The Wallacea Wetland Research Collaboration Center: A Nexus for Ecosystem Data, Biodiversity Insights, and Management Strategies

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Abstract. The Wallacea Wetland Research Collaboration Center was founded in 2024 through BRIN's Research Collaboration Center Program, in partnership with Halu Oleo University and BRIN's Research Center for Limnology and Water Resources. It focuses on wetland ecosystems in Wallacea—covering Sulawesi, Nusa Tenggara, and Maluku—regions rich in biodiversity and endemism but still underexplored. The center integrates ecosystem data, assesses biodiversity, and develops inclusive wetland management strategies. Through interdisciplinary collaboration, it promotes ecological data collection, biodiversity synthesis, and adaptive frameworks that blend global conservation principles with local wisdom. Addressing challenges like habitat degradation, climate resilience, and fair resource governance, the center emphasizes wetlands as vital yet often overlooked ecosystems. Rooted in scientific diplomacy, social justice, and community empowerment, it fosters knowledge exchange, policy dialogue, and capacity building among academic and local stakeholders. Ultimately, it envisions wetlands as both ecological treasures and socio-cultural landscapes where biodiversity and community livelihoods thrive together.

Key words: aquatic ecosystems, collaboration, wetlands, wallacea

1 Introduction

The Wallacea region, encompassing Sulawesi and its surrounding islands, represents a biogeographic transition zone of exceptional ecological significance. Despite its rich biodiversity and high levels of endemism, Wallacea's freshwater wetlands—particularly swamps—remain underrepresented in scientific literature and policy discourse. These ecosystems play a vital role in regulating hydrological cycles, supporting food security, and sustaining local livelihoods, yet they are increasingly threatened by land conversion, pollution, and neglect. Globally, wetlands are recognized as among the most productive and multifunctional ecosystems. Swamps, as a subset of wetlands, serve as carbon sinks, flood regulators, habitats for migratory species, and sources of traditional knowledge and cultural practices [1].

In Indonesia, swamp ecosystems in Wallacea hold untapped potential for ecological resilience and community empowerment, yet they lack systematic documentation and integrated management frameworks [2]. In Southeast Sulawesi, the degradation of these ecosystems is accelerating due to insufficient data, fragmented governance, and limited public awareness. Without robust scientific monitoring and inclusive planning, they risk being lost—along with the vital services they provide. The vulnerability of Wallacean wetlands to climate change and anthropogenic pressures has been well documented, but policy responses remain inadequate. Addressing this gap requires a strategic, interdisciplinary approach that bridges limnology, socio-ecological research, and policy innovation. This paper argues for the urgent establishment of a collaborative research center dedicated to Wallacean wetlands. Such a center would serve as a hub for data integration, stakeholder engagement, and evidence-based policy development—positioning Indonesia as a regional leader in sustainable wetland management.

2 Methods

The methodology of this article adopts a qualitative, exploratory approach that integrates desk study, focus group discussions (FGDs), SWOT analysis, and gap analysis to formulate strategic directions for the establishment of the Wallacea Wetland Research Collaboration Center. The desk study involved a comprehensive review of scientific literature, policy documents, and spatial data related to wetland ecosystems in the Wallacea region, particularly in Southeast Sulawesi, to identify degradation trends, socio-ecological functions, and conservation frameworks [3]. FGDs were conducted in October 2024 and July 2025 at Halu Oleo University, the Research Center for Limnology and Water Resources–BRIN, Hasanuddin University, and Tadulako University. Each FGD engaged around 50 participants, including researchers, lecturers local stakeholders, and environmental practitioners. Key invited institutions included Rawa Aopa Watomohai National Park, the Marine and Fisheries Office of Central Sulawesi Province, CSR Pertamina Foundation, the Sulawesi River Basin Agency, the Peatland Ecosystem Management Working Group of the Ministry of Environment and Forestry, and the Swamp Land Agriculture Research Center of the Ministry of Agriculture. These discussions explored research priorities, institutional readiness, and collaborative potential. A SWOT analysis was applied to assess internal strengths and weaknesses as well as external opportunities and threats, while a gap analysis identified disconnects between research capacity, policy needs, and community engagement. Findings were triangulated to ensure analytical rigor and synthesized into strategic recommendations for institutional design, functional scope, and collaborative mechanisms.

