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# Integrating Management Effectiveness and University Social Responsibility: A Co-Learning Model for Qingluo Wetland

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## Abstract

This study evaluates the management effectiveness of the Qingluo Wetland in Penghu, Taiwan, with the aim of identifying its governance strengths and challenges as a "nationally important wetland." The site possesses significant ecological value and plays multiple roles in supporting sustainable local development and social participation. However, its island geography and competing land-use demands impose considerable constraints on management, particularly in balancing conservation objectives with local development pressures. The study employs the Management Effectiveness Tracking Tool as its analytical framework, applying 30 indicators across five dimensions—planning, inputs, process, outputs, and outcomes—scored on a scale from 0 to 3. Based on focus group interviews with key stakeholders, the results indicate a moderate level of management effectiveness (average score = 0.62). While the wetland performs relatively well in terms of legal status and conservation objectives, notable deficiencies remain in staffing, financial stability, community engagement, and threat management. Beyond providing targeted recommendations, this study highlights the importance of incorporating island-specific governance contexts and strengthening cross-sectoral co-management mechanisms. Furthermore, by examining the involvement of the National Penghu University of Science and Technology, the research demonstrates how university social responsibility initiatives can function as knowledge intermediaries, bridging governance gaps through student engagement and community co-learning. The findings offer practical insights for advancing sustainable management and regional revitalization in similar offshore wetland contexts.

## Keywords

collaborative governance; island wetland governance; Qingluo Wetland; university social responsibility

## 1. Introduction

In the global context of climate change, biodiversity loss, and wetland degradation, the importance and complexity of wetland governance have drawn increasing attention. As critical providers of ecosystem services, wetlands regulate climate, conserve water resources, and play essential roles in sustaining biodiversity and supporting human well-being. While international frameworks such as the Ramsar Convention emphasize "wise use," many protected areas worldwide struggle with management effectiveness gaps due to resource scarcity. Since Taiwan launched its wetland conservation policy in 2001, a hierarchical "Nationally Important Wetlands" system has gradually been established. Among them, the Qingluo Wetland in Penghu was designated a national-level wetland in 2015, highlighting its significance in ecological conservation and coastal sustainability.

However, as a typical offshore island site, the Qingluo Wetland faces multifaceted governance challenges stemming from its insular geography and fragile landscape. The management practices are often caught in a tug-of-war: On one hand, there are strict conservation mandates for indicator species; on the other, there are pressing demands for local recreation and economic development. This tension, exacerbated by limited human resources and financial dependence, often results in fragmented and contradictory governance outcomes. Thus, systematically assessing its current governance status and fostering local co-learning have become critical issues for both practice and scholarship.

This research presents a case study on the integration of university social responsibility (USR) into the governance of protected areas. It employs the internationally recognized Management Effectiveness Tracking Tool (METT) as a diagnostic framework to systematically evaluate the site's operational performance. In parallel, the study builds on literature concerning higher education sustainability and collaborative governance, which emphasizes universities as boundary-spanning actors within socio-ecological systems (Lozano et al., 2013; Trencher et al., 2014; Etzkowitz & Leydesdorff, 2000). By involving students in project-based learning and ecological education, the study examines how USR can complement formal management efforts.

This study fills a critical research gap in island wetland governance. Unlike mainland wetlands, island sites face higher degrees of isolation and resource constraints, making the governance gap more pronounced. The findings aim to serve as an integrative reference for policy implementation and academic dialogue, demonstrating how wetland governance can transition from a top-down regulatory approach toward a resilient model of co-learning and co-management that is applicable to similar coastal and island contexts globally. To provide spatial context for the study area, Figure 1 illustrates the geographic location and habitat zoning of the Qingluo Nationally Important Wetland, including its regional setting within the Taiwan Strait and key ecological zones.

