Application of Korean Framework of Wetland Management Effectiveness Evaluation

Nak-Hyun Choi

National Institute of Ecology

Jung-Hun Yeum (✉ zelkovayeum@gmail.com)

Gangneung-Wonju National University <https://orcid.org/0000-0003-2038-1237>

Han Kim

National Institute of Ecology

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Abstract

This study applies the Korean framework of wetland management effectiveness evaluation for national wetland protected areas to obtain key insights into developing national wetland management policy. The quantitative evaluation framework was based on the basic evaluation framework of the International Union for Conservation of Nature, reflecting the characteristics of South Korea's wetland management policy. The framework comprises a total of 29 evaluation and 21 detailed items. Through the first quantitative evaluation of the entire target sites, a statistical analysis of the evaluation results was performed in line with management characteristics. The second and third qualitative evaluations, conducted by external research teams, were conducted after selecting a pilot target site for each group. After evaluation, the sites were divided into three groups: Group B showed the highest average values in all sectors of design, appropriateness, and delivery. The management effects in the pilot sites were, 43.9% in Yongneup of Mt. Daeam, 37.4% in Damyang riverine wetlands, and 58.9% in Upo wetlands, compared to the ideal management level. As a result, four important suggestions are derived. First, management effectiveness evaluation should consider national environmental and management policy characteristics based on an international framework. Second, an integrated management system should be established. Third, stakeholders should participate in building governance. Fourth, the participation of external experts is essential.

1. Introduction

Protected areas are geographical spaces encompassing cultural values and biodiversity conservation and are managed by legal or other effective measures to conserve ecosystems (Dudley, 2004). In particular, wetlands have diverse ecosystem service functions, such as excellent biodiversity and natural disaster reduction (Flecher et al, 2011), and are considered ecosystem types with high social, cultural, and economic values, as well as aesthetic functions (Tilton et al, 2001). For the effective management of such protected areas, the international community has recommended the implementation of management effectiveness evaluation for qualitative improvement and a quantitative increase in protected areas. The Convention on Biological Diversity (CBD) has made efforts to improve the quality of protected areas through the Programme of Work on Protected Areas (PoWPA) since 2004 (Ervin et al, 2008); since 2010, it has also recommended the implementation of management effectiveness evaluation of the parties through the adoption of Aichi targets and related resolutions (Decision X/31). In addition, in the Ramsar Convention, the Ramsar Site Management Effectiveness Tracking Tool (R-METT) was adopted (Resolution XII.15) In the 4th Ramsar Strategic Plan (2016–2024), the implementation rate of management effectiveness evaluation (%) was recommended. Protected area management effectiveness assessments (PAME) at the site level have been implemented in a number of protected areas since the 1990s (Rivero and Gabaldon, 1992; Cifuentes et al, 2000). The basic assessment framework was developed by the World Commission on Protected Areas (WCPA) of the International Union for Conservation of Nature (IUCN) to provide to the international community (Hockings et al, 2004; 2006). In addition, the World Bank, the Global Environment Fund (GEF), and the Worldwide Fund for

Nature (WWF) have supported budget and manual development to evaluate management effectiveness in protected areas (Belokurov et al, 2009).

According to Stoll-Kleemann (2010), more than 85 countries have evaluated management effectiveness using various methods such as METT, Rapid Assessment, and Enhancing our Heritage (EoH) toolkit. It has been suggested that evaluation by management entities, a regular evaluation cycle (Margoluis and Salafsky, 1998), systematic participation of stakeholders and external experts, and open discussion should be integrated for effective management. It is important to have a direct connection with local decision-makers with practical experience and to draw out their strengths (Hockings et al, 2008). In particular, the commonly applied METT was developed to monitor management procedures at individual sites (Stolton et al, 2007), which employs a method to increase explanatory power and transparency through a scorecard survey for stakeholders. In addition, METT is based on a self-assessment system and hence comparing it with other sites not essential (Stoll-Kleemann, 2010).

Management effectiveness evaluation has been applied diversely in inland and offshore areas (Graces et al, 2013; Nassep et al, 2017). According to Stoll-Kleemann (2010), mutual evaluation studies of management effectiveness evaluation tools showed revealed diversity in the number and types of assessors who determine evaluation methods and indicators, designation periods of protected areas, regions, and IUCN categories. In other words, within the framework of international guidelines, evaluation items and criteria reflecting local environments, local participation, and regular evaluation were included to enhance management effectiveness (Stolton and Dudley, 2016). The

South Korean government has expressed the need for regular management effectiveness evaluation and implementation in national policies such as the 3rd Basic Plan for Conservation of the Natural Environment and the 3rd Basic Plan for Wetland Conservation. To implement international recommendations, a management effectiveness evaluation was conducted for all protected areas designated by the Ministry of Environment (Heo et al, 2010). However, as a single framework was applied to all types of protected areas, there was a limitation in presenting management traits by type, and as evaluation results were presented at the basic plan level, it was impossible to reflect the current issues of each target site.

Therefore, in this study target protected wetland areas in South Korea. We apply the Korean framework of management effectiveness evaluation to reflect the location features and national wetland management policies. Then, we attempt to derive management traits by group and items of the target sites. The results of this study can improve national management policies for protected areas.

