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Developing a Landscape Sustainability Assessment Model Using an Analytic Hierarchy Process in Korea

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Abstract: With the increasing interest in integrative sustainable development, there has been a strong need for a landscape sustainability assessment tool independent from the existing green building rating system. This study aimed to establish an assessment model to objectively evaluate landscape sustainability using an analytic hierarchy process (AHP). Through an extensive literature review and expert survey, an initial list of assessment items was derived and used to set up an AHP model. An AHP survey with landscape architects and architects/engineers was then conducted to determine the importance of the assessment factors. In addition, the model was applied to three projects that were previously certified by a green building rating system in Korea. The AHP results showed that “site context” ranked as the most important factor of landscape sustainability followed by “soil and vegetation,” “maintenance,” “water,” “health and wellbeing,” and “materials.” Among the 20 assessment factors, “monitoring plan” was evaluated as the most important index, followed by “protection of cultural heritage” and “long-term management plan.” Landscape architects evaluated “soil and vegetation” as the most important in the assessment, while the engineers/architects group rated “site context” as the most important. When tested by applying them to the previously certified projects, the developed factors provided more objective and detailed information on landscape sustainability.

Keywords: landscape sustainability; assessment model; landscape performance; analytic hierarchy process; sustainability rating system

1. Introduction

Active discussions are being held worldwide on ways of improving the environment, such as optimizing buildings’ energy use and reducing CO₂ emissions to tackle climate change [1–3]. With the increasing awareness of severe environmental problems, such as contamination of the natural environment, destruction of the ecosystem, resource depletion, water shortages, and extreme weather events, there has been a strong need for sustainable development and an environmental paradigm throughout society [4,5]. As an outcome of these discussions, assessment criteria on the environmental performance of buildings have been established and implemented. Led by the Building Research Establishment Environment Assessment Method (BREEAM) of the UK in 1991 [6], there has been the development of Canada’s SBTool [7], Japan’s Comprehensive Assessment System for Built Environment Efficiency (CASBEE) [8], Australia’s Green Star [9], Singapore’s Green Mark [10], and the US’s Leadership in Energy and environmental Design (LEED) V1.0 enacted by the U.S. Green Building Council (USGBC) in 1998 [11–13]. Korea implemented the “Green Building Certification System” in 2002 [14].

The initial sustainability assessment systems focused on individual buildings, but with the increasing awareness of the importance of environmental issues occurring at the city/neighborhood levels, sustainability assessment systems worldwide have established separate landscape assessment systems at the city/neighborhood levels in addition to those for individual buildings. The US, in particular, has been implementing the Sustainable Sites Initiative (SITES) since 2012, apart from its existing green building certification system LEED, through which various landscape sustainability factors of all project sites are assessed regardless of buildings. This has also led to sustainable and integrated design, from development planning of the project site to design and management [11]. However, while the ecology category of the Green Standard for Energy and Environmental Design (G-SEED), Korea's green building rating system, includes sustainability assessment items related to landscape and external environment, this is strictly limited. G-SEED can only assess projects that include buildings and, thus, it is inadequate for assessing various forms of landscapes or parks, green spaces, and other facilities [15].

Precedent studies on landscape assessment systems have comparatively analyzed the BREEAM, LEED, and CASBEE [15–18], and some have examined the similarities and differences by comparing the BREEAM and LEED with Korea's green building rating system [19,20]. Studies on green space have either comparatively analyzed the sustainability of apartment complexes [21], Seoul's new built-up areas and green spaces in new town housing complexes of metropolitan areas [22], using the assessment items of "land use and transportation" and "ecological environment" in Korea's Green Building Certification System, or established village-type sustainability factors [23]. These studies have performed landscape assessment using the limited green space assessment items of the certification system that targets buildings. The studies related to sustainability assessment factors have used various methods, such as literature reviews [4,13], the Delphi method [24,25], expert surveys [26,27], and field surveys [3,28,29].

