Application of the Korean Framework of Wetland Management Effectiveness Evaluation

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Abstract
This study applied the Korean framework of wetland management effectiveness evaluation to national wetland protected areas and identified key insights into developing a national wetland management policy. The framework is based on the basic evaluation framework of the International Union for Conservation of Nature and reflects the characteristics of South Korea’s wetland management policy. The evaluation framework comprises a total of 29 items and 21 detailed items in the design, appropriateness, and delivery sectors. Based on a cluster analysis, which considered the management levels of 22 sites that conducted first-stage self-assessment, the sites were divided into Groups A, B, and C. The second and third stages of qualitative evaluation were conducted on the representative target sites of each group by external research teams. The average score for the overall management level was the highest for Group B, followed by Groups C and A. Significant differences were observed among the groups for five items in the design sector, seven items in the appropriateness sector, and two items in the delivery sector. The management levels in the pilot sites were 43.9% in Yongneup of Mt. Daeam, 37.4% in the Damyang riverine wetland, and 59.8% in the Upo wetland, compared to the ideal condition. Important suggestions were derived through the evaluation framework. 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. Lastly, the participation of an external expert is essential.

Keywords Wetland protected areas · Qualitative evaluation · National framework · Management plan

Introduction
Protected areas are geographical spaces encompassing cultural values and biodiversity conservation; they are managed by legal or other effective measures to conserve ecosystems (Dudley 2004). In particular, wetlands have distinct ecosystem service functions, such as supporting a high degree of biodiversity and reducing the risk of natural disasters (Flecher et al. 2011). They are characterized by high social, cultural, and economic values, as well as aesthetic functions (Tilton et al. 2001). To effectively manage such protected areas, the international community recommends the implementation of management effectiveness evaluation for the qualitative improvement and a quantitative increase in protected areas. Since 2004, the Convention on Biological Diversity (CBD) has worked towards improving the quality of protected areas through the Programme of Work on Protected Areas (PoWPA) (Ervin et al. 2008). Since 2010, it has also recommended the implementation of management effectiveness evaluation of the involved countries through the adoption of the Aichi targets and related resolutions (Decision X/31). Additionally, the Ramsar Site Management Effectiveness Tracking Tool (R-METT) (Resolution XII.15) was adopted during the Ramsar Convention. The 4th Ramsar Strategic Plan (2016–2024) recommends the implementation rate of management effectiveness evaluation (as a percentage). Since the 1990s, protected area management...
Effectiveness assessments at the site level have been implemented in several protected areas (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) for the international community (Hockings et al. 2004, 2006). In addition, the World Bank, Global Environment Fund (GEF), and Worldwide Fund for Nature (WWF) have supported the 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 is suggested that the evaluation by management entities, a regular evaluation cycle (Margoluis and Salafsky 1998), systematic participation of stakeholders and external experts, and open discussions, should be integrated for effective management. It is important to directly connect with local decision-makers with practical experience and utilize their strengths (Hockings et al. 2008). The frequently applied METT was developed to monitor management procedures at individual sites (Stolton et al. 2007); it employs a method that increases explanatory power and transparency through a scorecard survey for stakeholders. Additionally, METT is based on a self-assessment system and hence comparing it with other sites is not essential (Stoll-Kleemann 2010). With respect to the efficient use of time and economic and human resources, Mun- gua and Heinen (2021) have recently suggested a simplified hybrid format of the R-METT and Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) framework for Ramsar sites; this may be an effective way of collecting international management information.

Management effectiveness evaluation has been applied diversely in inland and offshore areas (Graces et al. 2013; Nassep et al. 2017). Mutual evaluation studies of management effectiveness evaluation tools revealed diversity in the number and types of assessors who determine evaluation methods and indicators, and designation periods of protected areas, regions, and IUCN categories (Stoll-Kleemann 2010). 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. A management effectiveness evaluation was conducted for all protected areas designated by the Ministry of Environment (Heo et al. 2010). However, since a single framework was applied to all the protected areas, there was a limitation in presenting management traits by type. As the evaluation results were presented at the basic plan level, they could not reflect the current issues of each target site.

Therefore, this study focused on protected wetland areas in South Korea. We applied the Korean framework of management effectiveness evaluation to reflect location features and national wetland management policies. Then, we identified management traits based on the evaluation groups and items of the target sites. The results of this study can help develop better national management policies for protected areas.