2. Methods

1) Study Area

Since the initial designation of four areas, including the Upo wetland in 1999, a total of 25 inland wetland protected areas in South Korea were designated as of 2019, with a total area of 129 km². There are three

designation criteria for protected wetland areas: the national-level pristine natural state of areas or areas with rich biodiversity; areas containing rare or endangered wild animals and plants; and areas with unique landscapes or topographical, or geological values. This study targeted a total of 22 protected wetland areas to evaluate management effectiveness, excluding three sites in which the basic evaluation data were not secured (Figure 1): 14 mountainous wetlands (Yongneup of Mt. Daeam), six river-type wetlands (Damyang riverine wetland), and three lake-type wetlands (Upo wetland). Except for the Incheon river estuary, all areas were managed under the five-year Basic Plan for Wetland Conservation and corresponding policies. As five-year detailed ecological survey and conservation plans were established for each target site, there was a basic management system for each site at a national-level.

2) Approaches to Korean Framework of Management Effectiveness Evaluation

To conduct a cross-analysis of management effectiveness evaluation items and criteria in domestic and foreign protected areas, this study analyzed the IUCN's management effectiveness evaluation framework, which is a model used internationally. This study employed the IUCN framework, but evaluation items and criteria of Ramsar-METT that partially reflect some characteristics of wetland ecosystem management were also referred to. In particular, regarding the IUCN's management effectiveness evaluation, the evaluation items of safety, climate change, carbon dioxide reduction, threat factors, the conservation status of key indicator species, and habitat changes, which were newly presented in 2019, were considered and supplemented in this study.

To derive the items and criteria considering features of domestic wetland management, along with the national-level evaluation items and criteria derived from the analysis of the management characteristics of domestic wetland protected areas, the keywords of policies presented in the 3rd Basic Plan for Wetland Conservation (2018–2022) (Figure 2) were reviewed.

For the cross-analysis to establish Korean management effectiveness evaluation (MEE) evaluation items and standards, phased decision-making processes were applied by asking the following questions: “Are the international evaluation items suitable for the characteristics of domestic wetland management?”; “Are the national-level evaluation items, criteria, and wetland management policy keywords overlapped with the international evaluation items?”; and “Are the criteria based on international evaluation items appropriate, considering the current status of domestic wetland management?” The final (draft) evaluation items and criteria were established through self-evaluation of internal research teams and the assessment of external experts.

3) Implementation of Korean Framework of Management Effectiveness Evaluation

The Korean framework of management effectiveness evaluation (MEE) (Table 1) consists of four evaluation data sheets: data sheet 1 (management outline), data sheet 2 (quantitative evaluation), data sheet 3 (management-focused evaluation), and data sheet 4 (trends of ecosystem changes). This study mainly focused on data sheet 2 (Table 2), which can be quantitatively evaluated for scoring. The MEE system proceeds in three stages. In the first step, a self-assessment was carried out based on the

management governance for each target site. In the second step, a qualitative evaluation was conducted, as it makes it possible to create a consensus between local stakeholders and external assessors. In the third step, along with the qualitative evaluation outcomes based on self-evaluation, an external assessor adjusted scores through a consensus evaluation system. In the first stage, all 22 target sites were evaluated, and in the second and third stages, three pilot sites, one representative of each type, were analyzed: the mountain-type, such as Yongneup of Mt. Daeam; river-type, such as Damyang riverine wetland; and lake-type, such as Upo wetland. The evaluation score was based on a 4-point scale (0–3); a penalty (-1) was applied to one detailed item (e.g., excessive installation of facilities). As for the evaluation method, since the MEE prioritizes improvement through a self-evaluation and is not compared between target sites (Stoll-Kleemann, 2010), the percentage (%) of the evaluation score was presented by counting the total score of items applied to each target area; based on that, regular improvement was the aim. There were a total of 29 evaluation items, and a supplementary evaluation was performed for the detailed items set in line with the domestic wetland management policy (Table 2). The evaluation items were split into three sectors: design, appropriateness, and delivery. The design sector consisted of nine evaluation items, two evaluation items, and one detailed item. Evaluation Item 4 (establishment and implementation of wide-area management plan) evaluates whether the geographic information and conservation management of the target wetland area are reflected in the city-level statutory management plans (e.g., city- and county-level management plans, river maintenance plans, landscape plans). Item 7 (setting management (use) district) handles whether management districts are set for efficient spatial management. In Item 3 (Establishment and implementation of management (conservation) plans), a supplementary question, 3b (sharing of results after the plan establishment), was added to reflect the need for sharing with the local community after the establishment of the plan. The appropriateness sector consisted of a total of 16 evaluation items, with 13 detailed items and three evaluation items newly added: Item 10 (DB establishment for comprehensive environmental survey and monitoring), Item 23 (public relations to raise awareness), and Item 24 (purchase and management of private land). All added and deducted items in the appropriateness sector were added to reflect the keywords related to conservation plan and policy for protected wetland areas. The delivery sector consisted of four evaluation items, and one evaluation item, and four detailed items were added. Evaluation Item 27 (Conservation of Cultural Value of Wetland) was added to evaluate whether traditional knowledge of life, religion, and culture of residents, which has been passed down for generations, is effectively managed in target wetlands. All added items in the delivery section were added by reflecting the keywords associated with the conservation plan and policy for protected wetland areas.