Recently in Korea, there has been a need for an independent system of landscape sustainability assessment, and active discussions have been made accordingly. However, there is a gap in the perception of sustainability assessments for outdoor spaces and landscapes as well as directions for improvement between non-landscape experts, such as architects/engineers, and landscape experts [11,30]. The purpose of the research is to analyze the possibility of using an analytic hierarchy process (AHP) as a decision-making tool in the process of selecting the assessment items for a landscape sustainability rating system. This study established the following three objectives:

- (1) to establish an assessment model to objectively evaluate landscape sustainability;
- (2) to comparatively analyze the importance of assessment factors by landscape architects and non-landscape architects;
- (3) to test the applicability of the model developed in this study by applying it to G-SEED-certified projects.

2. Methodology

2.1. Research Scope and Sampling

The assessment items in this study were limited to assessment criteria that may be used to establish or remodel outdoor spaces of buildings, parks, and green areas in urban or suburban areas. Assessment criteria for sustainable buildings or community environment were excluded. In the current situation, where only building certification exists in Korea, we focused on developing assessment criteria that may be used as basic data to establish sustainability certification for landscaping and outdoor spaces in the future.

Interviews and surveys were employed to collect data in this study. The sample for the AHP survey included 70 landscape architecture experts as well as 71 engineers/architects who had experience in the G-SEED certification process. Given the discrepancy between the landscape architect group

and the architects/engineers group in terms of perception on landscape sustainability rating systems, purposive sampling techniques were employed to select the respondents from the two groups.

2.2. Analytic Hierarchy Process (AHP)

The analytic hierarchy process (AHP) is one of the most widely used methods in multi-attribute decision making. The AHP, developed by Thomas Saaty in 1977, was designed to help decision makers incorporate qualitative and quantitative aspects of a complex problem with multiple subjective criteria. It is considered a promising framework for evaluation due to its potential to explicitly take into account conflictual, incommensurable, and uncertain effects of decisions. The AHP involves the following basic steps: (1) the building of a hierarchical AHP model consisting of criteria and factors of the problem, (2) pairwise comparisons between elements at each level to derive the weights and relative priorities of factors, and (3) the synthesis of the priorities of the criteria for weights into an overall rating based on which best alternative is decided.

The strength of the AHP method lies in its ability to reduce complex decisions to a series of one-on-one comparisons by assisting with identifying and weighting selection criteria, analyzing the data collected for the criteria, and expediting the decision-making process [31]. Comparisons can be made according to preference, importance, or likelihood, whichever is most appropriate for the elements considered.

The AHP has already been applied for developing sustainability assessment systems, such as sustainable community rating tools [23], Korean traditional house sustainability [32], and sustainable interior material [33]. The AHP is implemented using Expert Choice software, which can provide visualized results.

2.3. Research Framework

In this study, we prioritized the factors for assessing landscape sustainability and developed an assessment model using the AHP method. The process of our study went through three stages for assessing landscape sustainability, involving (1) defining the assessment criteria and factors, (2) identifying the weights of criteria and factors through the AHP method, and (3) applying the assessment model to G-SEED-certified projects.

The overall research process is presented in Figure 1, and the following subchapters describe each phase in detail.

Figure 1. Research flowchart.

2.3.1. Phase I: Defining the Criteria and Factors

An extensive review of precedent research and previous evaluation instruments related to landscape sustainability was performed in order to determine the initial set of assessment factors. A variety of factors concerning outdoor or landscape sustainability were derived from the existing rating systems, including LEED, Leadership in Energy and Environmental Design for New Construction (LEED-NC), Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND), SITES, Seattle Green Factor, and Helsinki Green Factor [14,34–39] (Table 1).

We conducted unstructured interviews with five experts in landscape architecture in order to elaborate the initial criteria and factors from the literature review. The experts checked if the initial sets of factors were mutually exclusive and non-redundant. Based on their comments, a total of 6 criteria and 34 factors were generated.

Since assessment factors should be defined based on expert knowledge and the local context of Korea, we conducted the unstructured interviews with 11 practitioners from landscape architecture firms. The interviewees were asked to identify which factors they considered most important for the assessment of landscape sustainability to develop a new assessment system on a 5-point Likert scale. The interviewees had 10–25 years' experience as practitioners in the field of landscape planning and design. As a result of the interviews, 20 items in six criteria were selected.