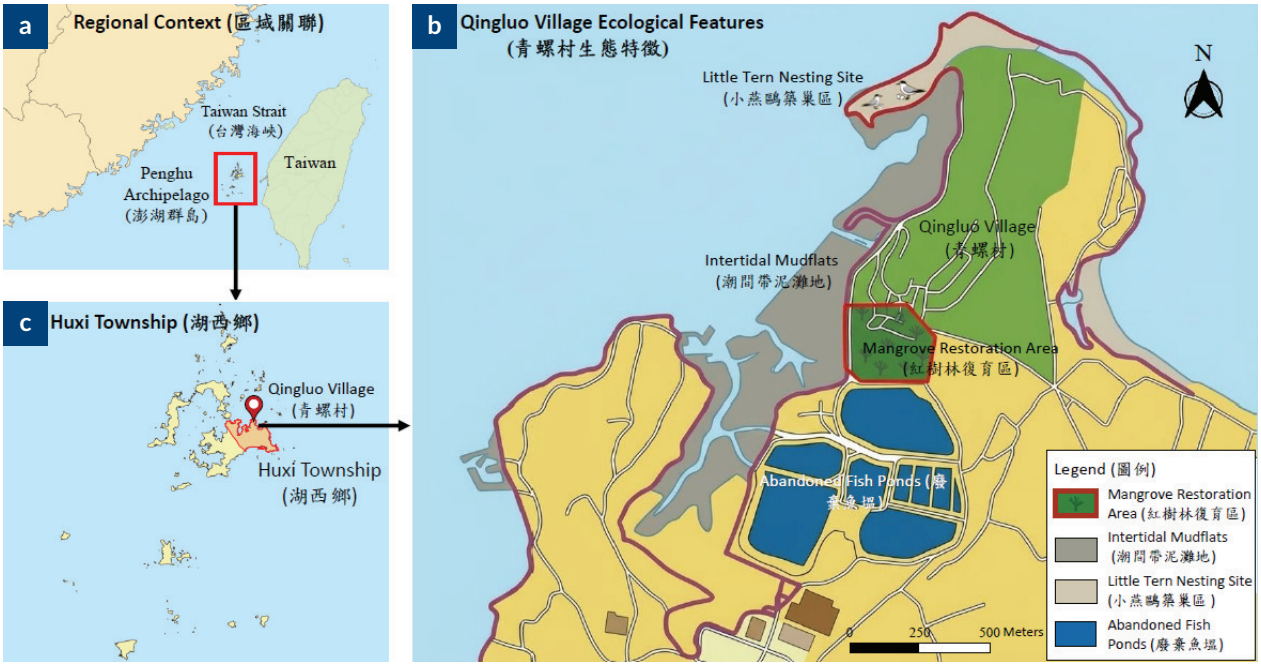


**Figure 1.** Geographic location and habitat zoning of the Qingluo Nationally Important Wetland: (a) location of the Penghu Archipelago within the Taiwan Strait; (b) spatial extent of the 55-hectare wetland in Huxi Township; (c) detailed zoning and key ecological features, including mangrove restoration areas, intertidal mudflats, and nesting habitats of the little tern (*Sterna albifrons*). Note. Adapted from national wetland conservation report, by Construction and Planning Agency (2024).

## 2. Literature Review

### *2.1. Wetland Governance: From Control to Collaboration*

Wetlands are critical providers of ecosystem services and play an essential role in climate regulation and biodiversity conservation. Since the adoption of the Ramsar Convention on Wetlands in 1971 (Ramsar Convention Secretariat, 2013), global wetland management has gradually shifted from a strict resource control model toward collaborative governance and ecosystem-based management. Although Taiwan is not a contracting party to the Ramsar Convention, the Wetland Conservation Act has established a graded management system since 2001. Previous research indicates that effective governance depends on adaptive capacity and multi-stakeholder participatory mechanisms (Ostrom, 2009; Reed, 2008). Effective governance increasingly relies on adaptive co-management, which emphasizes knowledge generation and social learning among bridging organizations (Armitage et al., 2009; Berkes, 2009).