4) Analysis Methods

For the quantitative evaluation of the 22 sites in the first step of this study, the sites were statistically analyzed using SPSS 25.0. First, the target sites with similar result values were grouped using hierarchical cluster analysis, a method of classifying sites into several clusters with similar traits. Evaluation values for individual items by sector, such as design, appropriateness, and delivery, were used for dependent variables. For the clustering method, Ward's method (1963), which is mostly used to determine the number of clusters, was employed, and the squared Euclidean distance was used as a

measurement value. After grouping based on the integrated values of design, appropriateness, and delivery, a multiple analysis of variance (MANOVA) analysis, which is applicable to two or more groups, and three or more variables, was performed to confirm whether the differences between groups by sector were significant. Descriptive statistical values by group, such as mean values and standard deviation, and results from a multivariate test and a test of between-subjects effects, were analyzed. As the evaluation values of individual items by sector, such as design, appropriateness, and delivery, were used as dependent variables, post-evaluation of detailed items was performed to determine which items created differences between groups. Considering that the number of target sites per group was different, Scheffe's test was conducted to determine homogeneity.

3. Results

3.1 Results of Management Effectiveness Evaluation at the First Step

Based on hierarchical cluster classification analysis, sites were classified into Groups A, B, and C. The dendrogram combined with Ward's method (Figure 3) shows the protected wetland target areas on the vertical axis and the relative distance on the horizontal axis. After clustering, Group A included Yongneup of Mt. Daeam (site 1), Moojechineup (site 8), Sajapyeong (site 9), Sinbulsan wetland (site 10), Hwaeomneup (site 11), and Incheon river estuary (site 20); Group B included Upo wetland (site 21), Munkyeong Doline wetland (site 12), Ungok wetland (site 13), Wolyeong wetland (site 14), Nakdong river estuary (site 18), Hwapocheon (site 19), and Gonggumji (site 22); Group C included the Damyang riverine wetland (site 15), 1100 m altitude wetland (site 2), Dongbaekdongsan (Site 3), Mulyeongari-oreum (Site 4), Muljangori-oreum (Site 5), Sumeunmulbaengdui (site 6), Jang-do wetland (site 7), Dongcheon estuary (site 16), and Chimsil wetland (site 17).

The average value of the design sector for all 22 target sites was $20.95 (\pm 3.15)$, of the appropriateness sector was $25.95 (\pm 5.76)$, and of the delivery sector was $6.36 (\pm 2.59)$. As for descriptive statistics per group, the averages in the design sector were $19.67 (\pm 3.14)$ for Group A, $24.14 (\pm 2.61)$ for Group B, and $19.33 (\pm 1.32)$ for Group C; the averages in the appropriateness sector were $19.50 (\pm 5.21)$ for Group A, $29.71 (\pm 3.35)$ for Group B, and $27.33 (\pm 4.00)$ for Group C; the averages in the delivery sector were $5.17 (\pm 0.98)$ for Group A, $8.86 (\pm 3.29)$ for Group B, and $5.22 (\pm 0.97)$ for Group C. The mean value of Group B was the highest in all sectors of design, appropriateness, and delivery. The standard deviation of Group A was relatively higher than other groups in the sectors of design and appropriateness, whereas that of Group B was the highest in the delivery sector (Table 3).

As a result of analyzing Box's test statistic (M) for homogeneity verification of the covariance matrix (Table 4), the hypothesis of the covariance matrix was rejected ($P = 0.000$) as the sample size was too small or the hypothesis of covariance invariance was violated; Pillai's trace, which is used when there is a difference in the size of groups (Hair et al. 2010), was applied. Levene's test confirmed that the variance of the evaluation result values, which are the dependent variables of the three groups, was homogeneous, and the significance of the difference between groups by sector of design, appropriateness, and delivery,

which are dependent variables between groups, was recognized. As a result of analyzing eta-squared values (0.453–0.501), it was confirmed that the dependent variables of design, appropriateness, and delivery and independent variables of Groups, had sufficient effects on the differences between groups.

Scheffe's post-hoc test was used to confirm the significance level of the differences between groups, the average difference between Group B and Groups A and C was significant in the design and delivery sectors, based on a 95% confidence interval; in the appropriateness sector, the average difference between Group A and Groups B and C was significant (Table 5).

Analysis of the dependent variables in the design sector showed significant differences in five items that led to significant differences between groups (Table 6): Items 3 (Establishment and implementation of management (conservation) plans), 4 (Establishment and implementation of wide-area management plan), 5 (Establishment and implementation of annual management action plans), 6 (wetland management boundaries), and 7 (setting management (use) district). In the appropriateness sector, differences between groups stemmed from seven items: Items 10 (DB establishment for comprehensive environmental survey and monitoring), 12 (Employee training), 16 (Visitor center), 20 (Habitat restoration project), 21 (Research), 22 (Tour and education programs), and 23 (Public relations to raise awareness). In the delivery sector, differences between groups stemmed from two evaluation items: Items 28 (revitalization of the local economy) and 29 (capacity building).

3.2 Evaluation of Target Sites of Three-Step Pilot Projects

Yongneup of Mt. Daeam, the protected wetland area, showed an overall management effect of 43.9%, with the highest management effect (58.1%) in the design sector, and lower effects in the appropriateness (38.3%) and delivery (37.5%) sectors.

