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# Protected Area Management Effectiveness of the Agusan Marsh Wildlife Sanctuary, Philippines: An Assessment Using the Management Effectiveness Tracking Tool (METT)-4

*Harold Jay Sumilhig[1,2], Sarah Jane Mulig[1,2], Sherrilyn Vasquez[1]*, Glorie Joy Deniega[1]*

[1]Protected Area Management Office of Agusan Marsh Wildlife Sanctuary, IPAS Complex, Mambalili, Bunawan, Agusan del Sur 8506, Philippines
[2]Master of Science in Environmental Science and Management, Graduate School, Caraga State University, Ampayon, Butuan City 8600, Philippines

*Corresponding Author
*Email: pasuamws@gmail.com
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**ABSTRACT**

The Agusan Marsh Wildlife Sanctuary (AMWS) is a critical wetland whose long-term sustainability depends on the effectiveness of protected area governance and management. This study assessed the management effectiveness of AMWS using the Management Effectiveness Tracking Tool version 4 (METT-4), focusing on how management inputs, processes, and institutional arrangements address threats and deliver conservation outcomes. Data were collected through Key Informant Interviews (KII) with 44 members of the AMWS Protected Area Management Board (PAMB), complemented by secondary data from management plans, spatial datasets, and institutional records. Threat analysis indicated that overall pressures were perceived as low but emerging, particularly human intrusion and disturbance ($\overline{x}$ = 0.523), agriculture and aquaculture expansion ($\overline{x}$ = 0.432), and energy production and mining activities in adjacent areas ($\overline{x}$ = 0.386), based on normalized scores ranging from 0 (no threat) to 1 (maximum threat). These pressures are concentrated mainly in Multiple Use Zones (MUZs) and are driven by population growth, land-use conversion, and external extractive activities. The overall METT score for AMWS was 75.52%, indicating excellent management effectiveness. Context scored highest (100%), reflecting a strong legal and institutional foundation and clear recognition of tenure and governance arrangements. Planning, outputs, and outcomes received good ratings (76.63%, 72.73%, and 70.19%), supported by structured management planning, co-management mechanisms, biodiversity monitoring, and livelihood interventions. Inputs (65.32%) and processes (68.23%) scored lowest, highlighting constraints related to financing, logistics, monitoring coverage, and the absence of a formal buffer zone. Overall, AMWS demonstrates strong participatory governance but requires adaptive management, strengthened enforcement, and sustainable financing to maintain long-term effectiveness.

Keywords: *Management Effectiveness Tracking Tool, Protected Area*

## 1 Introduction

The Agusan Marsh Wildlife Sanctuary (AMWS) is an extensive inland wetland system of freshwater marshes, lakes, and interconnected waterways that function as natural catch basins for floodwaters in the Agusan Valley, moderating river flows during the monsoon season and reducing downstream flooding. Proclaimed a protected area under Presidential Proclamation No. 913 on October 31, 1996, AMWS

spans 38 barangays across six municipalities in Agusan del Sur, Caraga Region (Sumilhig et al. 2024). Beyond its biodiversity significance, the sanctuary contains the largest intact peatland in the Philippines, serving as a significant carbon sink while supporting wetland-dependent livelihoods and fisheries, and providing habitat for endemic, migratory, and threatened species. AMWS is the largest protected area in Agusan del Sur, the second-largest wetland protected area in the Caraga Region. It ranks second nationally among marshlands in the Philippines, behind LiguasanMarsh (Guerrero 2021). It is legally protected under the NIPAS Act (RA 7586, as amended by RA 11038). Despite its legal status, AMWS faces persistent and emerging threats, such as habitat degradation, land-use conversion, and unsustainable resource use, which remain inadequately regulated, posing ongoing risks to ecosystem integrity and long-term conservation outcomes.

AMWS has gained substantial recognition at the local, national, and international levels for its outstanding ecological value its conservation status. Internationally, AMWS was first designated as a Wetland of International Importance under the Ramsar Convention (Ramsar Site No. 1009) on November 12, 1999, establishing its global significance as a wetland ecosystem; this was followed by its declaration as ASEAN Heritage Park (AHP) No. 42 on November 8, 2018, reflecting its regional importance within the Southeast Asia, and its more recent recognition as a Flyway Network Site (EAAF159) under the East Asian–Australasian Flyway Partnership (EAAFP) on November 10, 2025, underscoring its critical roles in supporting migratory waterbirds along the flyway (Orella et al. 2022, EAAFP 2025). At the national level, the Philippine Government has further recognized the importance of AMWS biodiversity through its classification as an Important Bird Area (IBA PH085), followed by its designation as a Key Biodiversity Area (KBA No. 180) and a Conservation Priority Area (CPA No. 126).

The sustainable management of AMWS, is both crucial and imperative, as effective management enables the identification of degraded areas requiring rehabilitation and the protection of ecologically significant zones. However, persistent degradation of protected areas is frequently rooted in governance failures that are directly reflected in key dimensions of management effectiveness. In the context of the Management Effectiveness Tracking Tool (METT) framework, these failures primarily manifest as weaknesses in management inputs and processes, including inadequate financial and human resources, insufficient logistical support, and limited technical capacity to implement management interventions. Governance challenges are further reflected in weak planning and decision-making processes, poorly coordinated land-use and management plans, overlapping and fragmented institutional mandates among multiple government agencies, and ineffective policy implementation and enforcement mechanisms. Additional constraints include limited monitoring and evaluation systems, unreliable or insufficient data to support evidence-based management, and the absence of capable, empowered, and actively engaged stakeholders. Collectively, these deficiencies undermine adaptive management, reduce management responsiveness to emerging threats, and contribute to the continued undervaluation of protected area and watershed resources (Cruz 2014, Kagaya & Wada 2021, Sulistyaningsih et al. 2021).