**Methods**

**Study Area**

Since the initial designation of four national wetland protected areas, including the Upo wetland, in 1999, 25 inland wetlands, with a total area of 129 km², have been designated as protected areas in South Korea as of 2019. There are three designation criteria for protected wetland areas: 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 value. Of the 25 sites, this study only targeted a total of 22 protected wetland areas to evaluate management effectiveness; however, three sites were excluded as basic evaluation data were not available (Fig. 1). The 22 sites included 14 mountainous wetlands (Yongneup of Mt. Daeam), six river-type wetlands (Damyang riverine wetland), and two lake-type wetlands (Upo wetland). Other than 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 management plans were established for each target site, each site had a national-level basic management system.

**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 examined IUCN’s internationally used management effectiveness evaluation framework. This study employed the IUCN framework as well as evaluation items and criteria of Ramsar-METT that partially reflect characteristics of wetland ecosystem management. Additional evaluation items, that is, safety, climate change, carbon dioxide reduction, threat factors, the conservation status of key indicator species, and habitat changes, which were newly presented in IUCN’s management effectiveness evaluation.
evaluation in 2019, were considered and supplemented in this study.

The keywords of policies presented in the 3rd Basic Plan for Wetland Conservation (2018–2022) (Fig. 2) were reviewed to identify the items and criteria pertaining to features of domestic wetland management, along with the national-level evaluation items and criteria derived by analyzing the management characteristics of domestic wetland protected areas.

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

Fig. 1 Map of the survey sites
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-assessment by internal research teams and assessment by external experts.

**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 | Nine questions + four supplementary questions | Appropriateness | 16 questions + 13 supplementary questions | Delivery | Four questions + four supplementary questions |
| Assessment method (self-assessment) | Gain score / total score (%) for design | Gain score / total score (%) for design | Two steps (form a bond of sympathy with local stakeholder) | Three steps (form a bond of sympathy with local stakeholder) |
| Assessment steps       | One-step (self-assessment) | | | | |

**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 focused primarily on data sheet 2 (Table 2), which can be quantitatively evaluated for scoring. The MEE system
| Issue     | Division     | Item                                                                 | Score | Question                                                                 |
|-----------|--------------|----------------------------------------------------------------------|-------|--------------------------------------------------------------------------|
| Design    | Context      | 1. Legal protection                                                  | 3     | Does the target wetland have a legal status?                            |
| Planning  | Planning/ Process | 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 according to 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? |
| Planning/ Process | (Supplement question) 3a |                                | 1     | Are the opinions of key stakeholders (including local residents and local NGOs) appropriately reflected, based on establishing management (conservation) plans? |
| Planning/ Process | (Supplement question) 3b |                                | 1     | After establishing a management (conservation) plan, are the results shared among stakeholders? |
| Planning/ Process | (Supplement question) 3c |                                | 1     | There are fixed plans and procedures for regular updates on the management (conservation) plans. |
| Planning/ Process | (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 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? |
| Planning/ Process | 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 (database) establishment for comprehensive environmental survey and monitoring (Supplement question) 10a | 3     | Is a DB for comprehensive environmental survey and monitoring results established? |
|           |                   | (Supplement question) 10b                                           | 1     | A DB for cultural resources such as traditional knowledge is established. |
|           |                   | (Supplement question) 10c                                           | 1     | A DB for the characteristics of the tour, such as the tour route and visiting, is established. |
|           |                   | 11. Number of employees                                             | 3     | Are there sufficient professionals with job security to manage wetlands? |
Table 2 (continued)

| Issue | Division | Item | Score | Question |
|-------|----------|------|-------|----------|
|       | 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? |
|       | Process  | (Supplement question) 12a | 1 | Job security for field managers is guaranteed. |
|       | Process  | (Supplement question) 12b | 1 | Participate regularly in wetland education. |
|       | Process  | (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? |
|       | Process  | (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? |
|       | Process  | (Supplement question) 20a | 1 | Key species (e.g., flagship species) for habitat conservation and restoration are selected. |
|       | Process  | (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? |
|       | 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? |
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, facilitating a bond of sympathy between local stakeholders and external assessors. In the third step, along with the qualitative evaluation outcomes based on self-assessment, an external assessor adjusted scores through a consensus evaluation system. In the first stage, all 22 target sites were evaluated. 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). Since the MEE prioritizes improvement through self-assessment and is not compared between target sites (Stoll-Kleemann 2010), the percentage (%) of the evaluation score was presented by