As a result of the Step 1 (self-assessment) evaluation of the design sector, Item 1 (Legal protection) scored 3 points; four evaluation items, Items 2 (establishment of wetland management direction), 3 (establishment and implementation of management (conservation) plans), 8 (Implementation and reflection of comprehensive environmental survey), and 9 (Monitoring detailed items and its reflection), scored 2 points; and Items 5 (Establishment and implementation of annual management action plans), 6 (wetland management boundaries), 7 (setting management (use) district), and 4 (establishment and implementation of wide-area management plan) scored 0 points. As a result of the final evaluation Steps 2 (form a bond of sympathy with local stakeholders) and 3 (external specialist), one additional point was given to Item 4, as the item suggests the necessity for conserving Yongneup of Mt. Daeam, and its location information in the wide-area level of a higher plan. In the case of detailed items such as 3c and 3d for additional points, there was no scoring for their pre-evaluation. However, considering that five-year conservation plans are established based on the Wetland Conservation Act and that implementation evaluations of previous conservation plans have been implemented before setting new conservation plans, additional points were assigned to the detailed items in the case of qualitative evaluations. In the Step 1 (self-assessment) evaluation of the appropriateness sector, Items 21 (Research) and 24 (Purchase and management of private land) scored 3 points; evaluation Items 11 (Number of employees), 15

(Budget management), 18 (Management equipment and facility management), 19 (Visitor management system), 20 (Habitat restoration project), and 22 (Tour and education programs) scored 2 points. Items that scored 1 point were as follows: 10 (DB establishment for comprehensive environmental survey and monitoring), 12 (Employee training), 13 (Current budget), 16 (Visitor center), and 23 (Public relations to raise awareness). Item 25 (Wetland management governance) scored 0 points. As a result of the final evaluation via Steps 2 and 3, the evaluation results were corrected for items 12, 16, and 17. One point was given for the detailed items of 12a and 20b in the same manner as the self-evaluation; evaluation scores were corrected for other detailed items. As a result of Step 1 (self-assessment) evaluation in the delivery sector, no items scored 3 or 0 points; Item 28 (Revitalization of the local economy) scored 2 points and three items scored 1 point, Item 26 (Status on key management targets), Item 27 (Conservation of cultural value of wetland), and Item 29 (Capacity building). One additional point was assigned to the detailed items of 29a and 20b; evaluation scores were corrected for other detailed items via Steps 2 and 3 (Figure 4).

The Damyang riverine wetland, the protected wetland area, had a management effect of 37.4%; the management effect in the design sector was the highest at 48.4%, the appropriateness sector was 38.3%, and the delivery sector was particularly low at 12.5%.

As a result of the Step 1 (self-assessment) evaluation of the design sector, Item 1 (legal protection) scored 3 points; four items, Items 2 (Establishment of wetland management direction), 3 (Establishment and implementation of management (conservation) plans), 5 (Establishment and implementation of annual management action plans), and 8 (implementation and reflection of comprehensive environmental survey), scored 2 points. Three items scored 1 point: Items 4 (Establishment and implementation of wide-area management plan), 6 (wetland management boundaries), and 9 (monitoring detailed items and their reflections). Item 7 (setting management (use) district) scored 0 points. As a result of the final evaluation via Steps 2 (form a bond of sympathy with local stakeholders) and 3 (external specialist), the evaluation outcomes of Items 2, 3, 6, 8, and 9 produced by administrative agencies were adjusted through the process of forming a consensus and reviews from external experts. an additional point was given to 3c in both self-evaluation and external expert evaluation, with no other additional points.

As a result of Step 1 (self-assessment) evaluation in the appropriateness sector, the evaluation Items 12 (Employee training), 13 (Current budget), 14 (Budget security), 15 (Budget management), 17 (Introduction of management equipment and facilities), and 19 (Visitor management system) scored 3 points: Items 16 (Visitor Center), 18 (Management equipment and facility management), 22 (Tour and education programs), 23 (Public relations to raise awareness), and 24 (Purchase and management of private land) scored 2 points. Items 11 (number of employees) and 21 (research) scored 1 point. Items 10 (DB establishment for comprehensive environmental survey and monitoring), 20 (Habitat restoration project), and 25 (Wetland management governance) scored 0 points. As a result of the final evaluation via Step 2 and Step 3, the self-evaluation results for Items 12, 13, 14, 15, 19, and 21 were corrected: one point was given to the detailed item, 12a, but no scores were assigned to other detailed items.

As a result of Step 1 (self-assessment) evaluation in the delivery sector, no items scored 3 or 0 points; Items 26 (status on key management targets) and 27 (conservation of cultural value of wetland) scored 2 points, and two items such as Item 28 (Revitalization of the local economy) and 29 (Capacity building) scored 1 point. Via Steps 2 and 3, all items of 26, 27, and 29, except for Item 28, were corrected, and no additional points were assigned. In particular, in the case of this target site, it was clear that the current management level was overestimated to some extent during the self-evaluation, or there was a lack of understanding due to the rotation of managers (Figure 5).