The Management Effectiveness Assessment (MEA) is widely recognized as a critical tool for improving conservation outcomes in protected areas (Geldmann et al. 2015, Hockings et al. 2015, Munguía and Heinen 2021). In the context of AMWS, systematically evaluating management strategies using the METT allows identification of gaps in governance, resource allocation, and operational processes, providing evidence to strengthen adaptive management and long-term conservation measures. Key Informant Interviews (KII) with AMWS Protected Area Management Board (PAMB) members are appropriate for this multi-stakeholder protected area, as they capture diverse perspectives and locally grounded knowledge, which are essential for an accurate assessment of management effectiveness and threat mitigation. This study, therefore, aimed to identify the prevailing threats to AMWS and to evaluate the effectiveness of its management strategies using METT-4, thereby supporting more informed, participatory, and evidence-based decision-making.

## 2 Materials and Methods

### *Location of the Study*

The study focused on the Agusan Marsh Wildlife Sanctuary (AMWS), located in the middle of the Agusan River Basin, the third-longest in the Philippines. AMWS is located in the municipalities

of San Francisco, Bunawan, Rosario, Talacogon, Loreto, and La Paz, all in Agusan del Sur. It lies between 8° 07' and 8° 27' East and 125° 47' and 125° 59' North, covering a total area of 40,490.96 hectares. The AMWS also encompasses 11,446.525 hectares designated as a Strict Protection Zone (SPZ), where activities are limited exclusively to research and monitoring. In addition, it includes 29,494.435 hectares classified as Multiple Use Zone (MUZ), where regulated human interventions and sustainable livelihood activities are permitted, subject to the issuance of appropriate clearances and permits and compliance with the Environmental Impact Assessment (EIA) requirements under Presidential Decree No. 1586. Furthermore, AMWS is a sacred ancestral homeland of the Agusan Manobo, encompassing four (4) major Certificates of Ancestral Domain Title (CADT) areas, including CADT 077, CADT 142, CADT 136, and CADT 090 in the municipalities of Talacogon, Rosario, Bunawan, and Loreto, respectively (Figure 1).

***Management Effectiveness Tracking Tool (METT)***

The Management Effectiveness Tracking Tool (METT) is an assessment instrument designed to monitor progress in improving the management effectiveness of protected areas. It is one of the most widely used, globally applicable, and generic evaluation systems for assessing protected area management effectiveness (WWF International 2007, Apdohan et al. 2019). METT was first introduced in 2002 and is designed to align with the IUCN World Commission on Protected Areas (IUCN WCPA) framework for Protected Area Management Effectiveness (PAME). It was initially developed by the World Bank-WWF Alliance for Forest Conservation and Sustainable Use to provide a standardized and practical method for evaluating the performance of protected area management (IUCN WCPA 2002, World Bank and WWF 2002, Campos et al. 2021). In 2020, METT version 4 was developed and presented as an Excel-based tool to facilitate the implementation and compilation of assessment results, accompanied by a new edition of the METT Handbook. The updated version was officially launched in November 2021 and provides comprehensive guidance on management effectiveness, best practices for applying the METT, illustrative case studies, and resources for enhancing the quality of METT assessments using SMART indicators. It also integrates complementary assessments through the Site-level Assessment of Governance and Equity (SAGE) tool to evaluate governance and equity aspects at the protected area level (IUCN 2021).

Since 2010, the Department of Environment and Natural Resources – Biodiversity Management Bureau (DENR-BMB) has been employing the Management Effectiveness Tracking Tool (METT) to evaluate the strengths and weaknesses of Philippine legislated and proclaimed protected areas, including Local Conservation Areas (LCAs) and other protected areas managed by LGUs (DENR-BMB, 2014). Dizon et al. (2013) highlighted the application of METT in assessing seven (7) Marine Protected Areas (MPAs), demonstrating the tool's flexibility and effectiveness across both terrestrial and marine conservation contexts. At the local level, Campos et al. (2021) applied the METT to evaluate the LGU-managed Mt. Magdiwata Watershed Forest Reserve (MMWFR), while Longaquit (2025) assessed the legislated Tinuy-an Falls Protected Landscape (TFPL), both located in Agusan del Sur.
Furthermore, the METT framework is organized around six (6) core elements of management effectiveness: Context, Planning, Inputs, Processes, Outputs, and Outcomes (Stolton et al. 2020). It employs a rapid assessment approach using a scorecard questionnaire that covers all six elements of the IUCN/WCPA framework. It also comprises two primary components. The first is a set of datasheets that collect key information on the protected area, including its characteristics, management objectives, identified threats, and the personnel responsible for conducting the assessment. The second component consists of assessment forms, which provide a composite evaluation of management effectiveness across thirty-eight (38) parameters corresponding to the six (6) WCPA elements. Each question in the assessment form has four (4) possible responses, scored from 0 (poor) to 3 (excellent), and includes sections for notes, score justification, recommended management improvements, and sources of information (IUCN WCPA, 2002; World Bank & WWF, 2002). The datasheets also feature a threat-ranking system to assess the impact of pressures on protected area values. Threats are classified as high (causing severe degradation, affecting >10% of values), medium (moderate impact, affecting >5–10%), or low (minimal impact, affecting <5%) (Apdohan et al., 2019; Stolton et al., 2020).