2.3.2. Phase II: Identifying the Weights of Criteria and Factors through the AHP Method

An AHP model was formatted based on the literature review and expert interviews (Figure 2). In addition, an AHP questionnaire was designed with a pairwise comparison format to give the relative importance among the criteria and factors. The values of importance were based on a 9-point scale, with a value of 9 indicating the absolute importance of one item over the other and a value of 1 meaning equal importance. Table 2 shows the AHP pairwise comparison scale.

Figure 2. Analytic hierarchy process model.

Table 1. Derivation of landscape sustainability assessment factors.

Criteria	Items of Existing Rating Systems and Assessment Subject				
	G-SEED	LEED-NC/ND	SITES	Seattle Green Factor	Helsinki Green Factor
	<i>Building</i>	<i>Neighborhood Development</i>	<i>Landscape</i>	<i>Greenery</i>	<i>Greenery</i>
Site context	<ul style="list-style-type: none"> Ecological value of existing site Outside pedestrian walkway network Proximity of public transportation 	<ul style="list-style-type: none"> Brownfield redevelopment Smart location 	<ul style="list-style-type: none"> Select brownfields or grayfields for redevelopment Preserve threatened or endangered species and their habitats Use integrated site development process 	<ul style="list-style-type: none"> Landscaped areas Bio-retention facilities 	
Soil/vegetation	<ul style="list-style-type: none"> Biotope creation Green network Green space ratio Ecological area ratio 	<ul style="list-style-type: none"> Protect or restore habitat Historic resource preservation and adaptive use 	<ul style="list-style-type: none"> Minimize soil disturbance in design and construction Use native plants Preserve or restore appropriate plant biomass on site Preserve plant communities native to ecoregion 	<ul style="list-style-type: none"> Plantings Green roofs Vegetated walls Structural soil systems Drought tolerance of native plant species 	<ul style="list-style-type: none"> Preserved vegetation and soil Planted/new vegetation Green roofs Green walls, vertical areas
Water	<ul style="list-style-type: none"> Validity of rainwater load reduction measures Rainwater utilization Install graywater 	<ul style="list-style-type: none"> Protect or restore habitat Site design for habitat or wetland and water body conservation 	<ul style="list-style-type: none"> Preserve wetlands Protect and restore riparian areas, wetlands, and shoreline buffers Rehabilitate lost streams, wetlands, and shorelines Manage stormwater on site 	<ul style="list-style-type: none"> Approved water features Use of harvested rainwater Permeable paving 	<ul style="list-style-type: none"> Permeable pavement Rain garden Stormwater Wetland Infiltration pit Retention swale covered with natural vegetation Selection of native species
Materials	<ul style="list-style-type: none"> Use of certified green products for effective recycling (prerequisite) Information display for carbon emissions of materials 		<ul style="list-style-type: none"> Use recycled content materials Use regional materials 		<ul style="list-style-type: none"> Tree species native to Helsinki and flowering trees and shrubs
Health/wellbeing	<ul style="list-style-type: none"> Community facility Whether to create pedestrian walkway inside complex Whether to install bike storage and bike road 	<ul style="list-style-type: none"> Maximize open space Historic resource preservation and adaptive use 	<ul style="list-style-type: none"> Protect and maintain unique cultural and historical places Provide opportunities for outdoor physical activity Provide outdoor spaces for social interaction 	<ul style="list-style-type: none"> Adjacent public right of way or public open spaces 	
Maintenance	<ul style="list-style-type: none"> Rationality of site management plans considering the environment 		<ul style="list-style-type: none"> Monitor performance of sustainable design practices 		

Table 2. AHP pairwise comparison scale (source: Saaty 1977).

Intensity of Relative Importance	Definition
1	Equal importance
3	Weak importance
5	Essential or strong importance
7	Demonstrated importance
9	Absolute importance
2,4,6, and 8	Intermediate values between two adjacent judgments

A total of 183 copies of the questionnaire were distributed to experts from different fields, such as landscape architecture, architecture, and engineering, via e-mail in October of 2018. The respondents ranged in age between 20 s and 60 s and had 3–43 years' experience in practice. While the response rate was 100%, only 141 responses whose consistency ratio (CR) was less than 0.19 were used for further analysis. The CR value reflects the internal consistency and values of $CR \leq 0.2$ were also accepted [40]. The respondents were composed of landscape architects (49.6%) and engineers/architects (50.4%) (Table 3).