| Issue | Division | Item | Score | Question |
|-------|----------|------|-------|----------|
| (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 (m²) 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 benefit local communities systematically. |
| 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. |
counting the total score of items applied to each target area; based on this, consistent improvement was encouraged. A total of 29 evaluation items were included in the study, and supplementary evaluation was performed for the detailed items in accordance with the domestic wetland management policy (Table 2). The evaluation items were split into three sectors: design, appropriateness, and delivery. The design sector comprised nine evaluation items and four detailed items. 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) evaluates 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 planned 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 additional evaluation items: 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 management plans and policy for protected wetland areas. The delivery sector comprised four evaluation items, and four detailed items were added. Evaluation Item 27 (Conservation of Cultural Value of the Wetland) was added to evaluate whether traditional knowledge of life, religion, and culture of the residents, which has been passed down for generations, is effectively managed in target wetlands. All items in the delivery sector were added based on keywords associated with the management plan and policy for protected wetland areas.

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, classifying sites into several clusters with similar traits. Evaluation values for individual items by sector, such as design, appropriateness, and delivery, were used as dependent variables. Ward’s method (1963), which is used to determine the number of clusters, was used for clustering because it is similar to hierarchical clustering methods (Jang 2013) when group numbers are small. 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), which is applicable to two or more groups and three or more variables, was performed to confirm significant differences between groups by sector. Descriptive statistical values by group, such as mean 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 identify items that differed across the groups. Considering that the number of target sites per group was different, Scheffe’s test was used to verify homogeneity.

Results

First Step of the Management Effectiveness Evaluation Framework

Based on hierarchical cluster classification analysis, sites were classified into Groups A, B, and C. The dendrogram combined with the Ward’s method (Fig. 3) has 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. Daem (site 1), Moojechineup (site 8), Sajapyeong (site 9), Sinbulsan wetland (site 10), Hwaeom neup (site 11), and Incheon river estuary (site 20); Group B included the Upo wetland (site 21), Munkyung 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), 1,100 m altitude wetland (site 2), Dongbaekdongsan (Site 3), Muljangori-oreum (Site 4), Muljungari-oreum (Site 5), Sumeunmulbaengdui (site 6), Jang-do wetland (site 7), Dongchon estuary (site 16), and Chimsil wetland (site 17).

The average values for all 22 target sites were 20.95 ± 3.15 for the design sector, 25.95 ± 5.76 for the appropriateness sector, and 6.36 ± 2.59 for the delivery sector. As for descriptive statistics per group, the averages in the design sector were 19.67 ± 3.14 for Group A, 24.14 ± 2.61 for Group B, and 19.33 ± 1.32 for Group C; the averages in the appropriateness sector were 19.50 ± 5.21 for Group A, 29.71 ± 3.35 for Group B, and 27.33 ± 4.00 for Group C; the averages in the delivery sector were 5.17 ± 0.98 for Group A, 8.86 ± 3.29 for Group B, and 5.22 ± 0.97 for Group C. The mean value of Group B was the highest in all sectors. The standard deviation of Group A was relatively higher than that of other groups in the design and appropriateness sectors, whereas Group B had the highest standard deviation in the delivery sector (Table 3). After 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 size difference among the groups (Hair et al. 2010), was applied. Levene’s test was performed to confirm that the variance of the evaluation result values, which are the dependent variables of the three groups, was homogeneous. The significance of the difference among groups by sector of design, appropriateness, and delivery, dependent variables between groups, was recognized. Upon 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).

The analysis of the dependent variables in the design sector exhibited significant differences in five items leading to significant differences among the groups (Table 6). These were 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).

Evaluation of Target Sites of Three-Step Pilot Projects

Yongneup of Mt. Daem, 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.