***Data Gathering, Analysis, and Interpretation***

Key Informant Interviews (KII) using the

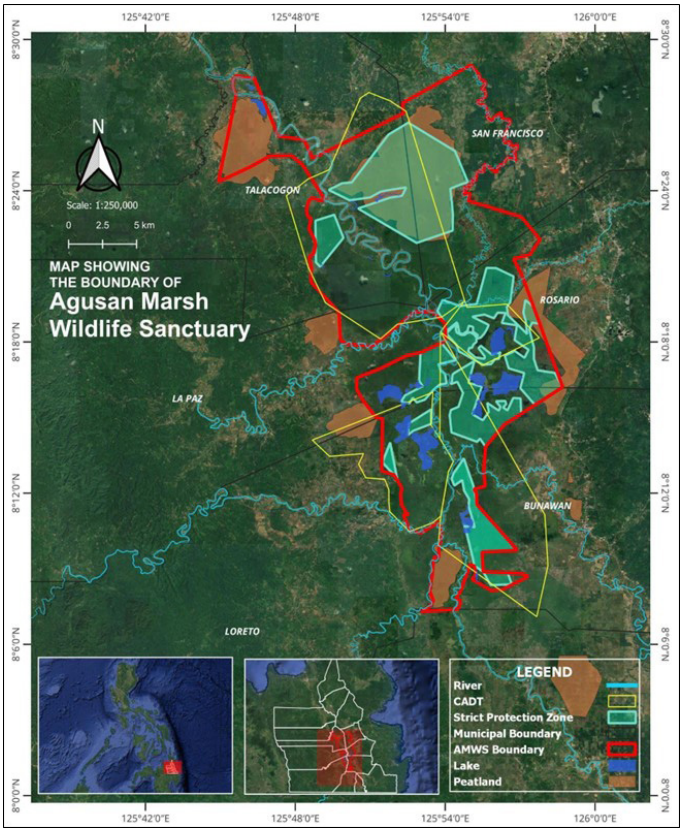


**Figure 1.** Map showing the boundary and management zones of Agusan Marsh Wildlife Sanctuary (AMWS), Agusan del Sur, Caraga Region, Philippines.

METT 4 survey questionnaire were conducted from February to August 2024 to collect primary data in accordance with DENR Technical Bulletin 2018 05. A total of forty-four (44) respondents, comprising thirty-two (32) males and twelve (12) females, participated in the KIIs. Respondents were selected based on their active membership in the Protected Area Management Board (PAMB), which includes representatives from the Provincial Government of Agusan del Sur, the municipalities of San Francisco, Rosario, Bunawan, Talacogon, Loreto, and La Paz, as well as Barangay LGUs, National Government Agencies (NGAs), Non-Government Organizations (NGOs), Certificates of Ancestral Domain Title (CADTs), and People's Organizations (POs).

In addition, secondary data, including the Protected Area Management Plan, Ancestral Domains Sustainable Development and Protection Plans, and management zones shapefiles, were obtained from the Department of Environment and Natural Resources (DENR), specifically from the Protected Area Management Office of Agusan Marsh Wildlife Sanctuary (PAMO AMWS). The collected data were analyzed using descriptive statistical methods to summarize and interpret the findings. Table 1 presents the interpretation of management effectiveness scores.

## 3 Results and Discussion

Following the METT 4 methodology, a datasheet for the AMWS was developed to document its key characteristics, identified threats, and management objectives. The corresponding assessment form was completed using a questionnaire comprising four alternative responses, each assigned a score ranging from 0 (poor) to 3 (excellent).

### *A. Datasheet of AMWS*

#### *AMWS Baseline Conditions (based on secondary data)*

**Table 1.** Management Effectiveness Rating Interpretation based on DENR Technical Bulletin 2018-05.

| Management Effectiveness Rating | Interpretation |
|---|---|
| 75-100% | Excellent |
| 51-74% | Good |
| 26-50% | Fair |
| <25% | Poor |

***i. Biophysical***

The Agusan Marsh Wildlife Sanctuary (AMWS) is a complex inland wetland ecosystem characterized by extensive freshwater wetlands, peatlands, rivers, and interconnected water bodies, which together underpin its ecological integrity and biodiversity. Wetland vegetation dominates, providing critical habitat for wetland-dependent species. At the same time, human-modified areas, including agricultural lands and limited built-up zones, occupy a minor fraction of the area, indicating that anthropogenic pressures are currently concentrated in peripheral zones (AMWS Protected Area Management Plan 2021–2031). Management relevance lies in prioritizing core wetland areas for strict protection and focusing enforcement on areas susceptible to human disturbance.

Hydrologically, AMWS functions as the floodplain of the Agusan River, receiving inflows from nine (9) major river systems across a 661,696-hectare catchment (Santillan et al. 2019). Its intricate network of lakes, creeks, and peatlands sustains hydrological connectivity, sediment deposition, and nutrient cycling, but also complicates enforcement and spatial management. High connectivity allows upstream disturbances, such as mining, drainage, or pollution, to propagate through the marsh, underscoring the need for coordinated basin-wide management. Peatland extent further increases vulnerability to fire, drainage, and unsustainable resource use, highlighting the importance of fire mitigation, hydrological regulation, and mining impact assessments. The low to moderately elevated topography (30–200 m above sea level) facilitates seasonal inundation, which supports natural flood regulation but also necessitates adaptive zoning to balance human activities with ecosystem protection. Soils are predominantly alluvial, with localized clay loam, volcanic, and sandy deposits along rivers, influencing habitat stability and restoration potential. Geological variation among municipalities, for example, San Francisco, dominated by alluvium (~60%) versus Rosario with Neogene to recent deposits, affects erosion risk, drainage behavior, and suitable management interventions (Penida et al., 2021). Climatically, AMWS experiences high and evenly distributed rainfall, with peaks from November to January, a long-term average of ~3,600 mm, and a mean annual temperature of 25.6°C (Manlosa and Valera, 2016; Mora-Garcia et al., 2020). These conditions sustain wetland productivity but require flood preparedness, climate-adaptive management, and careful placement of infrastructure.

The AMWS also overlaps four (4) major Certificates of Ancestral Domain Title (CADT) areas, collectively representing the Agusan Manobo ancestral homeland. Indigenous stewardship is central to co-management, enabling the integration of traditional knowledge into sustainable resource use, fire mitigation, and enforcement strategies, particularly in sensitive peatland and hydrologically connected areas (AMWS Protected Area Management Plan 2021–2031). AMWS's baseline characteristics, including wetland dominance, peatland extent, hydrological connectivity, soil variability, and climatic regime, directly shape management priorities. These features inform zoning effectiveness, enforcement strategies, fire and flood risk mitigation, sustainable livelihood planning, and long-term ecosystem resilience.