Upo wetlands showed an overall management effect of 59.8%; the management effect in the design sector was evaluated as the highest at 77.4%; the management effect in the delivery sector was 62.5%, whereas the appropriateness sector showed a relatively lower effect (48.3%). As a result of Step 1 (self-assessment) evaluation in the design sector, the following items scored 3 points: Item 1 (legal protection), 5 (establishment and implementation of annual management action plans), 6 (wetland management boundaries), 8 (implementation and reflection of comprehensive environmental survey), and 9 (monitoring detailed items and their reflections). Four items scored 2 points: Items 2 (Establishment of wetland management direction), 3 (Establishment and implementation of management (conservation) plans), 4 (Establishment and implementation of wide-area management plan), and 7 (setting management (use) district). As a result of the final evaluation via Steps 2 (form a bond of sympathy with local stakeholders) and 3 (external specialist), corrections were made to Items 7, 8, and 9, and additional points were attributed to detailed items of 3a, 3c, and 3d. As a result of Step 1 (self-assessment) evaluation in the appropriateness sector, the following evaluation items scored 3 points: 15 (budget management), 16 (visitor center), 17 (introduction of management equipment and facilities), 18 (management equipment and facility management), 19 (visitor management system), 22 (tour and education programs), and 25 (wetland management governance). The evaluation Items 10 (DB establishment for comprehensive environmental survey and monitoring), 13 (current budget), 20 (habitat restoration project), 21 (research), and 24 (purchase and management of private land) scored 2 points. Items 11 (number of employees) and 14 (budget security) scored 1 point, whereas items 12 (employee training) and 23 (public relations to raise awareness) scored 0 points. As a result of the final evaluation via the Step 2 and Step 3 process, the evaluation results of Items 10, 11, 16, 17, 18, 19, 22, and 23 were corrected with additional points attributed to the detailed items 10a, 20a, 20b, and 22a. As a result of Step 1 (self-assessment) evaluation in the delivery sector, Items 26 (status on key management targets) and 29 (capacity building) scored 3 points, whereas Item 27 (conservation of cultural value of wetland) and item 28 (revitalization of the local economy) scored 2 points. The self-evaluation scores of Items 27 and 29 were corrected through the process of Step 2 and Step 3, and additional points were given to detailed items 26a and 29a (Figure 5).

4. Discussion

4.1. Reflection of National Environment and Policies

For MEE, international communities such as the IUCN and CBD provide the main evaluation framework to ensure qualitative management and quantitative evaluation of protected areas, and to continuously encourage parties to achieve evaluation targets of management effectiveness. In addition, the evaluation manual provided by other organizations, such as the World Wide Fund for Nature (Stolton and Dudley, 2016), suggests the operation direction: application of MEE in different national conditions, regular evaluation of management status, evaluation by diverse stakeholders, creation of consensus (local community participation), capacity strengthening of assessors, guideline preparation, and establishment of a self-assessment-based procedure to verify external assessors. This is also in line with the operation direction of MEE suggested in previous studies (Margoluis and Salafsky, 1998; Stoll-Kleemann, 2010).

This study has significant contributions in that the MEE was applied to protected wetland ecosystems in South Korea, while providing specific evaluation items and being applied on a trial basis, after considering the national environment and policies. Taking into account the characteristics of domestic wetland management, the design sector had two more evaluation items and one additional detailed item; the appropriateness sector had three more evaluation items and 13 more detailed items; the delivery sector had one additional evaluation item and four more detailed items. In particular, previous MEE studies on protected areas in South Korea (Heo et al, 2010) suggested a simple status identification at a basic plan level because when a single evaluation framework was applied to diverse ecosystem types, there was a limit to deriving ongoing issues for each target site. However, this study is significant as a three-step evaluation procedure was applied to the pilot target sites, and suggests the direction in which parts should be intensively managed by the sectors of design, appropriateness, and delivery at the conservation plan level. According to Stoll-Kleemann (2010), there are various differences in the evaluation framework of management effectiveness depending on IUCN categories. Appropriate evaluation items and criteria must be set considering types of protected areas, characteristics of ecosystems, and national policy and environment.

Primary local efforts are required for continuous improvement. However, at the national-level, it is meaningful to present basic policy data to support preferential support for areas requiring intensive management by group, after grouping target sites based on the first evaluation (self-evaluation). As a result of the analysis in this study, Group B had higher evaluation values than other groups in all sectors of design, appropriateness, and delivery. Group A was required intensive management as it showed relatively low values in all sectors. Group C had median values required intensive management in the design and delivery sectors, although there were variations by target site. In addition, several factors led to differences in evaluation items between sites in the same group. For example, if there was no system in place for implementation evaluation after the establishment of the management plan in the design sector, or a system was in place but with slow implementation, the target sites scored low, leading to large differences between target sites. The target sites also scored low when there was an absence of set management districts such as core, buffer, and transitional areas for protected wetland areas. If the awareness of local communities of wetland management boundaries was low, the target sites scored low. In the appropriateness sector, factors were highlighted which lowered the evaluation values by target site: lack of databases related to natural ecosystems, tours, and traditional knowledge, a lack of sharing

with the local community, and the absence of a systematic education system for employees. In the case of the visitor center, if there has been infrastructure or the local community could not participate in creating or organizing content, the site would have received a low score. Furthermore, if there have been plans but actual field research was not carried out, the target site would have also received a low score, leading to significant differences between target sites. The level of public relations for touring, education programs, and awareness-raising also led to significant differences between target sites. In the delivery sector, the existence of social enterprises to revitalize the local economy positively impacted the evaluation; there was a huge difference in evaluation scores by target site depending on whether a stakeholder's capacity strengthening program was established. Therefore, the national support program and budget establishment for priority management evaluation items by sector should be simultaneously implemented.