Table 3. Demographic data of respondents.

		Landscape Architects (<i>n</i> = 70)	Engineers/Architects (<i>n</i> = 71)	Total (<i>n</i> = 141)
Gender	Male	47(33.3%)	63(44.7%)	110(78%)
	Female	23(16.3%)	8(5.7%)	31(22%)
Age	20 s	20(14.2%)	8(5.7%)	28(19.8%)
	30 s	36(25.5%)	26(18.4%)	62(44.0%)
	40–60 s	14(10%)	37(26.2%)	51(36.2%)
Practitioner experience (average years)		7.67	13.2	10.45

Expert Choice, decision-making software developed to implement the AHP, was used to produce weights, consistency ratios, and rankings. All the comparisons were synthesized to rank the assessment items. The output of the AHP was a prioritized ranking of the assessment items based on the overall importance expressed by the participants.

2.3.3. Phase III: Applying the Developed Assessment System

We tested the applicability of the developed assessment system by assessing three projects that were previously certified by G-SEED, a sustainable building rating system in Korea. The three G-SEED-certified projects—an office campus landscape, hotel and commercial building landscape, and housing complex landscape—had different characteristics in terms of site area, landscape area, design intentions, etc. (Table 4). For the assessment, each item was rated on a 5-point Likert scale for sustainability by nine experts who had participated in the projects, and the means as well as previously derived weightings were considered in calculating the percentages of each field and project.

Table 4. Study sites used to test developed assessment factors.

	LH-HQ	Renaissance	Sejong
Project type	Company building	Hotel and business district	Housing complex
Total area	97,165.70 m ²	18,489.70 m ²	7,261,643 m ²
Location	Jinju, Gyeongsangnam-do	Gangnam-gu, Seoul	Dajeong-dong, Sejong
Landscape area	30,690 m ² (31.59%)	2954 m ² (15.98%)	33,891 m ² (46.67%)
Landscape characteristics	Wide open space Multiple layers of planting in high density Multi-purpose playground, ecological pond with aquatic plants, rooftop garden	Redevelopment project in urban center Emphasis on historicity and symbolism Terrestrial and aquatic biotopes	Dry stream using LID technique Wind path, central open space plaza, courtyard, complex circulation community streets
Site plan
View of overall site
G-SEED rating and landscape item scores	5 Stars (Total 81.85 points) - Green space ratio (1.5/2 points) - Ecological area (3/6 points) - Biotope creation (4/4 points) - Ecological value of site (0/2 points)	5 Stars (Total 80.30 points) - Green space ratio (0.5/2 points) - Ecological area (3/6 points) - Biotope creation (4/4 points) - Ecological value of site (2/2 points)	4 Stars (Total 67.55 points) - Green space ratio (0.5/2 points) - Ecological area (3/6 points) - Biotope creation (4/4 points) - Ecological value of site (0/2 points)

3. Results

3.1. The Relative Importance of Criteria and Factors

Table 5 and Figure 3 show the results of the AHP survey. With respect to the results of the weightings of the six criteria, “site context” ranked as the most important factor of landscape sustainability, representing about 21.0% of the total certification, followed by “soil and vegetation,” with a weighting of about 19.7%. The weightings of these two criteria represented more than 40% of the total. The weightings of the “maintenance” and “water” criteria were 17.9% and 16.7%, respectively. “Health and wellbeing” (14.4%) and “materials” (10.3%) were evaluated as having relatively low importance.

Table 5. Weights of assessment criteria and factors.