Furthermore, the AMWS supports exceptionally high biodiversity across multiple taxonomic groups. Faunal assessments have recorded 150 bird species (Sumilhig et al. 2024), 36 amphibians (Almeria and Nuñeza 2013, Sularte et al. 2015, Relox and Camino 2018), 59 fish species (Cuadrado et al. 2019, Baclayo et al. 2020), 11 mollusks (Travis et al. 2007), 32 mammals, 66 butterfly species, and 66 reptile species (Sanguila et al. 2016) within the sanctuary. In addition, 27 species of aquatic beetles have been documented, further highlighting the ecological richness of the wetland ecosystem (Varela and Degamo 2016). Floral diversity in AMWS is equally remarkable, with a total of 721 plant species recorded (Aribal and Fernando 2014, 2018, Sarmiento and Varela 2023). Of these, 205 species are endemic, while 75 species are classified as

threatened, including 9 Critically Endangered (CR), 18 Endangered (EN), 33 Vulnerable (VU), 12 Near Threatened (NT), and 3 Other Threatened Species (OTS) (AMWS Protected Area Management Plan 2021–2031).

Biodiversity data in AMWS are used both diagnostically and as contextual background in METT scoring. High species richness and endemism indicate areas of high conservation value, generally correlating with higher METT context and planning scores. Conversely, threatened species are often concentrated in zones experiencing higher perceived threats, such as human settlement, resource extraction, or hydrological disturbance, highlighting critical areas for enforcement, habitat restoration, and targeted monitoring. The exceptional richness, endemism, and threatened status of AMWS taxa underscore the area's ecological importance and inform priority management actions. These include spatially explicit zoning to protect critical habitats, targeted enforcement and patrolling in high-risk zones, integration of sustainable resource use in community-managed areas, and restoration of degraded wetlands to maintain ecosystem integrity and resilience.

***ii. Socioeconomic***

The Agusan Marsh Wildlife Sanctuary (AMWS) supports a resident population whose daily activities directly influence conservation outcomes, thereby shaping both the threat profile and the METT assessment results. Within the protected area, an estimated 2,686 households reside, including 123 tenured migrants, reflecting sustained settlement within wetland zones. Infrastructure is predominantly residential, with limited commercial and industrial facilities, indicating low levels of large-scale urbanization consistent with the area's protected status (AMWS Protected Area Management Plan 2021–2031). However, the spatial distribution of households within and adjacent to Multiple-Use Zones (MUZs) increases localized pressure on aquatic habitats, peatlands, and forest margins. These settlement patterns help explain the moderate to high perceived threats related to human intrusion, resource use, and habitat disturbance reflected in the KII-based METT scoring, particularly under context, planning, and process components.

Indigenous Peoples (IPs) constitute a significant proportion of the population in the direct impact communities of AMWS. The total Indigenous population in these communities is estimated at 72,842 individuals, distributed across six municipalities, while at the provincial scale, Indigenous Peoples number 152,884 individuals across several ethnic groups, with the Manobo as the dominant group (CADT 090 ADSDPP 2024-2034) (Figure 2). This demographic composition has direct management implications. On one hand, Indigenous governance systems and customary resource-use practices can strengthen participatory planning, legitimacy of zoning regulations, and community-based enforcement, factors that may positively influence METT scores related to stakeholder engagement and management processes. On the other hand, population growth and continued reliance on wetland resources increase aggregate demand for fisheries, agricultural land, and forest products, thereby contributing to the pressures identified in threat assessments.

Additionally, livelihood activities within AMWS are largely natural resource–dependent, reinforcing the linkage between socioeconomic conditions and conservation pressures. Primary income sources include freshwater fishing, corn and rice cultivation, and ecotourism-related services (Campos et al. 2023). Fishing intensity and small-scale agriculture, particularly within MUZs, align with perceived threats to aquatic biodiversity, peatland edges, and riparian habitats recorded during the METT evaluation. Community-based enterprises using wetland-derived materials and adaptive strategies such as floating vegetable gardens (Sitcharon and Malaque 2023) demonstrate resilience and potential compatibility with conservation goals; however, they also underscore continued dependence on ecosystem services. During the KII-based METT assessment, respondents frequently contextualized management effectiveness in relation to livelihood pressures, tenure arrangements, and community participation, indicating that socioeconomic variables influenced perceptions of enforcement adequacy, zoning effectiveness, and overall management performance.

The socioeconomic structure of AMWS, characterized by resident households, tenured migrants, Indigenous stewardship, and resource-dependent livelihoods, serves as both a driver of conservation pressure and a foundation for participatory management. Integrating these socioeconomic dynamics into threat analysis provides a clearer basis for interpreting METT results and identifying priority interventions in enforcement, zoning, and sustainable livelihood support.

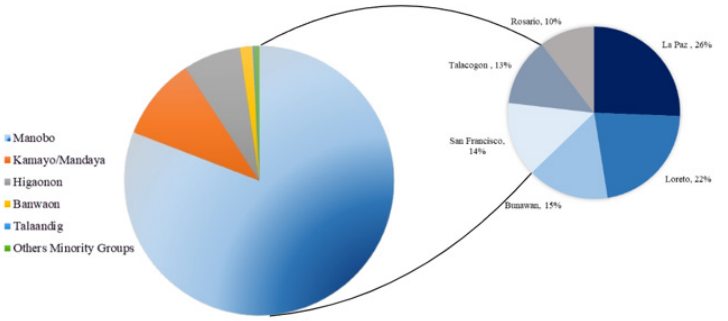


**Figure 2.** (a) Provincial-scale distribution of Indigenous populations in Agusan Marsh Wildlife Sanctuary (AMWS), with Manobo as the dominant group. (b) Distribution of Agusanon Manobo population across six municipalities in AMWS.

***Key Issues and Threats (based on the KIIs)***

Despite its designation as a legislated protected area, the Agusan Marsh Wildlife Sanctuary (AMWS) continues to face several management concerns identified through the Key Informant Interviews (KII) (Table 2). The maximum possible threat score was forty-four (44), equivalent to the total number of respondents. However, actual scores per threat category may be lower, as some respondents indicated "no data" or "not applicable," which were excluded from the analysis. Thus, the results should be interpreted as indicative rather than absolute measures of threat intensity.