### *2.2. The METT Framework in Island Contexts*

The METT, developed by the IUCN and the World Bank, is a globally recognized diagnostic framework for protected areas. It evaluates governance through five dimensions: planning, inputs, process, outputs, and outcomes. While METT has been applied to over 3,000 sites worldwide (Leverington et al., 2010), its application in offshore island wetlands remains limited. This study employs METT not only as an assessment tool, but also to identify the governance gaps specific to insular environments—where financial and human resource inputs often lag behind legal designations.

### 2.3. USR as a Complementary Governance Mechanism

USR expands the role of higher education from traditional teaching to active social and environmental engagement. According to Wang and Lin (2018), USR integrates ethical responsibility and knowledge contribution into local contexts. In wetland governance, universities act as knowledge nodes, using curriculum design and citizen science to bridge the gap between academic research and community needs (Huang, 2019; Li, 2019; Lin, 2020). This aligns with broader perspectives on co-learning governance, which emphasize iterative knowledge exchange between institutions and communities (Trencher et al., 2014).

This study conceptualizes USR as a locally grounded complement to formal governance. By documenting the engagement of NPU in the Qingluo Wetland, we propose an integrated framework where USR practices compensate for the low "input" and "process" scores often revealed by METT evaluations, thereby fostering a model of co-learning and co-management.

## 3. Research Methods

### 3.1. Study Area: Overview of the Qingluo Wetland, Penghu

The Qingluo Wetland is located along the coast of Qingluo Village in Huxi Township, Penghu County. It is a typical intertidal mudflat wetland covering approximately 55 hectares and was designated as a "Nationally Important Wetland" in 2015 under the Wetland Conservation Act of Taiwan. This designation functions as a protected-area status, managed by the Interior Ministry's Land Administration Office in coordination with the Penghu County Government. Governance is dictated by the Qingluo Wetland Conservation and Utilization Plan, which mandates the protection of core habitats while allowing for "wise use" in peripheral zones. However, enforcement remains complex due to overlapping jurisdictions between fisheries, tourism, and environmental bureaus.

The Qingluo Wetland encompasses mangroves, halophytic plant communities, intertidal algae, and habitats for protected species such as the little tern (*Sterna albifrons*) and the tri-spine horseshoe crab (*Tachypleus tridentatus*), reflecting the broader ecological characteristics of the Penghu marine environment (Marine National Park Headquarters, 2016). These ecosystems are embedded within a wider socio-ecological system shaped by long-term fisheries practices and marine resource utilization in Penghu (Fisheries Research Institute, 2024).

Beyond its ecological value, the wetland is also situated within a socially embedded landscape. The implementation of community co-learning workshops follows established USR models that bridge higher education with regional revitalization (Huang, 2019; Li, 2019). In this context, the use of visual and participatory learning tools—such as mind mapping and other interactive approaches—has been shown to enhance environmental awareness and facilitate stakeholder engagement (Lozano et al., 2013; Reed, 2008).

In addition, the cultural significance of the area, including local beliefs and traditional seaweed harvesting practices, has been documented as an integral component of the region's socio-ecological fabric (Cai, 2015; H. Zhang, 2017; Z. Zhang, 2017).

### 3.2. Research Framework and Data Collection Methods

This study adopts a mixed-methods case study approach, integrating the METT with an analysis of USR practices. To ensure academic rigor and transparency, the following sections describe the procedures that were implemented.

#### 3.2.1. METT Assessment and Focus Group Discussions

The METT component applies the 2016 assessment framework, comprising 30 indicators across five dimensions—planning, inputs, process, outputs, and outcomes—each scored on a scale of 0 to 3 based on specific criteria defined by the IUCN. The scoring was conducted through a consensus-building process during two focus group meetings held between May and June 2024. To provide an overview of the study participants, Table 1 summarizes the composition and background of the focus group members ($N = 12$).