4.2. Essential Factors to Establish an Integrated Management System

Systematic management of protected areas requires an integrated management system encompassing investigation and monitoring, establishment of basic and management plans, and MEE. In the case of protected wetland areas in South Korea, based on the Wetland Conservation Act, there is stipulations, such as five-year detailed investigations and establishment of basic and management plans. Annual monitoring of individual sites is carried out by the Regional Environment Agency according to guidelines. However, it is difficult to present the direction for management plans; there is a limit in suggesting the direction of the management plan, that is, which management item is particularly insufficient and requires continuous and intensive management. To supplement this, it is necessary to regulate MEE. To this end, although the ultimate goal is voluntary management, there should be legal guidelines until policy stabilization for evaluation implementation is achieved. A national effort should also be made in parallel with establishing a MEE manual that specifies the roles of stakeholders and ways to secure evidence for clear evaluation results.

4.3. Importance of Creating Governance with Stakeholder Engagement

A three-step evaluation procedure was used in this study: The first step was self-evaluation in which management and administration-related stakeholders conduct self-evaluations. The second step was a discussion forum in which the Ministry of Environment, residents, NGOs, and local governments participated, along with external experts who had reviewed the self-evaluation report in advance. This was a crucial step for understanding the field by forming a consensus; after experts participated in the discussion forum and asked intensive questions on the items, the evaluation scores might require re-examination, or the self-evaluation scores could be confirmed. This was in line with previous studies (Hockings et al, 2008; Stoll-Kleemann, 2010) that found that MEE should be integrated with stakeholder participation from the basic stage, and that open conversation draws out the strength of the target sites. In particular, it was confirmed that, in the second step review process, if target site-related stakeholder consultative groups were not created, and there was a frequent rotation of administrative personnel, the

result of the first step self-evaluation was relatively inaccurate, and it was difficult to form a consensus and ask questions.

4.4. The Need for Participation of External Experts

This study presented a three-step evaluation procedure, and external experts reviewed the self-evaluations in the third step. The expert pool mainly consisted of experts in the field of wetland conservation and management. If experts with little experience in other types of protected area have participated, there would have been a limit to make a reasonable evaluation as they depended on their knowledge and experience and reflected local specificity and environments. In this regard, we confirmed that the participation of experienced external experts in wetland management policy had clear effects in explaining the connection between evaluation items and national wetland policy to local stakeholders and asking the appropriate questions to address the situation. We concluded that external experts should not only participate in the third step, but also in the second step of forming a consensus, which is in line with the principle of the international community in which self-evaluation is required, but external expert reviews are also necessary (Stolton and Dudley, 2016).

5. Conclusions

This study aimed to efficiently derive management issues and solve problems at the site-level by applying the Korean wetland management effectiveness evaluation framework to improve the quality of national wetland protected areas. Based on the self-assessment of 22 wetland protected areas and the statistical analysis, the results show Group B with the highest average value among the three groups. From the selection of a pilot site for each group and conducting a second- and third-stage (qualitative and external specialist evaluations, respectively), it was confirmed that the management effects were 43.9% in Yongneup of Mt. Daeam, 37.4% of Damyang riverine wetland, and 58.9% of Upo wetland, respectively. Consequent to the comprehensive evaluation process, four important suggestions were derived. First, the management effectiveness evaluation should include the characteristics of national environment and management policies based on an international framework. In the process of supplementing and embodying the international framework presented by the IUCN WCPA, a concrete evaluation framework that fully reflects Korea's environmental management policy was completed, and the applied result was that site-level presented specific directions for establishing management plans. In addition, through grouping according to management level, areas and evaluation improvement items that are in urgent need of better management were derived, and the evaluation framework was confirmed to reflect the domestic environment efficiently without significantly increasing evaluation items through supplementing additional detailed items. Second, it is important to establish an integrated management system. Basically, a feedback system between investigation, monitoring, and management plan establishment, while the management effectiveness evaluation must be established, and not only management plans at the site-level but also systems-levels of national policies, to ensure basic plans are effective. Third, it is very important to form governance in which stakeholders can participate. In the verification process of local stakeholders and external experts of the second stage, errors in evaluation results and

misunderstandings between stakeholders were largely resolved by comprehensively collecting opinions from various stakeholders. Fourth, it was confirmed that the participation of external experts was of great help in verifying the exaggerated or distorted parts of some evaluation results.

This study is of great significance in evaluating the national-level approach process to establish the framework of management effectiveness evaluation, an internationally-recommended tool for improving the quality management of protected areas. However, since the evaluation to which all three steps were applied is limited to the pilot target site, it is necessary to expand our study in the future, and include legal guidelines and manuals at the national level. It is also believed that it can be used as a reference in the process of preparing and applying the management effectiveness evaluation framework in other countries.

Declarations

Ethics approval

Not applicable

Consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and material

All data presented in this article and other materials are available from the corresponding author upon a reasonable request.