Criteria.			Factors				
Content	Local Rank	Local Weight	Content	Local Rank	Local Weight	Global Rank	Global Weight
Site context	1	0.210	Conserve and restore habitats	1	0.32	5	0.067
			Integrated design process	2	0.301	6	0.063
			Eco-friendly layout planning	3	0.243	9	0.051
			Brownfield project	4	0.136	18	0.029
Soil & vegetation	2	0.197	Protect plant communities	1	0.283	8	0.056
			Optimize biomass	2	0.237	10	0.047
			Reuse/recycle topsoil	3	0.190	12	0.036
			Use native plants	4	0.168	16	0.033
			Green wall/green roof	5	0.131	19	0.026
Maintenance	3	0.179	Monitoring plan	1	0.582	1	0.104
			Long-term management plan	2	0.418	3	0.075
Water	4	0.167	Restore aquatic ecosystems	1	0.431	4	0.072
			Natural/permeable areas	2	0.359	7	0.06
			Rainwater management	3	0.210	15	0.035
Health & wellbeing	5	0.144	Protect cultural heritage	1	0.520	2	0.075
			Support physical activity	2	0.251	14	0.036
			Support resting and socializing	3	0.230	17	0.033
Materials	6	0.103	Use green-certified facilities	1	0.431	11	0.044
			Use recycled materials	2	0.353	13	0.036
			Use regional materials	3	0.217	20	0.022

With regard to the “site context” category, “conserve and restore habitats” (0.320) was found to be the most important, followed by “integrated design process” (0.301), “eco-friendly layout planning” (0.243), and “brownfield project” (0.136). Within the “soil and vegetation” category, “protect plant communities” (0.283) was found to be the most important, followed by “optimize biomass” (0.237) and “manage healthy soils” (0.190). “Restore aquatic ecosystems” (0.431) was evaluated as having higher importance within the “water” category than “natural/permeable areas” (0.359) and “rainwater management” (0.210). Among the items in the “health and wellbeing” category, “protection of cultural heritage” (0.520) had a considerably higher weight than “support physical activity” (0.251) and “support resting and socializing” (0.230), emphasizing the importance of preserving the history and culture of the existing site. Within the materials category, “use green-certified facilities” (0.431) had a higher weight than “use recycled materials” (0.353). The item of “use regional materials” (0.217) had the lowest weight.

Figure 3. Relative weights of assessment factors of AHP.

3.2. Comparison of Importance in Different Professions

We investigated the differences of priorities between the landscape architects group and the engineers/architects group. Landscape architects evaluated “soil and vegetation” as the most important in the assessment, while the engineers/architects group evaluated “site context” as the most important. For the landscape architects group, “site context” came second in the weighting, followed by “water,” “maintenance,” “health and wellbeing,” and “materials.” On the contrary, the order of importance for the engineers group was “maintenance,” “health and wellbeing,” “soil and vegetation,” “water,” and “materials” (Table 6). Figure 4 illustrates the differences of importance between the two groups.

Table 6. Comparison of rankings between landscape architects and engineers/architects groups.

Rank	Total (n = 141)		Landscape Architects (n = 70)		Engineers/Architects (n = 71)	
	Category	Weighting	Category	Weighting	Category	Weighting
1	Site context	0.210	Soil/vegetation	0.235	Site context	0.211
2	Soil/vegetation	0.197	Site context	0.206	Maintenance	0.185
3	Maintenance	0.179	Water	0.171	Health/wellbeing	0.165
4	Water	0.167	Maintenance	0.171	Soil/vegetation	0.164
5	Health/wellbeing	0.144	Health/wellbeing	0.123	Water	0.162
6	Materials	0.103	Materials	0.094	Materials	0.112

Figure 4. Discrepancy of importance in landscape sustainability criteria.

3.3. Application of the Landscape Sustainability Model to G-SEED-Certified Projects

Table 7 shows the results of applying the weightings derived from the AHP to the three G-SEED-certified projects. The AHP weightings were multiplied by mean scores of experts for each item, and the ratio of individual weighted scores out of total scores was calculated. Total weighted point of each project was 3.43, 2.52, and 2.56. There was also a big difference in the level of sustainability among items and criteria within a single project.

LH-HQ obtained higher scores than the other two projects mainly in “maintenance” and “health/wellbeing” criteria. By item, the scores were high in “monitoring plan” (0.46), “long-term management plan” (0.32), and “natural/permeable areas” (0.30). This is because the project had the locational benefit of securing natural soil and provided many exercise facilities/rest areas. It obtained high scores in the maintenance criteria, especially since there was a landscape maintenance plan. Renaissance Hotel showed high scores in “monitoring plan” (0.32) and “protection of cultural heritage” (0.23) because it preserved architectural history in a high-density area in downtown Seoul. The Sejong construction showed relatively high scores in “support resting and socializing” (0.13) and “support physical activity” (0.14). Being a housing complex, it obtained relatively high scores in the “health and wellbeing” category, which benefits residents more directly compared to other items.