In step 1 (self-assessment) evaluation of the design sector, Item 1 (Legal protection) scored 3 points; Items 2 (establishment of wetland management direction), 3 (establishment and implementation of management (conservation) plans), 8 (Implementation and reflection of the 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. After the final evaluation steps 2 (form a bond of sympathy with local stakeholders) and 3 (external expert), Item 4 received

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Fig. 3 Hierarchical clustering dendrogram

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Sajipyeong, Sinbulsan wetland, Hwaeom neup, Mooijehinesup, Yongneup of Mt. Daem, Incheon river estuary

Hwapocheon, Upo wetland, Nakdong river estuary, Munkyung Doline wetland, Gonggumji, Ungok wetland, Wolyeong wetland

Dongcheon estuary, Chirimsil wetland, Jang-do wetland, Damyang riverine wetland, Muljangori-oreum, Sumeunmulbaengdai, 1100 altitude wetland, Dongbaekdongsan, Mulyeongari-oreum

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0 5 10 15 20 25

Rescaled Distance Cluster Combine

Dendrogram Combined with Ward’s Method

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one additional point because this item indicates the need to conserve Yongneup of Mt. Daeam and its location information in the wide-area level of a higher plan. Detailed items, such as 3c and 3d, did not receive pre-evaluation scores for additional points. However, considering that 5-year management plans are established based on the Wetland Conservation Act, and that implementation evaluations of previous management plans have been implemented before setting new management plans, additional points were assigned to the detailed items in qualitative evaluations. In 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

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’s test (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 |
|---------------------|-------------|-------------|--------------------------|----------------|---------|-------------------------|
| Design              | A           | B           | -4.48*                   | 1.303          | .010    | -7.93 -1.02             |
|                     | C           | B           | .33                      | 1.234          | .964    | -2.94 3.61              |
|                     | B           | A           | 4.48*                    | 1.303          | .010    | 1.02 7.93               |
|                     | C           | A           | 4.81*                    | 1.180          | .003    | 1.68 7.94               |
|                     | C           | B           | -3.33                    | 1.234          | .964    | -3.61 2.94              |
|                     | B           | C           | -4.81*                   | 1.180          | .003    | -7.94 1.68              |
| Appropriateness     | A           | B           | -10.21*                  | 2.322          | .001    | -16.38 4.05             |
|                     | C           | B           | -7.83*                   | 2.200          | .008    | -13.67 2.00             |
|                     | B           | A           | 10.21*                   | 2.322          | .001    | 4.05 16.38              |
|                     | C           | A           | 2.38                     | 2.103          | .538    | -3.20 7.96              |
|                     | C           | B           | 7.83*                    | 2.200          | .008    | 2.00 13.67              |
|                     | B           | C           | -2.38                    | 2.103          | .538    | -7.96 3.20              |
| Delivery            | A           | B           | -3.69*                   | 1.122          | .014    | -6.67 -0.71             |
|                     | C           | B           | -0.6                     | 1.063          | .999    | -2.88 2.76              |
|                     | B           | A           | 3.69*                    | 1.122          | .014    | 0.71 6.67               |
|                     | C           | A           | 3.63*                    | 1.016          | .008    | .94 6.33                |
|                     | C           | B           | 0.06                     | 1.063          | .999    | -2.76 2.88              |
|                     | B           | C           | -3.63*                   | 1.016          | .008    | -6.33 2.94              |
and education programs) scored 2 points. Items that scored 1 point were: 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. Following the final evaluation via Steps 2 and 3, the evaluation results were corrected for items 12, 16, and 17. One point was assigned to the detailed items 12a and 20b in the same manner as the self-assessment; evaluation scores were corrected for other detailed items. In 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 Item 26 (Status on key management targets), Item 27 (Conservation of cultural values of wetlands), and Item 29 (Capacity building) scored 1 point. One additional point was assigned to the detailed items 29a and 20b; evaluation scores were corrected for other detailed items via Steps 2 and 3 (Fig. 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%.

In 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 the comprehensive environmental survey), scored 2 points. Three items, 4 (Establishment and implementation of wide-area management plan), 6 (wetland management boundaries), and 9 (monitoring detailed items and their reflections) scored 1 point. Item 7 (setting management (use) district) scored 0 points. In 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 a consensus and reviews from external experts. An additional point was assigned to 3c in both self-assessment and external expert evaluation, with no other additional points assigned to other detailed items.

In 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; and Items 10 (DB establishment for comprehensive environmental survey and monitoring), 20 (Habitat restoration project), and 25 (Wetland management governance) scored 0 points. In the final evaluation via Step 2 and Step 3, the self-assessment results for Items 12, 13, 14, 15, 19, and 21 were corrected; one point was assigned to the detailed item, 12a, but no scores were assigned to other detailed items.