3 Result and Discussion

3.1 Wallacean Wetlands: Ecology and Characteristic

Findings from desk studies and Focus Group Discussions (FGDs) involving BRIN, Halu Oleo University, Hasanuddin University, and Tadulako University reveal that Wallacean wetlands represent a diverse mosaic of freshwater ecosystems—from seasonally inundated swamps to karstic floodplains—shaped by biogeographic isolation and hydrological complexity. These wetlands support endemic biodiversity, regulate water cycles, and sustain traditional livelihoods such as fishing, farming, and plant harvesting. For example, Lake Tempe in South Sulawesi functions as a floodplain lake with dynamic seasonal expansion, contributing to fisheries, agriculture, and water transport, with an estimated annual economic value exceeding IDR 1.489 trillion [4]. The Ramang-Ramang karst wetlands in Maros combine limestone hydrology, riparian vegetation, and cultural landscapes, forming part of the UNESCO Global Geopark and supporting ecotourism and heritage conservation [5]. Meanwhile, Rawa Aopa Watumohai National Park—a Ramsar-listed site spanning over 105,194 hectares—demonstrates zoned wetland management for research, education, and ecotourism, while enabling community use across dozens of villages. A picture of the ecosystem conditions in several swamp ecosystems in Sulawesi can be seen in Figure 1.

Despite their ecological richness and strategic location, Wallacean wetlands face increasing threats from land conversion, sedimentation, and hydrological disruption—exacerbated by fragmented governance and low public awareness. Stakeholders emphasized the absence of integrated data systems and coordinated research frameworks, which hampers ecological monitoring and policy development. These wetlands are frequently excluded from national conservation priorities, creating a persistent gap between scientific knowledge and institutional response [4]. The diversity and multifunctionality of Wallacean wetlands highlight the urgent need to establish a collaborative research center to integrate data, empower communities, and inform sustainable management strategies across Sulawesi's inland waters.

3.2 Wallacean Wetlands: Present Challenges and Emerging Threats

Wallacean wetlands are increasingly exposed to ecological and governance pressures that threaten their integrity and sustainability. Habitat fragmentation and land conversion for agriculture, plantations, and infrastructure development have accelerated across Sulawesi and Maluku, reducing connectivity between wetland patches and disrupting endemic species migration routes. Between 2014 and 2022, significant deforestation linked to mining and oil palm expansion contributed to the decline of key species such as the anoa and babirusa, while also degrading wetland buffer zones [5].

Upstream activities—including logging, land clearing, and poorly managed agriculture—have led to sedimentation and declining water quality in floodplain lakes and swamp systems. These changes affect fish recruitment, aquatic vegetation, and local livelihoods dependent on clean water and stable hydrology. Despite the ecological importance of Wallacean wetlands, spatial and temporal data for ecosystem monitoring remain scarce and fragmented, limiting the ability to track changes or inform adaptive management. Governance gaps further exacerbate these challenges: legal protections are uneven, enforcement is weak, and coordination among agencies is limited. Civil society organizations have called for stronger legal frameworks and inclusive governance models to safeguard wetland ecosystems and community rights [6].

Aopa Swamp - South Konawe Southeast Sulawesi (lowland peat, Ramsar site)

Rono Bungi-Palu Central Sulawesi (urban delta system)

Lake Tempe - South Sulawesi (seasonal floodplain lake)

Rammang-Rammang-South Sulawesi (karst wetland within a geopark)

Fig. 1. The picture of the ecosystem conditions in several wetland-swamp ecosystems in Sulawesi

A strategic assessment of Wallacean wetlands reveals a complex interplay of strengths, weaknesses, opportunities, and threats (Table 1). While the region holds high ecological value and potential for sustainable use, it suffers from fragmented data, weak institutional capacity, and limited legal recognition. The accompanying gap analysis (Table 2) highlights critical discrepancies between current conditions and desired outcomes—particularly in ecosystem monitoring, regulatory frameworks, funding mechanisms, and regional collaboration. Bridging these gaps will require integrated interventions that combine scientific research, policy reform, community engagement, and transboundary cooperation.