As a result of comparing the mean weighted scores in the six criteria (Figure 5), it was found that the distribution of the scores in each category shared a similar trend among the three projects. In other words, “maintenance” showed relatively higher mean scores than the other criteria. On the other hand, “water” showed lower mean scores than the other criteria at 0.12, 0.09, and 0.10, respectively. Accordingly, it was discovered that the G-SEED-certified projects in Korea are concentrated on certain criteria in terms of landscape sustainability, whereas other criteria are considered relatively less important.

Table 7. Application of developed assessment factors to Green Standard for Energy and Environmental Design certified projects.

Criteria	Index	Weight	LH-HQ			Renaissance			Sejong		
			Point	Weigh-Ted Point	%	Point	Weigh-Ted Point	%	Point	Weigh-Ted Point	%
Site context	Conserve and restore habitats	0.067	2.11	0.14	4.1%	2.22	0.15	5.9%	1.89	0.13	4.9%
	Integrated design process	0.063	4.22	0.27	7.7%	3	0.19	7.5%	3.22	0.20	7.9%
	Eco-friendly layout planning	0.051	4	0.20	5.9%	2.11	0.11	4.3%	3.11	0.16	6.2%
	Brownfield project	0.029	3.67	0.11	3.1%	2.33	0.07	2.7%	2.56	0.07	2.9%
Soil/vege- tation	Protect plant communities	0.056	2.33	0.13	3.8%	2.78	0.16	6.2%	2.11	0.12	4.6%
	Optimize biomass	0.047	4.22	0.20	5.8%	3	0.14	5.6%	3.67	0.17	6.7%
	Manage healthy soils	0.036	2.44	0.09	2.6%	1.78	0.06	2.5%	1.89	0.07	2.7%
	Use native plants	0.033	3.67	0.12	3.5%	2.89	0.10	3.8%	3.22	0.11	4.1%
	Green wall/green roof	0.026	4.11	0.11	3.1%	3.11	0.08	3.2%	3.22	0.08	3.3%
Mainte- nance	Monitoring plan	0.104	4.44	0.46	13.5%	3.11	0.32	12.8%	3	0.31	12.2%
	Long-term management plan	0.075	4.22	0.32	9.2%	2.78	0.21	8.3%	2.67	0.20	7.8%
Water	Restore aquatic ecosystems	0.072	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Natural/permeable areas	0.06	5	0.30	8.7%	3	0.18	7.1%	3	0.18	7.0%
	Rainwater management	0.035	3.11	0.11	3.2%	2.44	0.09	3.4%	2.89	0.10	3.9%
Health/wellbeing	Protection of cultural heritage	0.075	2.67	0.20	5.8%	3.11	0.23	9.2%	1.22	0.09	3.6%
	Support physical activity	0.036	4.78	0.17	5.0%	2.33	0.08	3.3%	3.89	0.14	5.5%
	Support resting and socializing	0.033	4.67	0.15	4.5%	3	0.10	3.9%	4	0.13	5.2%
Materials	Use green-certified facilities	0.044	4	0.18	5.1%	2.78	0.12	4.9%	3.33	0.15	5.7%
	Use recycled materials	0.036	3	0.11	3.1%	2.22	0.08	3.2%	2.33	0.08	3.3%
	Use regional materials	0.022	3.22	0.07	2.1%	2.56	0.06	2.2%	2.89	0.06	2.5%
Total		1	68.61	3.43	100.0%	50.55	2.52	100.0%	54.11	2.56	100.0%

Figure 5. Results of application of assessment system.

4. Discussion

The following discussions can be had to develop assessment factors to objectively evaluate landscape sustainability.

First, as a result of applying the AHP to the newly derived items, “site context” and “soil and vegetation” showed the highest weightings in the main criteria, while “monitoring plan” showed the highest weighting in the sub-criteria, followed by “protection of cultural heritage” and “long-term management plan.” This result is similar to that of a study on factors for planning green apartment houses [21], which showed the highest importance in “principle of efficient use of land,” and that of a study on improving the Green Building Certification System for sustainable urban development [16], which showed the highest importance in “site selection and preservation.”