In 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 Items 28 (Revitalization of the local economy) and 29 (Capacity building) scored
1 point. Via Steps 2 and 3, items 26, 27, and 29, were corrected, and no additional points were assigned. In particular, in the case of this target site, the current management level was overestimated to a certain degree during the self-assessment, or there was a lack of understanding due to the rotation of managers (Fig. 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%). In 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 the 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). In the final evaluation via Steps 2 (form a bond of sympathy with local stakeholders) and 3 (external specialist), Items 7, 8, and 9 were corrected. Additional points were attributed to detailed items 3a, 3c, and 3d. In 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. In 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. In Step 1 (self-assessment) evaluation in the delivery sector, Items 26 (status on key management targets) and 29 (capacity building) scored 3 points. In contrast, Item 27 (conservation of cultural value of wetland) and item 28 (revitalization of the local economy) scored 2 points. The self-assessment scores of Items 27 and 29 were corrected through step 2 and Step 3, and additional points were given to detailed items 26a and 29a (Fig. 6).

Discussion

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. Additionally, the evaluation manual provided by other organizations, such as the World Wide Fund for Nature (Stolton and Dudley 2016), describes the direction of operation: the application of MEE in different nations, regular evaluation of management status, evaluation by diverse stakeholders, creation of consensus (local community participation), capacity strengthening of assessors, guideline preparation, and the establishment of a self-assessment-based procedure to verify external assessors. This is also
in line with the operation direction of MEE that were suggested in previous studies (Margoluis and Salafsky 1998; Stoll-Kleemann 2010).

The results of this study are significant because the MEE was applied to protected wetland ecosystems in South Korea; and it included specific evaluation items and was applied on a trial basis after considering the national environment and policies. Considering the characteristics of domestic wetland management, the design sector had two additional evaluation items and one additional detailed item; the appropriateness sector had three additional evaluation items and 13 additional detailed items, and the delivery sector had one additional evaluation item and four additional detailed items. In particular, previous MEE studies on protected areas in South Korea (Heo et al. 2010) suggested status identification at a basic plan level because when a single evaluation framework was applied to diverse ecosystem types, it limited the identification of ongoing issues for each target site. However, this study is significant because a three-step evaluation procedure was applied to the pilot target sites; this suggests the direction of intensive management for different sectors, that is, design, appropriateness, and delivery, at the management plan level. To avoid and reduce incomplete responses (Zimsky et al. 2010), the items should reflect the national and local policy and management situation.

According to Stoll-Kleemann (2010), the evaluation framework of management effectiveness differs depending on IUCN categories. Appropriate evaluation items and criteria must be set taking into consideration the types of protected areas, characteristics of ecosystems, and national policy and environment.

Primary local efforts are necessary for continuous improvement. However, at the national level, presenting basic policy data is meaningful for preferential support for areas requiring intensive management by the group after target sites are grouped based on the first evaluation (self-assessment). In this study, the evaluation values

Fig. 5 Evaluation of the results for Damyang riverine wetland

Fig. 6 Evaluation of the results for Upo wetland
were higher in Group B than in the other groups in all sectors. Group A required intensive management, as it showed relatively low values in all sectors. Group C had median values that required intensive management in the design and delivery sectors. However, there were variations among the target sites. In addition, several factors led to the differences in the evaluation items among the sites in the same group. For example, if no system had been developed for implementation evaluation after establishing the management plan in the design sector, or a system had been developed, but had slow implementation, the target sites scored low, leading to large differences between target sites. The target sites also scored low when there were no defined management districts, such as core, buffer, and transitional areas for protected wetland areas. Target sites with low local community awareness of wetland management boundaries had lower scores. In the appropriateness sector, factors which lowered the evaluation values were highlighted for each target site. These factors included lack of databases related to natural ecosystems, tours, and traditional knowledge; lack of sharing with the local community; and absence of a systematic education system for employees. In the case of the visitor center, even when infrastructure was present, if the local community could not participate in creating or organizing content, the site would have received a low score.