As shown in Table 2, human intrusion and disturbance recorded the highest mean threat value ($\bar{x} = 0.523$), followed by agriculture and aquaculture activities ($\bar{x} = 0.432$). These categories reflect human activities that alter, degrade, or disrupt habitats and wildlife, including land-use conversion, agricultural expansion, recreational and tourism-related activities, construction, and increased vehicular access within and around the protected area. While many of these activities occur within regulated zones such as the Multiple Use Zone (MUZ), their persistence and spatial expansion suggest mounting pressure on protected area resources.

Although overall threat levels were generally perceived as low by respondents, the concentration of higher mean values in anthropogenic categories indicates that human-driven pressures remain the most significant management concern. Population growth and increasing economic activities within and adjacent to the protected area may further amplify these pressures over time. Consequently, even moderate but sustained disturbances could accumulate and lead to more pronounced ecological impacts if not effectively managed.

These localized observations are consistent with broader land-use trends within the Agusan River Basin (ARB). Land cover classification analyses revealed that forest cover declined from 67.7% in 1995 to 62.8% in 2017, while agricultural areas expanded from 12.2% to 15.5% during the same period (Santillan et al. 2019). More recent studies have further documented notable land cover changes, including increases in built-up areas and rangelands, alongside reductions in barren lands, indicating ongoing landscape transformation driven by human activities (Makinano-Santillan & Santillan 2023). While overall threat levels in AMWS were generally perceived as low in intensity, the relatively higher mean scores for human intrusion and disturbance, as well as climate-related threats, indicate that specific pressure categories are already significant and potentially escalating. Thus, the perception of low overall intensity should not obscure the fact that anthropogenic and climate-driven stressors are emerging as dominant risks. When viewed alongside documented land-use changes in the broader ARB, these patterns suggest that cumulative and interacting pressures may increasingly challenge the long-term ecological integrity of AMWS.

Complementarily, respondents also identified energy production and mining activities within or outside the protected area ($\bar{x} = 0.386$) as a high-impact threat, particularly given the nearby operational Philsaga Mining Corporation (PMC) site in Rosario, Agusan del Sur. Mining activities are known to contribute to habitat degradation, sedimentation, and water pollution, affecting both terrestrial and aquatic ecosystems (Burdzieva et al., 2018; Wolkersdorfer and Mugova, 2022).

**Table 2.** Issues and Threats in AMWS based on the answers of the 44 KII respondents.

| Agusan Marsh Wildlife Sanctuary (AMWS) Threats | Threat Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | High | | Medium | | Low | | Overall | |
| | Total | Mean | Total | Mean | Total | Mean | Total | Mean |
| Residential and commercial development within a protected area | 17 | 0.386 | 11 | 0.250 | 15 | 0.341 | 43 | 0.326 |
| Agriculture and aquaculture within a protected area | 19 | 0.432 | 11 | 0.250 | 6 | 0.136 | 36 | 0.273 |
| Energy production and mining within or outside a protected area. | 17 | 0.386 | 6 | 0.136 | 21 | 0.477 | 44 | 0.333 |
| Transportation and service corridors within a protected area | 12 | 0.273 | 6 | 0.136 | 4 | 0.091 | 22 | 0.167 |
| Biological resource use and harm within a protected area. | 12 | 0.273 | 7 | 0.159 | 22 | 0.500 | 41 | 0.311 |
| Human intrusions and disturbance within a protected area. | 23 | 0.523 | 8 | 0.182 | 7 | 0.159 | 38 | 0.288 |
| Natural system modifications | 11 | 0.250 | 7 | 0.159 | 21 | 0.477 | 39 | 0.295 |
| Invasive and other problematic species and genes | 6 | 0.136 | 4 | 0.091 | 13 | 0.295 | 23 | 0.174 |
| Pollution entering or generated within protected area | 5 | 0.114 | 7 | 0.159 | 20 | 0.455 | 32 | 0.242 |
| Geological events | 6 | 0.136 | 5 | 0.114 | 11 | 0.250 | 22 | 0.167 |
| Climate change and severe weather | 7 | 0.159 | 10 | 0.227 | 27 | 0.614 | 44 | 0.333 |
| Specific cultural and social threats | 13 | 0.295 | 12 | 0.273 | 18 | 0.409 | 43 | 0.326 |
| **TOTAL** | **148** | **3.364** | **94** | **2.136** | **185** | **4.205** | **427.00** | **3.235** |

**Note:** Threats were classified as high (causing severe degradation and affecting >10% of conservation values), medium (moderate impact affecting >5–10%), or low (minimal impact affecting <5%), following the framework of Apdohan et al. (2019) and Stolton et al. (2020). Mean values represent the proportion of respondents who assigned each threat level to each category.

Moreover, the current METT scores reveal both strengths and limitations in AMWS's capacity to respond to such external extractive pressures. While the METT inputs indicate basic legal recognition, staff awareness, and some enforcement procedures, the process scores reflect limited operational mechanisms for addressing threats originating outside the protected area. In particular, the absence of a formal buffer zone reduces the regulatory leverage over adjacent mining and energy operations, constraining its ability to prevent indirect impacts such as pollution, hydrological alteration, and habitat fragmentation. Strengthening governance through formalized buffer management, improved inter-agency coordination, and proactive monitoring could enable AMWS to mitigate external pressures better and safeguard its ecological integrity.

### *B. Management Effectiveness Assessment (MEA)*

#### *Management Effectiveness Score*

The METT score results indicate an overall management effectiveness of 75.52%, corresponding to an "excellent" rating under DENR Technical Bulletin 2018-05. Among the METT components, the context obtained the highest score of 100%, reflecting an excellent rating due to the formal gazettement of AMWS through Presidential Proclamation No. 913 and Republic Act No. 7586 (NIPAS Act), as amended by Republic Act No. 11038 (Expanded NIPAS Act of 2018). The planning, outputs, and outcomes components

received good ratings of 76.63%, 72.73%, and 70.19%, respectively, mainly attributable to the presence of key management instruments, including the Protected Area Management Plan (2021–2031), Manual of Operations (2018), Ecotourism Management Plan (2023–2028), and three site-specific Wetland Management Plans. Meanwhile, the process and inputs components also obtained good ratings of 68.23% and 65.32%, reflecting improvements such as the revitalization of 200 Park Rangers and the establishment of regular patrolling routes within the protected area. Table 3 presents the summary of METT scores across all management components.

