Protective species: Saddleback, sparrow, buzzard, kestrel ○ Aquatic Organism - Phytoplankton: 3 families 24 genera 39 species - benthic macroinvertebrates: 35 genera 53 species - Fish: 4 genera 10 species

Table 4. Natural resources before the construction

After Construction	○ Land flora - Vegetation damage and damage trees in the planned area are about 31,824 - Increase of the area of natural environment 0, 1, 3 ○ Land animal fauna - Mammals avoid the surrounding mountainous areas during construction - Birds have short migration, dispersal to surrounding mountainous areas - Amphibians and reptiles are expected to decrease the population of species in the planned region - Legal protected species are species with wide habitat. ○ Aquatic Organism - It is expected that disturbance of the aquatic creature is expected due to the inflow of the landslide to the construction site.

Table 7. Natural resources after the construction

Prior to the development of the Oksan Industrial Complex, this project is mostly geographical distribution of the 4th grade of the Ministry of Land, Infrastructure and Environment evaluation. Other 5th, 3rd and 1st grade areas are distributed.

In the Oksan Industrial Complex, 77.81% of the land use is mainly in the 5th grade urban area, and 21.03% is in the 2nd grade forest. There are 0.40% of first grade, 0.33% of fourth grade, and 77.81% of fifth grade.
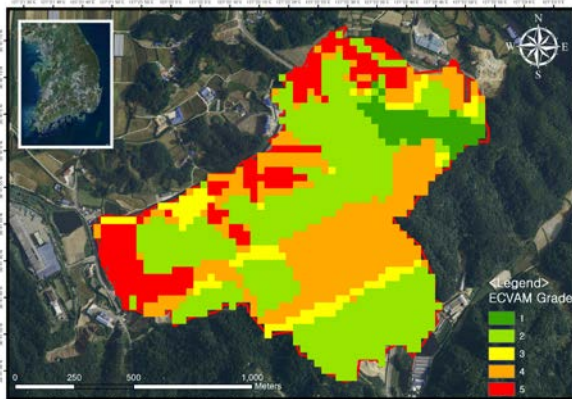

Figure 5. ECVAM of Cheongju Oksan Industrial Complex
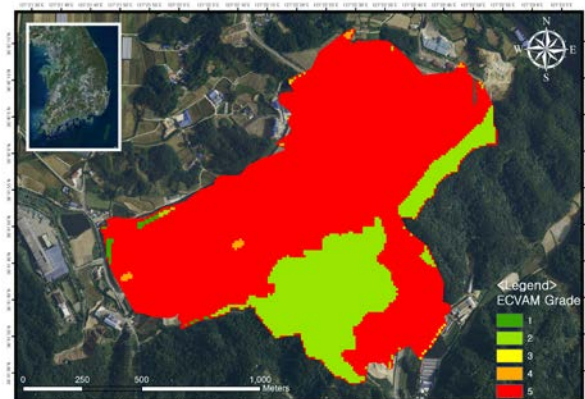(Before Construction)

Figure 8. ECVAM of Cheongju Oksan Industrial Complex
(After Construction)

Grade	Area (m^2)	Ratio (%)	Remarks
1st	65,700	5.20	
2nd	577,800	45.69	
3rd	89,100	7.05	
4th	354,600	28.04	
5th	177,300	14.02	

Table 6. ECVAM of Cheongju Oksan Industrial Complex
(Before Construction)

Grade	Area (m^2)	Ratio (%)	Remarks
1st	5,000	0.40	
2nd	269,100	21.28	
3rd	1,200	0.09	
4th	4,200	0.33	
5th	983,900	77.81	

Table 9. ECVAM of Cheongju Oksan Industrial Complex
(After Construction)

3.5 Status of Total Natural Resources - After the Project

The natural resources of the target areas after the construction referenced in the environmental impact assessment report are as follows.

3.6 Weighting by Grades

Weights were assigned to each grade of ECVAM. We assign a weight of 1 to the 1st grade that is the most environmentally worthy. The 2nd is given 0.5, the 3rd is 0.25, the 4th is 0.125, and the 5th grade is 0.0625.

Grade	Weight
1st	1
2nd	0.5
3rd	0.25
4th	0.125
5th	0.0625

Table 10. Granted Weight

3.7 Before and after construction calculation

The total amount before and after the project was defined as the product of the area and the weight of each grade. In 3.4 and 3.5, the area of each grade was derived and in 3.6, the weight of each grade was defined.

The total amount of before the project natural resources of the Oksan Industrial Complex is shown in the following table.