3.3 Social and Institutional Dimensions

Local communities in Wallacea are deeply reliant on wetland ecosystems for fisheries, seasonal agriculture, and plant harvesting. These ecosystems serve as vital sources of food, income, and cultural identity, especially in rural and upland areas. In South Sulawesi, participatory land rehabilitation efforts in micro-watersheds such as Datara and Mararin demonstrate how farmers actively engage in soil conservation and vegetation restoration when supported through inclusive approaches like PRA (Participatory Rural Appraisal) and PAR (Participatory Action Research) [7]. Such practices reflect embedded ecological knowledge and community stewardship, yet their integration into formal wetland governance remains limited.

Institutional fragmentation continues to hinder effective wetland management in Wallacea. Conservation and land-use policies are often siloed across forestry, agriculture, and village governance, with minimal coordination or data sharing. The need for integrative environmental research and cross-sectoral collaboration to address ecological vulnerability in Wallacea's unique biogeographic zones is critical. Without institutional synergy and meaningful community participation, wetland conservation risks being reactive, disconnected, and unsustainable.

Table 1. Strategic SWOT Summary of Wallacean Wetland Ecosystems

Internal **External**	**Strength (S)** - High biodiversity, including endemic flora and fauna - Presence of economically valuable aquatic species (e.g. lobster, native fish) - Ecosystem services supporting local communities - Strategic location within Wallacea biogeographic zone (endemic biota) - Water resources for people	**Weakness (W)** - There is no status on the utilization of ecosystem resources in wetland - Updated data on wetland outside conservation areas is not yet available - Updated data on wetland ecosystem biota has not been identified - Presence of invasive biota - Lack of basic and applied research related to wetland ecosystems - Lack of funding - Environmentally unfriendly fishing practices - Low human resource levels and public awareness - Institutional structures have not yet been established
Opportunities (O) - The increasing interest in international wetland studies - Government policies to support the development of aquaculture business - Government regulations related to the environment - The Aopa Watu Mohae wetland National Park is an example of a conservation area and utilization of the wetland ecosystem	**S – O Strategy** Government regulations on resource conservation in wetland ecosystems	**W – O Strategy** - Updated wetland ecosystem data - Government regulations for comprehensive management of wetland aquatic ecosystem to support sustainable use - Government funding policies for wetland ecosystem management - Funding policies for research activities on wetland ecosystems - Establishment of government institutions for wetland ecosystem management
Threats (T) - The increasing number of people utilizing wetland ecosystems - The impact of climate change on wetland ecosystems	**S – T Strategy** - Development of fish/lobster cultivation businesses - Development of fauna cultivation with biopharmaceutical value - Development of environmentally friendly fishing gear - Development of fishery product processing businesses	**W – T Strategy** - Research related to wetland ecosystems - Community outreach and empowerment - Establishment of community institutions for wetland ecosystem management

Table 2. Gap Analysis of Wallacean Wetland Governance and Ecosystem Management

Aspect	Current Condition (SWOT Findings)	Ideal Condition	Identified Gap	Strategic Intervention
Ecosystem & Species Data	Limited, outdated, and fragmented data; lack of species identification	Integrated, standardized, and open-access biodiversity database	Absences of monitoring systems and taxonomic clarity	Launch collaborative research and citizen science initiatives to revitalize data
Utilization Status & Regulation	No formal designation or sustainable use framework	Legal recognition with zoning and sustainable use protocols	Regulatory vacuum and weak institutional mandate	Evidence-based policy advocacy and regulatory framework development
Human Resources & Institutional Capacity	Low capacity, no formal wetland management institution	Skilled personnel and dedicated wetland management body	Lack of training and institutional structure	Establish regional training hubs and community-based management units
Funding for Research & Conservation	Limited and unsustainable funding sources	Long-term national and international funding schemes	Reliance on short-term or project-based funding	Integrate proposals into JSPS, BRIN, and global donor mechanisms
Environmental Pressure & Exploitation Practices	Destructive harvesting, invasive species threats	Eco-friendly practices and invasive species control	Low awareness and lack of incentives for conservation	Public education, green economy incentives, and alternative technologies
Economic Potential Utilization	Underutilized, inefficient value chains	Sustainable use based on local value and global market access	Fragmented supply chains and lack of product innovation	Develop local business models, bio-pharmaceuticals, and ecotourism
Collaboration & Regional Networking	Limited to local and sectoral initiatives	Cross-national, interdisciplinary collaboration platforms	Absence of coordinated regional mechanisms	Establish the Wallacea Wetland Research Collaboration Center (WWCRC) as a regional hub