Additionally, the overall METT Score (75.52%) indicates that AMWS has strong enforcement capacity, including routine monitoring, patrolling, and staff awareness of regulations, which collectively support day-to-day management operations. The rating also reflects a relatively high level of adaptive management readiness, suggesting that the sanctuary is capable of adjusting strategies and interventions in response to emerging threats or ecological changes. However, while overall management effectiveness is robust, limitations remain in responding to external pressures such as adjacent mining, agricultural expansion, or other land-use changes, highlighting areas where governance and operational interventions, such as formalized buffer zones and strengthened inter-agency coordination, could further enhance the long-term ecological integrity of AMWS.

***i. Context***

All key informants assigned a score of 3 (excellent) to the context component, reflecting their clear understanding of the legal status of the Agusan Marsh Wildlife Sanctuary (AMWS). This high score indicates strong legal design and formal recognition of the protected area, but does not necessarily reflect the effectiveness of the on-the-ground management or implementation. AMWS is one of the 249 protected areas in the Philippines, legally established through Presidential Proclamation No. 913 on October 31, 1996, under Republic Act No. 7586, otherwise known as the National Integrated Protected Areas System (NIPAS) Act of 1992. The proclamation initially covered 19,196 hectares of inland wetland habitats and timberlands, encompassing areas within the municipalities of San Francisco, Rosario, Bunawan, Veruela, Loreto, and La Paz in Agusan del Sur, while designating surrounding peripheral areas as buffer zones (Republic of the Philippines, 1996). The excellent context score, therefore, primarily reflects formal recognition and legal basis, rather than the current operational or enforcement capacity within the protected area.

The legal protection of AMWS was further strengthened through the enactment of Republic Act No. 11038, or the Expanded NIPAS Act of 2018, which amended RA 7586 during the administration of President Rodrigo Duterte, on June 22, 2018. This legislation not only reinforced the institutional and management framework of the protected area but also significantly expanded its coverage to 40,490.96 hectares, nearly doubling its initial proclaimed area. The expansion incorporated ecologically sensitive and globally significant ecosystems, particularly peatlands, which play a crucial role in biodiversity conservation, carbon storage, and hydrological regulation. Additionally, AMWS is under the administrative jurisdiction, supervision, and control of the Department of Environment and Natural Resources (DENR), through the Biodiversity Management Bureau (BMB), in coordination with other relevant government agencies. The protected area is mandated to conserve ecologically rich and unique landscapes, including critical habitats of rare, endemic, and threatened species, thereby underscoring its national and international conservation significance (Republic of the Philippines, 2018).

While the eNIPAS expansion strengthened legal recognition and institutional mandate, it has not automatically translated into commensurate increases in funding, staffing, or enforcement capacity. Operational improvements, such as revitalizing park ranger teams and establishing regular patrol routes, have been implemented. However, resource allocation and human capacity have not fully scaled to match the nearly doubled area. As a result, practical management effectiveness—including enforcement, monitoring, and adaptive management—remains constrained, particularly in newly added peripheral and ecologically sensitive zones. This highlights the gap between legal design and recognition, on the one hand, and on-the-ground implementation capacity, on the other, underscoring the need for enhanced governance, targeted resource allocation, and strengthened operational mechanisms to ensure the long-term ecological integrity of AMWS.

Furthermore, in terms of ancestral domain classification, approximately 29,782 hectares of the protected area are covered by four (4) Certificates

of Ancestral Domain Title (CADT), namely CADT 077, CADT 136, CADT 090, and CADT 142. These ancestral domains are recognized and protected under Republic Act No. 8371, otherwise known as the Indigenous Peoples' Rights Act (IPRA) of 1997. The presence of these CADTs within the protected area underscores the significant role of Indigenous Peoples in the stewardship, conservation, and sustainable management of the AMWS. It also highlights the importance of integrating customary laws, traditional knowledge systems, and Indigenous governance structures into protected area planning and management, in accordance with the principles of Free, Prior, and Informed Consent (FPIC) and collaborative governance mandated by IPRA (Republic of the Philippines 1997).

***ii. Planning***

Most key informants rated the planning and management component as 3 (excellent), indicating that regulations controlling human interventions, such as land-use conversion, agricultural expansion, and timber and wildlife harvesting, are actively enforced. The management interventions and strategies are aligned with the sanctuary's agreed objectives and supported by a concrete design for protected area activities. Key planning instruments, including the Protected Area Management Plan (2021–2031), Manual of Operations (2018), Ecotourism Management Plan (2023–2028), and three site-specific Wetland Management Plans, are reviewed annually, actively used in operational decision-making, and regularly updated to address emerging threats identified in the KIIs, such as human intrusion, agricultural expansion, and climate-related pressures. This iterative use of management instruments ensures that planning is not merely procedural but functionally integrated into adaptive management, guiding on-the-ground interventions, prioritizing enforcement, and informing resource allocation to maintain the ecological integrity of AMWS.

Unlike AMWS, which actively uses and periodically reviews its operational plans, Central Cebu Protected Landscape has formal planning instruments but struggles to turn them into effective management responses to pressures such as population growth and land use change, illustrating common limitations in Philippine protected areas where management plans are underutilized or weakly implemented (Quijano et al. 2021). Additionally, national assessments of Philippine protected areas more broadly have highlighted that many areas lack appropriate management infrastructure, funding, and capacity to implement or update their management plans, limiting their ability to respond effectively to evolving threats; in fact, over 40% of protected areas were reported to lack even basic management plans or sufficient capacity to implement them, despite legal status under NIPAS (Mallari et al. 2016).