**Table 1.** Composition of focus group participants ($N = 12$).

| Sector | Representing Organizations | No. of Participants |
|---|---|---|
| Government | Penghu County Bureau of Agriculture and Fisheries; Environmental Protection Bureau | 2 |
| Community | Qingluo Community Development Association; local volunteer groups | 4 |
| NGOs | Wetland conservation-focused NGOs | 3 |
| Academia | NPU; local high schools | 3 |
| Total | | 12 |

#### 3.2.2. USR Data Collection for the USR Component

The study analyzed documentation from NPU projects conducted between 2021 and 2024. Data were selected based on their direct relevance to wetland governance, including student fieldwork reports, course-based project outcomes (e.g., interpretive maps), community workshop records, and citizen science survey data. This allows for a cross-comparison between formal governance performance and university-led action-oriented interventions.

#### 3.2.3. Research Ethics and Data Analysis

Adhering to research ethics, all participants provided informed consent prior to the focus groups. Participants were informed of the study's purpose, their right to withdraw, and the guaranteed anonymity of their contributions. Quotations used in the results were de-identified to protect participant privacy. Quantitative METT scores were synthesized and visualized through radar and bar charts to highlight performance gaps. Qualitative data from focus group transcripts and USR documents were analyzed using content analysis to identify key themes (e.g., "resource shortage," "knowledge gaps"). This integrative analysis examines how USR initiatives fill the governance gaps revealed by the METT evaluation.

## 4. Research Results and Analysis

This section presents the management effectiveness evaluation of the Qingluo Wetland based on the five dimensions of the METT. It further analyzes the impacts of USR initiatives and synthesizes their potential to fill identified governance gaps.

### *4.1. Evaluation Results of the Five METT Dimensions*

The assessment followed the 2016 METT framework. Based on these indicators, the Qingluo Wetland achieved an overall management effectiveness index of 0.62. While the score reflects "moderate" performance, qualitative feedback from stakeholders reveals a more nuanced picture of progress and resilience. Table 2 provides a detailed score breakdown, and Figure 2 illustrates the dimension-based performance.

**Table 2.** Detailed METT indicator scores for Qingluo Wetland (2024).

| Dimension | Indicator | Score (0–3) | Key Observations |
|---|---|---|---|
| Planning | Legal Status | 3 | Designated National Importance in 2015. |
| | Management Plan | 2 | Plan exists but lacks long-term vision. |
| | Land/Water Use | 2 | Coordination with spatial planning in progress. |
| Inputs | Staffing Levels | 1 | Reliance on volunteers; no permanent staff. |
| | Current Funding | 1 | Dependent on annual government subsidies. |
| | Resource Inventory | 3 | Comprehensive ecological data available. |
| Process | Local Participation | 0 | Lack of institutionalized co-management. |
| | Law Enforcement | 2 | Routine patrols present but enforcement is weak. |
| | Climate Adaptation | 0 | No specific climate strategy for the wetland. |
| Outputs | Threat Reduction | 2 | Issues with marine debris and stray dogs. |
| | Education Program | 1 | Ceremonial events rather than systematic curricula. |
| | Visitor Facilities | 1 | Infrastructure remains underdeveloped. |
| Outcomes | Natural Values | 3 | Indicator species (little terns, fiddler crabs) show stable breeding. |
| | Habitat Status | 2 | Anthropogenic disturbances (tourism) persist. |

#### 4.1.1. Planning: Legal Foundation and Vision Ambiguity

The high scores in legal status and objectives (3 points) reflect the site's stable status as a national-level wetland. However, stakeholders highlighted a lack of long-term strategic clarity. As one participant noted, the absence of a visible roadmap makes it difficult to align local development with conservation.

#### 4.1.2. Inputs: Resource Scarcity and Volunteer Dependency

This dimension remains the weakest link (scoring 1 point in staffing and funding). Management is heavily dependent on external subsidies and local goodwill. Participants expressed concerns that without permanent, professional conservation staff, the long-term monitoring of the site's ecological health remains precarious.