Furthermore, plans were developed but field research was not conducted, the target site received a low score, leading to significant differences between target sites. The public relations levels for touring, education programs, and raising awareness also led to significant differences between target sites. In the delivery sector, social enterprises that revitalized the local economy positively impacted the evaluation; evaluation scores vastly differed by target site depending on the establishment of a stakeholder’s capacity strengthening program. Therefore, the sector’s national support program and budget establishment for priority management items should be simultaneously implemented.

**Essential Factors to Establish an Integrated Management System**

Systematic management of protected areas requires an integrated management system encompassing investigation and monitoring, the establishment of basic and management plans, and MEE. Based on the Wetland Conservation Act, here are stipulations for protected wetland areas in South Korea, such as 5-year detailed investigations and establishment of basic and management plans. The Regional Environment Agency annually monitors individual sites in accordance with the 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, regulating MEE is necessary. To this end, although the ultimate goal is voluntary management, there is a need for legal guidelines until policy stabilization for evaluation implementation is achieved. National level participation is necessary, alongside the development of a MEE manual specifying stakeholder roles and methods for evidence collection to obtain clear evaluation results. Although an effective and simple hybrid format (Munguía and Heinen 2021) was suggested for wetlands, it is not applicable to all cases, and depends on the management strength at the system or site level. If a strong management system establishes a regular management plan, detailed study, and monitoring system on site and is legally supported nationally, it fits the METT frame with detailed items reflecting the national management policy and natural areas corresponding with the integrated management system interactions among monitoring in various areas, management effectiveness evaluation for resolving the issues for management plan, and regular management plan. We found that although the steps and items used for this study seem complex, they could help identify local issues with stakeholders.

**Importance of Creating Governance with Stakeholder Engagement**

This study used a three-step evaluation procedure. The first step was self-assessment conducted by management and administration-related stakeholders. The second step was a discussion forum which included the Ministry of Environment, residents, NGOs, and local governments, along with external experts who had reviewed the self-assessment report. This step was crucial in understanding field conditions through consensus forming; after the experts participated in the discussion forum and asked intensive questions regarding the items, the evaluation scores required re-examination or the self-assessment scores were 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. The open conversation draws out the strength of the target sites. Especially, collective evaluation by stakeholders, which builds a bond of sympathy, plays a key role in reducing bias and subjectivity (Carbutt 2013).

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-assessment was relatively inaccurate, and it was difficult to form a consensus and ask questions.

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Participation of External Experts is Required

This study presented a three-step evaluation procedure, and external experts reviewed the self-assessment in the third step. The expert pool mainly consisted of experts in the field of wetland conservation and management. Participation of experts with little experience in other protected areas would limit their ability to effectively assess the sites, since experts rely on their knowledge and experience of the subject and reflect local specificity and environments. In this regard, we confirmed that the participation of external experts experienced in wetland management policy aided in understanding the relationship between evaluation items and national wetland policy and local stakeholders; this also aided in asking 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 consistent with international community principles which require self-assessment as well as, external expert reviews (Stolton and Dudley 2016).

Conclusions

This study aimed to efficiently identify 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 of the data, the results showed that Group B had the highest average value among the three groups. Through pilot site selection for each group and a second- and third-stage evaluation (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. Based on the comprehensive evaluation process, four important suggestions were derived. First, management effectiveness evaluation should include the characteristics of the 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 accomplished. The results revealed that site-level evaluation presented specific directions for establishing management plans. In addition, through grouping according to the management level, areas, and evaluation improvement items, the management practices were improved. We confirmed that the evaluation framework reflected the domestic environment efficiently without significantly increasing evaluation items by supplementing additional detailed items. Second, it is important to establish an integrated management system. A feedback system between the investigation, monitoring, and management plan establishment stages alongside with management effectiveness evaluation that must be established. Additionally, site-level management plans must be supported by national policies, to ensure the effectiveness of basic plans. Third, governance must include stakeholder participation. For local stakeholder and external expert verification in the second stage, errors in evaluation resulted in the resolution of misunderstandings between the stakeholders, as their opinions were comprehensively gathered. Fourth, we confirmed that the participation of external experts was helpful in verifying exaggerated or distorted assessments.

This study provides important insights into the national level approach towards establishing the framework of management effectiveness evaluation, which is an internationally-recommended tool for improving protected area management. 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. This study provides an important reference for developing and applying the management effectiveness evaluation framework in other countries.

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