Institutional support of AMWS is further reinforced through the Protected Area Management Board (PAMB), which operates through Executive and En Banc Committees supported by seven Technical Working Committees covering planning, biodiversity monitoring, law enforcement, education, partnerships, and Indigenous Peoples' relations. It ensures that planning instruments are actively applied in decision-making and operational management. The PAMB composition, comprising national and local government representatives, Indigenous Peoples, civil society, academic institutions, and the private sector, facilitates multi-level governance, adaptive management, and policy development by integrating research findings, annual Work and Financial Plans, and periodic policy reviews into routine management activities. This functional use ensures that planning instruments are practical tools that guide enforcement, biodiversity monitoring, resource allocation, and the implementation of management interventions, rather than remaining as formal documents. By directly linking plans to emerging threats and operational priorities, the PAMB enhances the effectiveness and responsiveness of AMWS management.

***iii. Input***

Most key informants rated the inputs component as fair (score = 2), reflecting the presence of established policy instruments, financial mechanisms, and institutional arrangements that support protected area management, while also acknowledging existing limitations. This rating is anchored on the adoption of AMWS PAMB Resolution No. 2017-008 and the implementation of DENR Administrative Order (DAO) 2016-24, which prescribes standardized rates for entrance fees, use of facilities, and resource utilization within protected areas. The Special Use Agreement in Protected Areas (SAPA) under DAO 2007-17 further provides a regulated mechanism for allowable resource use, ensuring safeguards for conservation objectives. Financial sustainability is supported by the Integrated Protected Area Fund

(IPAF) under Section 16 of Republic Act No. 11038 (Expanded NIPAS Act of 2018), with 75% of revenues retained through the Protected Area–Retained Income Account (PA-RIA) to finance operations, enforcement, and priority programs.

Despite these mechanisms, input limitations persist. These include absolute funding constraints, delays in fund release, and restrictions on the use of IPAF revenues, which can limit operational flexibility, especially in newly expanded or peripheral zones. Human resource capacity, although strengthened by the Protected Area Management Office (PAMO-AMWS) staff and the revitalization of 200 Bantay Danao (community-based Park Rangers) with logistical support from municipal and provincial governments, remains insufficient to fully cover the expanded 40,490-hectare area and all priority management tasks. Consequently, while policy, financial, and institutional inputs provide a strong foundation, these limitations constrain the full effectiveness of enforcement, monitoring, and adaptive management within AMWS.

***iv. Process***

The process component reflects the extent to which management actions and procedures are effectively implemented to achieve protected area objectives. In the case of the Agusan Marsh Wildlife Sanctuary (AMWS), this component received a generally good rating, supported by the establishment and operationalization of key management processes, including routine patrolling, biodiversity monitoring, enforcement protocols, and adaptive planning. However, gaps in these processes, such as limited coverage of patrol routes in peripheral zones, inconsistent monitoring of emerging threats, and delays in translating research findings into operational actions, can directly reduce the effectiveness of threat mitigation. For instance, human intrusion, agricultural expansion, and illegal resource extraction may persist in areas with insufficient monitoring. At the same time, climate-related impacts or habitat degradation may go unaddressed if early-warning or adaptive response mechanisms are not fully operational. Thus, while established processes provide a strong framework, their practical limitations constrain the protected area's capacity to entirely prevent or respond to emerging threats, highlighting areas for targeted improvement in AMWS management.

Notably, AMWS PAMB Resolution No. 2021-018 formally approved the protected area's management zoning scheme, designating 11,446.525 hectares as a Strict Protection Zone (SPZ) and the remaining area as a Multiple Use Zone (MUZ). SPZ includes the Crocodile Sanctuary, Flying Fox Sanctuary, Hornbill Sanctuary, and the peatlands. This zoning framework provides clear spatial guidance for protecting and sustainably using resources and supporting development activities, consistent with conservation priorities. The designation and regulation of areas for allowable resource use are implemented in accordance with existing national environmental laws and policies, including Republic Act No. 9147, Republic Act No. 8550, as amended by Republic Act No. 10654, and Republic Act No. 11038. These processes were carried out in compliance with protected area demarcation and delineation requirements under Section 9 of Republic Act No. 7586, as amended by RA 11038, and Rule 9.5 of DENR Administrative Order No. 2018-05. While the zoning provides a strong legal and spatial framework, enforcement effectiveness varies across zones. Patrolling and monitoring in SPZs are generally robust, supported by Park Rangers and community Bantay Danao. However, coverage in peripheral MUZs is limited, which can reduce compliance with resource use regulations. This highlights that, although zoning guides management actions, its conservation impact ultimately depends on the consistent implementation and capacity of enforcement mechanisms, particularly in areas exposed to human pressures such as agricultural expansion, fishing, and intrusion.

Management processes are further strengthened through monthly Communication, Education, and Public Awareness (CEPA) activities conducted by the PAMO-AMWS, aimed at enhancing stakeholder awareness, compliance, and support for conservation initiatives. Indigenous Peoples (IPs) within the CADT areas actively serve as co-managers of the protected area. They are directly involved as site implementers of ecotourism activities, reflecting inclusive and participatory governance. Additionally, IP communities have been key beneficiaries of rehabilitation and reforestation projects within the protected area, reinforcing livelihood support alongside ecosystem restoration.

Scientific monitoring processes are in place within AMWS, as evidenced by the establishment of nine Biodiversity Monitoring Sites (BMS), fifteen Asian Waterbird Census (AWC) sites, and a 2-kilometer Biodiversity Assessment and

Monitoring System (BAMS) transect in the Caimpugan Peat Swamp Forest. These mechanisms provide critical data to guide adaptive management and policy decisions. However, analysis of the METT process component indicates that specific indicators scored lowest, particularly "protection system", which evaluates whether systems are in place to control access and resource use within the protected area, and "resource management", which assesses whether active management of habitats and species is being undertaken. These low scores reflect limitations in the AMWS's ability to regulate human activities in peripheral zones and implement active interventions in resource management, partly due to the absence of a formally established buffer zone. This gap constrains the protected area's overall process effectiveness and highlights areas where enforcement, monitoring coverage, and active management need strengthening to maintain the ecological integrity of AMWS.