Fig. 2. Fishermen's activities and dominant fish (*Channa striata*) caught in Rawa Molara (North Konawe-Sotheast Sulawesi)

3.4 Strategic Role of the Wallacea Wetland Research Collaboration Center

The Wallacea Wetland Research Collaboration Center (PKR Wallacea) is part of the BRIN-funded "Riset dan Inovasi untuk Indonesia Maju" scheme, designed to advance science and technology for sustainable wetland ecosystem management. As a data hub for biodiversity and ecosystem dynamics, the center integrates fragmented ecological datasets and supports interdisciplinary research across ecology, social sciences, law, and environmental technology. This approach aligns with the Social-Ecological Systems (SES) framework, which emphasizes the interconnectedness of ecological resilience and governance [8]. PKR Wallacea also facilitates collaboration among universities, local governments, communities, and international partners, reinforcing BRIN's strategy for inclusive and synergistic research ecosystems.

The center's research domains include biodiversity monitoring, ecosystem health assessment, integration of local wisdom and citizen science, policy and governance analysis, ecohydrological modeling, and climate adaptation scenarios. Modeling tools such as SWAT and WEAP are employed to simulate hydrological changes and inform adaptive management strategies [9, 10]. PKR Wallacea also contributes to science diplomacy and evidence-based advocacy, supporting Indonesia's commitments under the IBSAP 2025–2045 and Ramsar Convention [11]. Through knowledge production and policy engagement, the center positions itself as a strategic actor in national and regional wetland conservation.

3.5 Recommendations for Management and Network Strengthening of the Wallacea Wetland Research Collaboration Center

To strengthen the strategic role of PKR Rawa Wallacea, it is recommended to develop an open data platform and integrated wetland information system specific to the Wallacea region. This system should support ecological monitoring, policy formulation, and community engagement. Wallacea's unique biogeography demands region-specific data infrastructure to support integrative environmental research and conservation, as emphasized in recent studies. Capacity building through localized training and knowledge exchange is also essential. Field-based learning in wetland ecosystems has been shown to significantly enhance ecological literacy and stakeholder participation, especially when linked to local biodiversity and cultural assets [12].

Mainstreaming collaborative approaches in planning and policy is critical for inclusive and adaptive wetland governance. Transparent and participatory decision-making in rural conservation projects leads to stronger community ownership and sustainability outcomes [13]. Furthermore, strengthening national and regional networks for tropical wetland conservation—through joint research, policy dialogues, and advocacy—is vital. Indonesia's biodiversity conservation efforts require coordinated action across provinces and sectors to address habitat fragmentation and species decline [14].

4 Conclusion

Wallacean wetlands represent a biologically rich yet institutionally overlooked landscape, facing mounting pressures from land conversion, sedimentation, and fragmented governance. The findings underscore the urgent need for equitable and sustainable management that integrates ecological integrity with community livelihoods and cultural values. Local dependence on wetland resources, coupled with limited data and weak legal protection, calls for a transformative approach that bridges science, policy, and public engagement. The establishment of the Wallacea Wetland Research Collaboration Center marks a strategic turning point—serving not only as a data and research hub but as a catalyst for interdisciplinary innovation and policy reform. By fostering open data systems, inclusive capacity building, and multi-stakeholder partnerships, the center can drive meaningful change across scales. Moving forward, broader collaboration across sectors, disciplines, and regions is essential to ensure that Wallacean wetlands are not only protected, but actively restored and reimagined as keystones of biodiversity, resilience, and social equity.

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