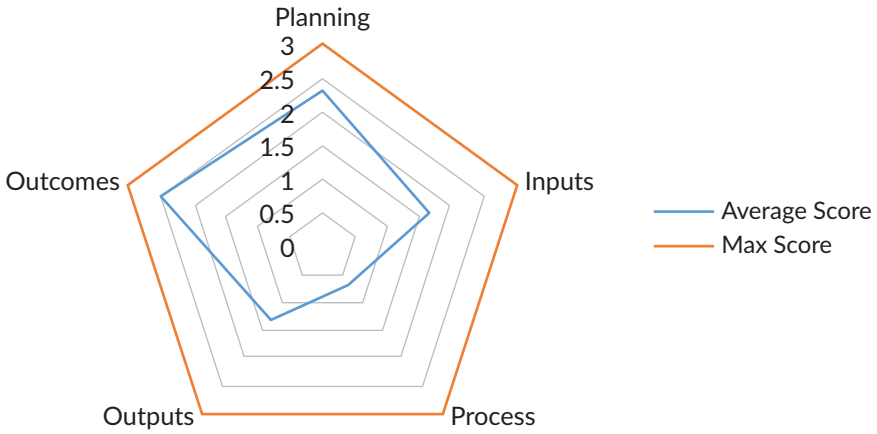


**Figure 2.** Radar chart of management effectiveness across the five METT dimensions. The chart illustrates a significant performance gap where Planning and Outcomes remain strong, while Process and Inputs represent the primary governance challenges in the Qingluo Wetland.

#### 4.1.3. Process: Strategic Intervention and Active Management

In the process dimension, the study found that active management measures have begun to show results. Indicators such as resource management (2 points) are supported by strategic interventions. One participant highlighted the benefits of active habitat maintenance:

> Moderate thinning is actually beneficial to the wetland. It is not just about visual openness; it allows the entire ecosystem to restore its original functions. (Participant F)

Another stakeholder emphasized that "protection" should not be equated with "non-interference":

> Conservation doesn't mean doing absolutely nothing. Proper intervention actually helps biodiversity, and we can clearly see the effects of this in the Qingluo Wetland. (Participant G)

#### 4.1.4. Outputs: Institutionalizing Visibility and Awareness

While threat reduction (2 points) and education programs (1 point) show progress, they lack institutionalized tracking. Despite these gaps, the overall output is perceived as positive in terms of preventing further environmental decline. As a summary of recent efforts, one manager remarked:

> Although there is still room for improvement in habitat conditions, overall, the management of the Qingluo Wetland in recent years has been effective; at the very least, it has successfully prevented the degradation of resources. (Participant L)

#### 4.1.5. Outcomes: Ecological Stability and Asset Evaluation

The Qingluo Wetland excels in its outcome indicators, particularly in key species conservation (3 points). Stakeholders provided strong evidence of a positive trajectory:

> From our observations, the Qingluo Wetland is not yet at its ideal habitat state, but we have seen clear improvements over the past few years. As management measures have been implemented, the overall ecological environment has become more stable than before. (Participant A)

Comparing the current state with the past, another participant noted:

> Compared to five years ago, the current habitat conditions have progressed. Although there are still structural issues to address, the site is no longer in a state of neglect. (Participant B)

Indicators of health are particularly tied to natural and cultural assets. Fiddler crabs, a key indicator species in Qingluo, serve as a benchmark:

> Natural environments, cultural backgrounds, and indicator species like fiddler crabs have not shown significant degradation. This suggests that the general direction of management has been correct. (Participant I)

Another expert added:

> The population and activity levels of fiddler crabs have remained stable without a noticeable decline, which is a critical basis for our judgment of the wetland's health. (Participant J)

### *4.2. USR Actions: Filling the Governance Gaps at Qingluo Wetland*

While the METT assessment in Section 4.1 identified significant gaps in "inputs" and "process," the analysis of USR projects (2021–2024) conducted by the NPU reveals how academic intervention serves as a critical governance supplement. These actions are categorized into three strategic dimensions, presented in the next three sections.