***v. Output***

The outputs component of the AMWS management effectiveness assessment received a fair score, reflecting not only the quantity of outputs produced but also their current level of effectiveness in addressing conservation objectives. In terms of physical infrastructure, AMWS has established key facilities that support conservation and visitor engagement, including the AMWS Visitor Center, a two-story floating building at Lake Panlabuhan co-managed with CADT 090, a designated rest area within the Caimpugan Peat Swamp Forest, bird hides at Lake Mambagongon, and a Park Ranger Station overseeing the Talacogon Peatland. These facilities demonstrate measurable progress in promoting environmental education, biodiversity appreciation, community-based ecotourism, and on-site protection.

Beyond physical infrastructure, outputs also include non-physical results, such as the implementation of zoning policies, enforcement regulations, strengthened partnerships with Indigenous Peoples and local government units, and community-based initiatives linked to ecotourism and conservation. These outputs contribute to institutional strengthening and stakeholder engagement, which are critical components of protected area governance.

However, the fair rating reflects that while outputs are present, their scale, distribution, and effectiveness relative to identified threats remain moderate. For example, although visitor facilities and ranger stations support awareness and protection, they may not yet be sufficient to fully mitigate pressing threats such as agricultural expansion, illegal resource extraction, and human intrusion in peripheral zones. Similarly, while partnerships and livelihood-related initiatives exist, their coverage and impact on reducing dependency on protected area resources require further strengthening. Thus, the assessment suggests that the challenge lies not merely in increasing the number of outputs but in enhancing their strategic alignment, reach, and measurable impact in addressing the most critical socio-ecological pressures affecting AMWS.

***iv. Outcome***

The outcome component reflects the broader ecological, social, and economic effects of AMWS management, as captured by METT indicators such as biodiversity conservation, sustainable resource use, and community benefits. In this assessment, outcomes are derived from a combination of measured indicators (e.g., biodiversity monitoring data and waterbird census counts), observed trends reported in management records, and perceived improvements reported by key informants. Economically, the AMWS supports local livelihoods by sustaining fish populations that feed into the local fishery market. Agricultural initiatives, including rice production and floating vegetable gardens, provide additional food security and income for Indigenous Peoples and other residents.

In terms of ecological outcomes, AMWS has been a pilot site for peatland research, supporting studies on hydrology, soil carbon sequestration, and biodiversity in peat swamp forests. The establishment of BMS and AWC sites has provided measurable indicators of species abundance and habitat quality, informing adaptive management and contributing to the protection of threatened species. Despite these positive indicators, the fair outcome score suggests that measurable ecological and socioeconomic impacts have not yet fully caught up with recent improvements in planning, zoning, and management processes. Conservation outcomes typically lag behind institutional and procedural reforms, particularly in large and recently expanded protected areas. Thus, while monitoring systems and governance frameworks have strengthened, sustained long-term data collection and impact evaluation are needed to conclusively demonstrate ecosystem recovery, increased biodiversity

resilience, and measurable livelihood gains across the entire AMWS.

## 4 Conclusions

The management effectiveness assessment of Agusan Marsh Wildlife Sanctuary (AMWS) using METT-4 indicates that the protected area possesses a strong legal and institutional foundation, supported by formalized governance structures, approved management plans, and recognized co-management arrangements with Indigenous Peoples. However, the assessment demonstrates that institutional design does not automatically translate into full governance performance on the ground. While policies, zoning frameworks, and planning instruments are in place, implementation capacity, particularly in enforcement coverage, ecological monitoring expansion, and logistical support, remains uneven across the 40,490-hectare protected area.

Anthropogenic pressures such as human intrusion, agricultural expansion, and nearby mining activities interact directly with these implementation gaps. Limited personnel, constrained financial resources, and incomplete monitoring coverage reduce the ability to regulate peripheral zones consistently, detect early signs of habitat degradation, and respond proactively to emerging threats. The absence of a formally established buffer zone further weakens the protected area's capacity to manage external pressures originating outside strict protection areas but affecting ecological integrity within them. Thus, while governance structures are robust in design, enforcement reach, monitoring intensity, and operational responsiveness require strengthening to mitigate socio-ecological pressures effectively.

To address weaknesses identified in the METT assessment, particularly in the inputs and process components, AMWS should strengthen governance and zoning by formally establishing a buffer zone and enhancing enforcement systems in Multiple Use Zones to regulate better peripheral pressures, such as agricultural expansion, human intrusion, and nearby extractive activities. Monitoring and science-based management should be expanded through broader assessments of biodiversity, water quality, fisheries, and peatlands, with standardized long-term datasets integrated into planning and budgeting to improve adaptive management and resource management indicators. To respond to funding, logistical, and personnel constraints reflected in moderate input scores, the sanctuary should improve IPAF utilization efficiency, explore sustainable financing mechanisms such as Payment for Ecosystem Services and strengthened ecotourism models, and invest in field equipment and capacity-building for PAMO staff to enhance enforcement reach. Strengthening community and Indigenous co-management through participatory monitoring, livelihood diversification, and expanded community-based enforcement will further improve governance performance and compliance with zoning regulations. Finally, periodic METT reassessments should be institutionalized to systematically track improvements in protection systems, resource management, and overall implementation capacity over time.

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## 6 Author Contribution

HJ Sumilhig contributed to the conceptualization and design of the study, including data collection, formal analysis, and manuscript writing. SJ Mulig handled data curation, assisted in formal analysis, and contributed to the writing and revision of the manuscript. GJ Deniega assisted in data collection, documentation, and materials preparation and contributed to manuscript review. S Vasquez led the planning, implementation, and supervision of the study, as well as provided technical guidance and critical revision of the manuscript.

## 7 Statement of Conflict of Interest

The authors declare no conflict of interest.

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