Grade	Area (m^2)	Weight	Total Amount
1st	65,700	1	65,700
2nd	577,800	0.5	288,900
3rd	89,100	0.25	22,275
4th	354,600	0.125	44,325
5th	177,300	0.0625	11,081
Total Amount			432,281

Table 11. Calculation of total amount before construction

The total amount of after the project natural resources of the Oksan Industrial Complex is shown in the following table.

Grade	Area (m^2)	Weight	Total Amount
1st	5,000	1	5,000
2nd	269,100	0.5	134,550
3rd	1,200	0.25	300
4th	4,200	0.125	525
5th	983,900	0.0625	61,494
Total Amount			201,869

Table 12. Calculation of total amount after construction

The total amount of natural resources after the operation of the Oksan industrial complex was 201,869, which was reduced by 230,412 compared with the total amount of natural resources before construction of 432,281. Operators will have to compensate for the reduced amount of natural resources by balance, replace, compensation, etc.

4. CONCLUSION

Total Natural Resources Management System before and after the project was calculated and the total amount of loss was calculated using the ECVAM.

The introduction of the total amount of natural resources has four effects. First, it is possible to prevent indiscreet development. The Total Natural Resources Management System is applied to the development activities that are carried out by damaging the natural resources, and it does not affect the development that is performed in the area where the existing development has occurred or the area where there is no natural resource. In other words, the subject of development will prefer the area that does not need compensation than the area where the compensation cost to be developed by damaging natural resources is needed. As a result, it is possible to switch the paradigm by developing a form that prevents indiscreet development and preserves excellent natural resources by including costs that would damage natural resources that are superior to development costs.

Second, it has the effect of preserving and improving natural resources. The total amount of natural resources starts from developing and avoiding excellent natural resources. Inevitably, if it is necessary to develop natural resources, it can be compensated through offsetting or substitution, and compensation can be paid for the deficiency. It is an institutional device that can improve natural resources through the introduction of the target total volume of natural resources and the operation of the ecological account system. It is possible to preserve and improve natural resources because the principle of natural resource conservation is to avoid or restore the natural resource damaged by development and to make it equal to the state before development (No Net Loss).

Third, integrated management of natural resource information is possible. Information that can be utilized for the total amount of natural resources can be utilized in a variety of information including map of urban ecological status, ecological naturalness, and the like. It is possible to increase the efficiency of environmental information management by integrating and managing the data to be utilized in the natural resource total amount system and the utilized data. The developer can collect and confirm the natural resource information through a single system, and calculate the total amount, thereby reducing the related work time.

Finally, it is possible to improve the quality of life of the people through natural environment restoration. Preventing irrational development and restoring natural resources can change the paradigm of the management of the national land space, and thus can have a macroscopic positive effect on climate change, urban heat island, landslide, and damage by wildlife. Indiscriminate development has been developed around local areas with abundant natural resources and relatively low land prices, so wildlife habitats have been reduced or fragmented, and large mammals have been affected by habitat loss, etc. have occurred. Since the total amount of natural resources does not reduce the resources such as wildlife habitat, forest, and wetland in principle, it can contribute to improvement of the quality of life of the people by reducing the damage caused by damaging natural resources such as damage caused by wild animals.

In this study, we have consistently assigned a weighting factor of two times for each class, but further discussion is needed on the setting of weights through the implementation of the Analytic Hierarchy Process (AHP) for natural resource experts. In addition, there is a limitation that the use of the ECVAM in the Total Natural Resources Management System does not distinguish the value of another natural environment within the same grade. As a result, it is considered that further study is required to reflect the value of ecosystem services as well as the regional fragmentation research in the same grade and further the conservation value.

In addition, in this study, only the aspect of the total amount of natural resources was taken into consideration. Further research will be needed to establish a specific methodology for avoidable, compensation, and substitution to introduce the full-scale natural resource amount system.

ACKNOWLEDGEMENTS (OPTIONAL)

REFERENCES

Nakhoon Choi, Jihyon Kil, and Youngkyu Shin. 2017. Exploring the Application of Impact Mitigation Regulations through Biotope Maps. *Ecology and Resilient Infrastructure*, 4(4), pp. 237-244. https://doi.org/10.17820/eri.2017.4.4.237

JunSeo, Lee. 2015. Legislative Issues Related with Remedies for Natural Environmental Damage Itself. *Journal of Law and Politics research*, 15(4), pp. 1185-1220.
http://doi.org/10.17926/kaolp.2015.15.4.1185

Eun Young Kim, Seong Woo Jeon, Won Kyong Song, Jaer Yun Kwak, June Lee. 2012. Application of ECVAM as a Indicator for Monitoring National Environment in Korea. *Journal of environmental policy*, 11(2), pp.3-16.

APPENDIX (OPTIONAL)

Any additional supporting data may be appended, provided the paper does not exceed the limits given above.

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