There were also some differences between the items considered important in overseas landscape sustainability rating systems and the results of the Korean working-level assessment of importance. For example, items such as “select brownfields or grayfields for redevelopment,” “preservation of soil and prevention of soil disturbance,” and “use recycled materials and regional materials” had a high distribution of scores in the SITES but showed low importance in Korea. Items not covered in G-SEED, such as “protection of cultural heritage,” “user health and wellbeing,” “monitoring plan,” and “long-term management plan,” also turned out to be important, indicating that there is an emphasis on comprehensive approaches, such as integrated planning and the design process.

In terms of sustainability assessment items, there was not much difference from the results of studies that used different methods from the AHP. In a study that conducted a survey on users of a residential complex [41] and studies focused on field surveys [3,28], “site selection” was considered an important item, along with “recycling of topsoil” and “use of rainwater.” The AHP model has the benefit of having the importance of assessment items determined by the experience and expertise of field experts and thus has greater value in terms of field applicability compared to other studies based only on a literature review or user survey.

Second, G-SEED is mostly focused on buildings. There is a perception gap between architects and landscape architects in the calculation of weightings for the landscape sustainability assessment items. Landscape architects gave higher weightings than architects to “soil and vegetation.” This is because they directly handle plants and deal with planting, and thus, they better understand and emphasize this item. This is similar to the finding of previous research [11] on the perception gap in landscape–architecture importance, showing that multilayered planting structure and diversity of plant species score high in landscape. It is also similar to the actual sustainability strategies and methods of the SITES in the US for soil, vegetation, water circulation management, and landscape materials [4], implying that it is necessary to develop objective landscape assessment items that have been overlooked in the existing building assessment criteria.

Third, the results of applying this assessment system to three G-SEED certified projects showed that while there was a slight difference in score overall, similar trends with criteria and factors are considered important from a landscape sustainability perspective. After analyzing the weighted average score for each field, we found that “maintenance” had the highest score with a relatively low score in “water” and “materials” in the three projects. These results indicate a need for more interest and effort in sustainable water management and material usage in Korea. In addition, the result revealed that Renaissance had a relatively high score of ‘protection of cultural heritage’, which highlighted the efforts to preserve architectural history in creating outdoor space. Considering these results derived from this assessment system, the assessment model of this study can be instrumental in supplementing G-SEED, which has relatively fewer assessment criteria for outdoor spaces. That is, a landscape-centered assessment system with various items would be useful in identifying outdoor sustainability issues and providing concrete solutions for the issues [42]. Therefore, continued efforts will be required to establish an assessment system for landscape sustainability that suits the Korean local context.

5. Conclusions

Many issues have been raised, including the notion that the landscape items of Korean sustainability certification are relatively scant and limited in terms of assessment and effectiveness, and thus, urgently require supplementation [3,4,10]. Therefore, to develop independent assessment factors to objectively assess landscape sustainability, this study derived items—including ecological value of the existing site, biotope creation, soil, vegetation, and water circulation management—not included in the existing assessment systems focusing on buildings and rated their importance using the AHP. The results showed that the existing G-SEED is inadequate for landscape assessment in many ways, and thus, there is a need for a differentiated certification system for landscape sustainability. Moreover, presenting the purpose and technology should be considered, rather than merely focusing on rating quantitative achievement, as should making assessment in terms of landscape performance, such as various creative sustainability strategies or technologies. In Korea, preliminary certification is often obtained at the end of the designing stage and main certification at the point of completion, for incentives. Thus, even though it is important in terms of reality, there are limitations in applying for certification in terms of post-occupancy evaluation or from the users’ perspective. It is necessary to establish the system to evaluate sustainability in the entire process of the project, including design, construction, and maintenance. However, this study’s significance lies in deriving assessment items that are applicable to landscape, instead of using the existing system in Korea that is focused on buildings, calculating weightings, and analyzing the trend based on specific cases of application, thereby presenting the possibility of developing a rational landscape assessment system.

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