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Code availability

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Authors' contributions

Material preparation, data collection and analysis were performed by Nak-Hyun Choi, Jung-hun Yeum and Han Kim. The first draft of the manuscript was written by Jung-hun Yeum and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. System of the Korean-type management effectiveness evaluation

Assessment Composition		Data Sheet 1: Management Outline, Data Sheet 2: Qualitative Evaluation, Data Sheet 3: Management-focused Evaluation, Data Sheet 4: Trends of Ecosystem Changes				
Quantitative assessment	Score	3 (excellent)	2 (good)	1 (fair)	0 (poor)	-1 (bad)
	Assessment question	Design		Appropriateness		Delivery
		9 questions + 4 supplementary questions		16 questions + 13 supplementary questions		4 questions + 4 supplementary questions
	Assessment method (self-assessment)	gain score / total score (%) for design		gain score / total score (%) for design		gain score / total score (%) for design
	Assessment steps	1 step (self-assessment)		2 steps (form a bond of sympathy with local stakeholder)		3 steps (external specialist)

Table 2. Items and questions in the quantitative evaluation data sheet to evaluate Korean-type management effectiveness (data sheet 2)

Issue	Division	Item	Score	Question
Design	Context	1. Legal protection	3	Does the target wetland have its legal status?
	Planning	2. Establishment of wetland management direction	3	Is the management direction (promotion strategy or goal) for the target wetlands established, and is it practically managed in line with the management direction?
	Planning/Process	3. Establishment and implementation of management (conservation) plans	3	Is there a management (conservation) plan for the target wetlands, and is it being implemented appropriately?
		(Supplement question) 3a	1	The opinions of key stakeholders (including local residents and local NGOs) are appropriately reflected, based on establishing management (conservation) plans.
		(Supplement question) 3b	1	After establishing a management (conservation) plan, are the results shared among stakeholders?
		(Supplement question) 3c	1	There are fixed plans and procedures for regular updates on the management (conservation) plans.
		(Supplement question) 3d	1	The implementation of previous management (conservation) plans was evaluated.
	Planning/Process	4. Establishment and implementation of a wide-area management plan	3	Is the conservation management content of the target wetlands reflected when establishing city-level wide-area management plans (City/Country-level management plans, river management plans, landscape plans, and environmental conservation plans)?
	Planning/Process	5. Establishment and implementation of annual management action plans	3	Are annual management action plans established and being implemented?
	Planning	6. Wetland management boundaries	3	Are the wetland management boundaries properly set and known to maintain the function of the wetland, inhabit the internal species, and minimize the influence from the surrounding area?
	Planning	7. Setting management (use) district	3	Is a management (use) district established for the systematic conservation and management of the target wetland?

	Planning/Process	8. Implementation and reflection of comprehensive environmental survey	3	Is a regular and detailed investigation system established and stably implemented, and is it reflected in the management (conservation) plan?
		9. Monitoring detailed items and their reflection	3	In relation to the comprehensive environmental survey, is regular monitoring of detailed items (e.g., observation of changes in the wetland (i.e., the physical environment and species), and monitoring after prevention and restoration) implemented stably, and is it reflected in the management(conservation) plan?
Appropriateness	Input	10. DB establishment for comprehensive environmental survey and monitoring	3	Is a DB for comprehensive environmental survey and monitoring results established?
		(Supplement question) 10a	1	A DB for cultural resources such as traditional knowledge is established.
		(Supplement question) 10b	1	A DB for the characteristics of the tour, such as the tour route and visiting, is established.
		(Supplement question) 10c	1	Information on comprehensive environmental surveys and monitoring is disclosed on the website.
		11. Number of employees	3	Are there sufficient professionals with job security to manage wetlands?
		(Supplement question) 11a	1	Job security for field managers is guaranteed.
	Process	12. Employee training	3	For proper conservation management of the target wetland, are the employees receiving regular training (e.g., competency strengthening workshops hosted by the Ministry of Environment and the National Institute of Ecology, and other professional wetland manager competency training programs), and are they being used in their work?
		(Supplement question) 12a	1	Field management staff regularly receive safety training on safety accidents.
		(Supplement question) 12b	1	Participate regularly in wetland education.
		(Supplement question) 12c	1	There are separate training programs for resident watchmen and natural environment interpreters.

Input	13. Current budget	3	Is the current budget sufficient for the proper management of the target wetland?
Input	14. Budget security	3	Is the budget for the full implementation of the management (conservation) plan stable?
Process	15. Budget management	3	Are budgets being managed to meet crucial management needs?
Input/Process	16. Visitor center	3	Is the visitor center adequate in size and function, and does it provide high-quality content?
Input	17. Introduction of management equipment and facilities	3	Are the equipment and facilities for the wetland conservation management (e.g., information boards, weather observation systems, fences, other safety facilities, observation posts, toilets, etc.) adequately secured?
	(Supplement question) 17a	-1	There are facilities unsuitable for wetland conservation (including excessive facilities).
Process	18. Management equipment and facility management	3	Are the equipment and facilities for the wetland conservation management (e.g., information boards, weather observation systems, fences, other safety facilities, observation posts, and toilets) adequately maintained?
Process	19. Visitor management system	3	Is an efficient visitor management system for the wetland conservation management (e.g., reservation-based tour, restricted access (for a certain period), resident watchmen, etc.) established?
Process	20. Habitat restoration project	3	Are the restoration projects in damaged areas planned for habitat improvement, and are they being implemented smoothly?
	(Supplement question) 20a	1	Key species (e.g., flagship species) for habitat conservation and restoration are selected.
	(Supplement question) 20b	1	Threat factors for habitat conservation and restoration (e.g., water quality or quantity (terrestrialization), ecosystem disturbance species, and disasters) are being managed.
Process	21. Research	3	Are studies on ecosystems, cultural resources, management infrastructure, and threat factors comprehensively conducted? ※ 8. The comprehensive environmental survey, 9. Monitoring detailed items and wetland conservation-related research
Process	22. Tour and education programs	3	Are educational programs related to the purpose and necessity of wetland management in place, and are they properly operated?
	(Supplement question) 22a	1	The wetland education program is being operated in connection with the regular