#### 4.2.1. Addressing "Inputs" Gaps Through Citizen Science and Student Engagement

The METT evaluation revealed a critical shortage of permanent staff and consistent funding (scores of 1). To compensate, NPU utilized its USR framework to mobilize students as a flexible conservation workforce. Between 2022 and 2024, over 150 students participated in systematic ecological monitoring as part of their coursework. By utilizing citizen science tools (e.g., iNaturalist) to document the population dynamics of the fiddler crab and the little tern, the university provided the high-resolution longitudinal data that the formal management office lacked due to budget constraints. This effectively transformed a low-input situation into a data-rich environment through academic resource reallocation.

#### 4.2.2. Strengthening the "Process" Through Community Co-Learning

The lowest score in the METT assessment was assigned to "local participation" (score of 0), reflecting a top-down management style that alienated residents. NPU's USR initiatives acted as a neutral intermediary through the establishment of community co-learning workshops. Instead of ceremonial lectures, these workshops utilized project-based learning, where students and residents co-created interpretive materials

and sustainable tourism maps. This process moved the community from passive subjects to active knowledge partners, creating a platform for dialogue between government bureaus and local stakeholders that had previously been absent.

#### 4.2.3. Enhancing "Outputs" via Educational Innovation

METT scores for "education programs" were low (score of 1) because existing government-led programs were often sporadic. NPU addressed this by institutionalizing ecological education. Key outputs included:

1. Curriculum integration: Developing 12 specialized lesson plans based on the Qingluo ecosystem for local elementary schools.
2. Technological application: Implementing QR-code-based interpretive systems and digital storytelling to increase the wetland's visibility among younger generations.
3. Waste management initiatives: Organizing design-thinking workshops to repurpose marine debris collected during beach cleanups into local handicrafts, directly addressing the threat management gap identified in Section 4.1.4.

### *4.3. Synthesis: USR as a Governance Intermediary*

Based on an integrated analysis of empirical findings and prior literature on USR and co-learning governance (Huang, 2019; Li, 2019; Lin, 2020), this study finds that university involvement functions as a governance intermediary within the broader socio-ecological system. Specifically, USR initiatives facilitate knowledge exchange, enhance local engagement, and support adaptive governance processes.

By bridging scientific knowledge and local ecological practices, universities help reduce the disconnect between formal policy frameworks and community-based realities. This intermediary role enables more responsive and context-sensitive governance, particularly in resource-constrained island settings. The resulting tripartite collaboration—where government provides institutional structure, universities contribute with intellectual and human capital, and communities offer local ecological knowledge—constitutes a resilient model for addressing the structural limitations of island wetland governance.

#### 4.3.1. Visualization of the Governance Compensation Effect

By overlaying the USR intervention data onto the METT dimensions, a clear compensation effect is observed. While the "inputs" and "process" dimensions initially showed the lowest performance due to resource scarcity, the USR actions—such as student-led monitoring and community workshops—effectively functioned as a "bridge," elevating the site's operational capacity without requiring immediate increases in government subsidies.

#### 4.3.2. The Tripartite Governance Framework

Based on the synthesis, this study proposes a tripartite collaboration model for island wetland governance. In this model:

1. Government (the anchor): Provides legal status, long-term conservation objectives, and basic infrastructure ("planning" and "outcomes").
2. University (the knowledge node): Provides human capital, data monitoring, and educational innovation, filling the "input" gaps.
3. Community (the context provider): Provides traditional ecological knowledge (TEK) and local participation, ensuring the sustainability of management processes ("process").

The synthesis demonstrates that when a university acts as a collaborative partner, it significantly lowers the threshold for effective governance in remote island contexts, creating a social-ecological buffer against resource fluctuations.