				school curriculum.
	Process	23. Public relations to raise awareness	3	Are there any promotional media (e.g., websites, promotional materials, and webtoons) or programs (e.g., photo contest, BI development, and app map construction) that can effectively inform the importance and value of wetlands through the target wetland?
	Process	24. Purchase and management of private land	3	Is there a smooth cooperative relationship with landowners, and is the private land managed systematically?
		(Supplement question) 24a	1	The ecosystem service payment system is being implemented.
	Process	25. Wetland management governance	3	Is a governance system for wetland management established, and is it being operated reasonably and efficiently?
		(Supplement question) 25a	1	The composition of the committee for the management of the target wetland is systematically stipulated.
Delivery	Outcome	26. Status of key management targets	3	Compared to the situation of initial management, how is the current status of important values of the target wetland?
	Output	(Supplement question) 26a	1	The logs of wetland management are regularly updated.
		(Supplement question) 26b	1	The area of restoration projects for habitat improvement (□) is continuously increasing.
	Outcome	27. Conservation of cultural value of wetlands	3	In relation to the target wetland, is the traditional knowledge of the local residents' lifestyle, culture, and religion being effectively managed?
	Outcome	28. Revitalization of the local economy	3	Does the target wetland provide economic benefits to the local community (e.g., sales of goods, operation of local paid programs, and employment)?
	Output	(Supplement question) 28a	1	The target wetland-related social, economic enterprises (e.g., social cooperatives) are established to systematically benefit local communities.
	Outcome	29. Capacity building	3	Is the capacity of stakeholders for the wetland management strengthened?
	Output	(Supplement question) 29a	1	Resident capacity building projects (e.g., implementation of wetland centers) are being implemented or were implemented.

Table 3. Average and standard deviation results by sector between groups

Cluster Type	Design		Appropriateness		Delivery	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Group A	19.67	3.14	19.50	5.21	5.17	0.98
Group B	24.14	2.61	29.71	3.35	8.86	3.29
Group C	19.33	1.32	27.33	4.00	5.22	0.97
Total	20.95	3.15	25.95	5.76	6.36	2.59

Table 4. Results of between-group multivariate and between-subject effects tests

Cluster Type	Pillai's trace	Dependent variables	Levene (p-value)	F	Df	p-value	Partial n2
Between groups	1.081 (p = 0.000)	Design	0.171	9.552	2	0.001	0.501
		Appropriateness	0.788	10.508	2	0.001	0.525
		Delivery	0.096	7.852	2	0.003	0.453

Table 5. Scheffe's post-hoc test between groups

Dependent variables	(I) Cluster	(J) Cluster	Average difference (I-J)	Standard error	p-value	95% confidence interval	
						Lower limit	Upper limit
Design	A	B	-4.48*	1.303	.010	-7.93	-1.02
		C	.33	1.234	.964	-2.94	3.61
	B	A	4.48*	1.303	.010	1.02	7.93
		C	4.81*	1.180	.003	1.68	7.94
	C	A	-.33	1.234	.964	-3.61	2.94
		B	-4.81*	1.180	.003	-7.94	-1.68
Appropriateness	A	B	-10.21*	2.322	.001	-16.38	-4.05
		C	-7.83*	2.200	.008	-13.67	-2.00
	B	A	10.21*	2.322	.001	4.05	16.38
		C	2.38	2.103	.538	-3.20	7.96
	C	A	7.83*	2.200	.008	2.00	13.67
		B	-2.38	2.103	.538	-7.96	3.20
Delivery	A	B	-3.69*	1.122	.014	-6.67	-.71
		C	-.06	1.063	.999	-2.88	2.76
	B	A	3.69*	1.122	.014	.71	6.67
		C	3.63*	1.016	.008	.94	6.33
	C	A	.06	1.063	.999	-2.76	2.88
		B	-3.63*	1.016	.008	-6.33	-.94

Table 6. Synthesis of dependent variable items for which significance was recognized between sectors

Category	Scheffe's post-hoc test (p<0.05)			
	Dependent variables	F	df	P-value
Design	3. Establishment and implementation of management (conservation) plans	3.641	2	0.046
	4. Establishment and implementation of wide-area management plan	10.907	2	0.001
	5. Establishment and implementation of annual management action plans	9.494	2	0.001
	6. Wetland management boundaries	4.618	2	0.023
	7. Setting management (use) district	4.845	2	0.020
Appropriateness	10. DB establishment for comprehensive environmental survey and monitoring	27.815	2	0.000
	12. Employee training	21.783	2	0.000
	16. Visitor center	9.730	2	0.001
	20. Habitat restoration project	6.000	2	0.010
	21. Research	31.874	2	0.000
	22. Visit and education programs	4.690	2	0.022
	23. Public relations to raise awareness	6.226	2	0.008
Delivery	28. Revitalization of the local economy	6.422	2	0.007
	29. Capacity building	8.322	2	0.003

Figures

Figure 1

The location map of the survey sites

Figure 2

Cross-analysis system of management effectiveness evaluation items and criteria for domestic and foreign protected areas

Dendrogram Combined with Ward's Method

Rescaled Distance Cluster Combine

Figure 3

Hierarchical clustering dendrogram

Figure 4

Evaluation results for Yongneup of Mt. Daeam

Figure 5

Evaluation results for Damyang riverine wetland

Figure 6

Evaluation results for Upo wetland