## 5. Discussion and Recommendations

### *5.1. Challenges in Governance Practice Revealed by METT Gaps*

The METT assessment of the Qingluo Wetland reveals a common paradox in protected area management: a strong legal framework ("planning") but weak operational execution ("inputs" and "process"). With an effectiveness index of 0.62, the site faces significant capacity shortfalls, particularly in staffing and financial security. These findings align with the global analysis by Gill et al. (2017), which argued that adequate staffing and budget are the most critical predictors of conservation success. In the case of Qingluo, the reliance on unpaid volunteers and temporary subsidies reflects a systemic institutional difficulty common in offshore island regions. Furthermore, while policy advocacy emphasizes community participation, the METT results show it remains largely passive. This lack of substantive co-management mechanisms limits the social resilience of the wetland, making it difficult to translate conservation objectives into local well-being.

### *5.2. The Potential of USR Actions as a Collaborative Bridge*

Compared with the limitations of conventional top-down governance, USR initiatives offer a "third path" of governance that acts as a complementary supplement. This study demonstrates that USR practices address METT-identified gaps in three primary ways. First, USR teams improve information transparency by building ecological databases through citizen science, which compensates for the lack of formal monitoring staff. Second, they deepen community engagement by acting as neutral intermediaries, facilitating two-way exchanges between residents and management agencies. Finally, USR functions as a platform for cross-sectoral collaboration, aligning the diverse needs of local schools, government bureaus, and NGOs. These actions transform the university from a mere educational institution into a knowledge node that bridges the gap between conservation policy and local practice.

### *5.3. Comparison: Island vs. Inland Wetland Governance*

It is important to consider the geographical specificity of these results. Unlike inland wetlands that may have access to larger urban resources and diverse funding streams, island wetlands such as Qingluo are characterized by geographical isolation and a smaller, more centralized stakeholder base. In such contexts, the governance gap is often more acute because the failure of a single government subsidy can stall all management activities. Consequently, the role of a local university becomes even more vital in offshore

regions. The university provides a stable, long-term intellectual presence that can sustain monitoring and education efforts even when political or financial cycles fluctuate. This suggests that the USR-integrated governance model proposed here is highly relevant for other small-island developing states or remote coastal protected areas globally.

### *5.4. Study Limitations and Future Perspectives*

Despite the insights gained, this study has certain limitations. First, as a single-case study focused on the Qingluo Wetland, the results may not be directly generalizable to all types of protected areas without local adaptation. Second, the METT assessment relies on the consensus of a specific focus group; different participants might produce slightly different scores. Finally, the project-based nature of USR initiatives means that their long-term sustainability is not guaranteed. Future research should involve multi-site comparisons across different island wetlands in Taiwan and abroad. Additionally, developing a standardized set of USR performance indicators that can be integrated into the formal METT framework would provide a more robust tool for managers to evaluate the impact of academic partnerships.

### *5.5. Governance Recommendations*

Based on the findings, this study proposes three strategic recommendations for future wetland governance:

1. Institutionalize assessment mechanisms: Management agencies should regularly implement METT evaluations to move beyond "ceremonial conservation" and establish data-driven policy reviews.
2. Formalize university–government partnerships: USR initiatives should transition from short-term projects to long-term collaboration agreements, ensuring that student engagement and research outcomes are officially recognized within management plans.
3. Establish co-learning platforms: Fostering a co-governance culture requires ongoing dialogue among residents, faculty, and managers. By transforming the wetland into a shared learning space, stakeholders can co-create knowledge and shift from conflict-oriented to collaboration-oriented management.

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## Conflict of Interests

The authors declare no conflict of interest.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical restrictions involving the participants of the focus group interviews.

## LLMs Disclosure

Gemini 1.5 was used during the preparation of this manuscript for the purpose of language editing, structural refinement of the abstract, and translation assistance. The authors reviewed and edited the content as needed and take full responsibility for the content of the published work.

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